Monday 18th July, 2022

Registration

Lobby

15:00 - 18:00

Tuesday 19th July, 2022

Registration

Lobby

07:00 - 17:30

Opening Address

Room 1

08:45 - 09:00

09:00 - 10:10 — Room 1

Session 1A1

Plenary Session I

09:00 : Plenary talk
Picocavities: confining light below the size of an atom
Jeremy Baumberg
University of Cambridge (United Kingdom)

We show how plasmonically-enhanced light-induced van-der-Waals forces pull single adatoms from metal facets, to create picocavities which confine light to volumes $textless$ 1nm3. The thousand-fold stronger optical forces depend on nearby molecules as well as temperature and local optical field, and offer a route to single molecule optical tweezers.

09:35 : Plenary talk
Plasmonic Lattices
Paivi Torma
Aalto University (Finland)

Plasmonic Lattices

Coffee Break

Session 1P1

Poster session I

10:10 - 10:50

Chaired by:

P1: Excitation-dependent emissive FeSe nanoparticles induced by chiral interlayer expansion and their multi-color bio-imaging
Junyoung Kwon[1], Jeonghyo Kim[2], Youngeun Choi[2], Jeong Yoon Park[2], Chul-Hong Park[2], Jaebeom Lee[2]
[1]*KAIST (Korea),* [2]*Chungnam National University (Korea)*

We report layered FeSe nanoparticles (NPs) coupled by L- or D-cysteine as a chiral stabilizer to show multi-colored excitation dependent emission (MEDE) for both 1- and 2-photon photoluminescence breaking conventional Kasha and Vavilov rules of luminescence, which is the first report in inorganic nanostructure system. The MEDE is revealed to originate from the impurity coupled to the Mott insulator character of FeSe and chiral interlayer expansion, utilized for multi-colored imaging of neuron cells / tissues from visible to near-infrared range.

P2: One-Pot Synthesis of Magnetoplasmonic Au@FexOy Nanowires: Bioinspired Bouligand Chiral Stack

Huu-Quang Nguyen, Dajeong Hwang, Sejeong Park, My-Chi Nguyen, Jaebeom Lee
Chungnam National University (Korea)

One-dimensional hybrid nanostructures composed of a plasmonic gold nanowire core covered by a shell of magnetic oxide nanoparticles (Au@FexOy NWs) were synthesized by a one-pot solvothermal synthesis process. A Bouligand-type chiral nematic film consisting of multistacked unidirectional layers of achiral NWs was fabricated using a modified layer-by-layer deposition method, which displays circular dichroism (CD) and chiral sensing capability. These intriguing properties of magnetoplasmonic anisotropic NWs and their self-assemblies could be consequently valuable for solid-state chiral sensing devices.

P3: Rapid Assembly of Magnetoplasmonic Photonic Arrays for Brilliant, Noniridescent, and Stimuli-Responsive Structural Colors

Van Tan Tran[1], Jeonghyo Kim[2], Sangjin Oh[2], Ki-Jae Jeong[2], Jaebeom Lee[2]
[1]*Phenikaa University (Vietnam),* [2]*Chungnam National University (Korea)*

A magnetic field-induced assembly for the rapid formation of scalable, uniform amorphous photonic arrays (APAs) featuring unique structural colors is demonstrated. The synergistic combination of surface plasmonic resonance of the Ag core and broadband light absorption of high refractive index (RI) Fe_3O_4 shell in hybrid magnetoplasmonic nanoparticles (MagPlas NPs) enables to produce brilliant, noniridescent structural colors with high tunability and responsiveness, which enables the fabrication of highly sensitive and reliable colorimetric sensors for naked-eye detection.

P4: Enhancement of multiphoton photoluminescence with resonant metastructures

Pavel Tonkaev[1], Yubin Fan[2], Yuhan Wang[2], Jiecai Han[2], Anastasia Zalogina[1], Aditya Tripathi[1], Hoo-Cheol Lee[3], Hong-Gyu Park[3], Sergey Makarov[4], Sergey Kruk[1], Qinghai Song[2], Shumin Xiao[2], Yuri Kivshar[1]
[1]*Australian National University (Australia),* [2]*Harbin Institute of Technology (China),* [3]*Korea University (Korea),* [4]*ITMO University (Russia)*

Multiphoton photoluminescence is a fundamentally important nonlinear process applied in microfabrication, data storage, and biological imaging. In general, nonlinear processes are much weaker compared with linear ones. We have studied multiphoton photoluminescence in perovskite metasurface and single AlGaAs nanoresonator and achieved significant enhancement in the vicinity of the Mie resonances.

P5: High-amplitude Broadband Directional Thermal Radiation

Yun-Jo Lee, Jin Woo Cho, Sun-Kyung Kim
KyungHee University (Korea)

Achieving angular selectivity with broad bandwidth from thermal radiation sources has been a long-standing challenge. Here, we achieved laterally directive ($\theta\, textgreater$ 60°), broad bandwidth (λ = 5-24 μm) polarization-independent thermal radiation from a thin-film-oxide-based hollow cavity array. The hollow cavity array allows light to strongly couple with phonon mode and Berreman mode at specific wavelengths and angles. These results will be further exploited for several radiative heat transfer applications, such as thermal camouflage, radiative cooling, and waste heat recovery.

P6: Perfect transmission microwave metamaterial based radar heaters

Eun-Joo Lee, Young-Bin Kim, Sun-Kyung Kim
Kyung Hee University (Korea)

A rational arrangement of well-known constituent materials, which is called metamaterial, can exhibit novel and effective material dispersions. Here, we report a metamaterial-based transparent radar heater working at microwave frequencies, as opposed to microwave shielding applications. The metamaterial transparent heater provides an effective route to achieve high conductivity and low signal attenuation, which ensures the reliable performance of radar systems under demanding environments.

P7: Geometric nature of electron hydrodynamics and 2D plasmonic metamaterials

Riki Toshio, Norio Kawakami

Kyoto University (Japan)

We formulate an electron hydrodynamic theory in noncentrosymmetric layered systems and clarify what a role the quantum geometry of Bloch electons plays in plasmonic metamaterial devices.

P8: Large Scale Fabrication of Extraordinary Transmission Plasmonic Metasurfaces Employing Ultrafast Lasers

Carlota Ruiz de Galarreta[1], Noemi Casquero[1], Euan Humphreys[2], Jacopo Bertolotti[2], Javier Solis[1], C. David Wright[2], Jan Siegel[1]

[1]*CSIC (Spain),* [2]*University of Exeter (United Kingdom)*

We demonstrate a versatile micro-fabrication technique based on ultrafast direct laser writing, towards the reliable, large-scale and low-cost fabrication of high-performance extraordinary transmission metasurfaces. Contrary to well-established lithographic-based fabrication methodologies, our technique enables the single-step realization of the EOT devices of several mm2 in a few minutes. Our fabrication methodology can be carried out in cleanroom-free environments and without generating chemical residues: conditions which reduce fabrication costs and are therefore affordable for a vast majority of industrial entities.

P9: Resonant phonon-magnon interactions in free-standing metal-ferromagnet multilayer structures

Urban Vernik[1], Alexey Lomonosov[1], Vladimir Vlasov[1], Leonid Kotov[1], Dimitry Kuzmin[1], Igor Bychkov[1], Paolo Vavassori[2], Vasily Temnov[1]

[1]*Ecole Polytechnique (France),* [2]*CIC nanoGUNE (Spain)*

We theoretically analyze resonant magneto-elastic interactions between standing perpendicular spin wave modes (exchange magnons) and longitudinal acoustic phonon modes in free-standing metal-ferromagnet multilayer structures. Whereas the ferromagnetic layer acts as a magnetic cavity, all metal layers control the acoustic frequencies and eigenmodes. Efficient resonant phonon-magnon interactions are governed by spectral and spatial mode overlap. Realistic simulations for gold-nickel multilayers show that sweeping the external magnetic field should allow for observing resonantly enhanced interactions between individual magnon and phonon modes.

P10: From antiferromagnetic to ferromagnetic fs-laser properties switching of FeRh thin films

Pavel Varlamov[1], Stephan Lempereur[1], Anna Semisalova[2], Michael Farle[2], Iliass Fendi[1], Ian Aupiais[1], Yannis Laplace[1], Anh Dung Nguyen[3], Olivier Noel[3], Michele Raynaud-Brun[1], Paolo Vavassori[4], Vasily Temnov[1]

[1]*Ecole Polytechnique (France),* [2]*University of Duisburg-Essen (Germany),* [3]*Le Mans Universite (France),* [4]*CIC nanoGUNE (Spain)*

We demonstrate the switching of ferromagnetic properties of FeRh thin films caused by fs-laser nanostructuring. The change of reflectivity, structure, and magneto-optical response of modified samples was observed. The correlation of reflectivity, magneto-optical signals, and relief depths of obtained structures was analyzed as a function of laser pulsed fluence.

P11: Active metasurface using ITO device in visible wavelength

Yong-Hae Kim, Chi-Sun Hwang, Jong-Heon Yang, Joo-Yeon Kim, Kyung-Hee Choi, Jaeheon Moon, Ji-Hun Choi

Electronics and Telecommunications Research Institute (Korea)

We propose a new ITO device for an active metasurface in a visible wavelength. New ITO device is consisted of Al/Al2O3/hyperbolic meta material (HMM)/Al2O3/Al antenna and can modulate the reflectivity' phase of 360o and the reflectivity's amplitude up to 10 %.

P12: Applications of Metasurfaces with Quadrupolar Moments

Ville Tiukuvaara, Olivier J. F. Martin, Karim Achouri

EPFL (Switzerland)

An extension of the generalized sheet transition conditions (GSTCs) to include multipolar moments has recently been shown, along with extensions of the Lorentz reciprocity and Poynting theorems to provide insights into the higher-order susceptibility terms involved. The additional susceptibility components provide new degrees of freedom for applications such as manipulation of the Brewster angle at a dielectric interface, and generalized refraction. In our presentation, we will show our latest developments in the modelling and applications of multipolar metasurfaces.

P13: Light scattering from rough silver surfaces in multilayered systems
Matin Dehghani, Christin David
Friedrich-Schiller-University Jena (Germany)

A theoretical approach to simulate the light scattering from multilayers of thin films with one rough surface is presented. Image processing is applied to calculate absorption for samples with different surface morphologies.

P14: Wide angle, polarization independent Metamaterial Absorber unit-cell for RCS reduction and energy harvesting applications
Said Choukri[1], Otman El Mrabet[2], Hakim Takhedmit[1], Mariem Aznabet[2], Laurent Cirio[1]
[1]*Gustave Eiffel University (France),* [2]*Abdelmalek Essaadi University (Morocco)*

In this work, a new design of Metamaterial Absorber unit-cell is presented with a high absorption coefficient of 99.78 % at 10 GHz. The numerical results show that the proposed unit-cell has constant performances regardless the polarization state of the incoming waves, a wide angle of absorption up to for TE polarized waves, and for TM, RHCP, LHCP polarized waves. Analytical circuit model has been developed to describe the matching process between the unit-cell and free space impedances.

P15: 10 dB Emission Suppression in Low Contrast 3D Quasiperiodic Structure
Meraj E. Mustafa[1], Soumyadeep Saha[2], Manfred Eich[1], Alexander Yu. Petrov[1]
[1]*Hamburg University of Technology (Germany),* [2]*Jadavpur University Kolkata (India)*

We demonstrated that 3D quasiperiodic structures with optimal number of overlapping gratings result in more than 10 dB emission suppression. We show this significant emission suppression for refractive-indices of 1.38, 1.43 and 1.58 by numerical simulations.

P16: Inverse-gain cavity oscillators for efficient micro and nano lasers
Gunpyo Kim, Seok Ho Song, Jae Woong Yoon
Hanyang University (Korea)

For realization of ultracompact lasers, we propose a new design principle for laser oscillators requiring lower threshold gain as reducing the cavity length. We explain the inverse-gain mechanism and show nanophotonic and plasmonic cavity structures applying inverse-gain mechanism. Using numerical analyses, our proposed cavity structures show significant reduction of threshold gain constants by one or three order of magnitude compared to conventional laser cavities.

P17: Plasmonic topological resonance states in a deep subwavelength structure
Yu Sung Choi, Ki Young Lee, Jae Woong Yoon
Hanyang University (Korea)

We theoretically demonstrate surface-plasmonic Jackiw-Rebbi-state resonances that take advantages ofdeep-subwavelength confinement and topological robustness properties. We make use of a metal-insulator-metal gratingstructure in which the surface plasmon-polariton mode resonantly couples with the radiation continuum and its topologicalphase is controllable with geometrical parameters. We provide a promising design for the telecommunicationsIR domain. Importantly, the proposed design shows a strongly confined resonance state in both lateral and vertical axes, andhighly robust Q-factor against decreasing in-plane footprint size.

P18: Assessing the performance of metalenses to enhance light collection by silicon photomultipliers
Augusto Martins[1], Chris Stanford[1], Taylor Contreras[1], Benjamin L. Sanderson[2], Carlos Ecobar[2], Adam Para[2], Michelle D. Stancari[2], Justo Martin-Albo Simon[3], Joon-Suh Park[1], Federico Capasso[1], Roxanne Guenette[4]
[1]*Harvard University (USA),* [2]*Fermi National Accelerator Laboratory (USA),* [3]*Instituto de Fisica Corpuscular (Spain),* [4]*University of Manchester (United Kingdom)*

We present a method of robust and effective simulation of large area metalenses for light collection enhancement. This method relies on splitting the metalens into smaller sectors that can be approximated by linear phase patches. Our method shows good agreement with experimental data for a metalens operating at 632 nm. We intend to use this method to characterize metalenses operating at VUV wavelenghts.

P19: Plasmonic response of metallic nanoparticles from UV to NIR range
Gaurav Pal Singh, Neha Sardana
IIT Ropar (India)

The optical properties of nanoparticles (NPs) metals displaying the highest plasmonic response (silver, gold, copper, and aluminum) were simulated in air, glass, and a-Si environment from the ultraviolet (UV) to the near-infrared (NIR) range. Embedding the metal NPs in a dielectric medium provides prevention from agglomeration, increased absorption, and protection from environmental effects. The effect of the material, size, shape, and environment was observed quantitively by analyzing the peak shifts of the dipole and higher-order poles.

P20: Plasmonic metasurface tailored for fluorescent enhancement

Roxana Tomescu, Veronica Anastasoaie, Cristian Kusko, Stefan Caramizoiu, Adrian Dinescu, Catalin Parvulescu, Cosmin Obreja, Dana Cristea
IMT Bucharest (Romania)

Plasmonic metasurfaces are often used in a variety of applications which require light processing, with miniaturized devices integrable in various systems. In this work, we propose metasurface structures specifically tailored for fluorescent enhancement of Rhodamine 6G. Using finite-difference time-domain simulations we observed that we could obtain an improvement of the localized electromagnetic field of 5.76 times with silver resonators of 60 nm height. The investigation performed with a fluorescent scanner confirm that the proposed and fabricated structures offer fluorescent enhancement.

P21: Simultaneous optical and mechanical sensing based on nano-optomechanical disks

Elena Sentre Arribas[1], Eduardo Gil Santos[1], Ivan Favero[2], Aristide Lemaitre[2], Montserrat Calleja[1], Javier Tamayo[1]
[1] *Instituto de Micro y Nanotecnologia (CSIC) (Spain),* [2] *Universite Paris-Saclay (France)*

In this work, we demonstrate that by bringing together optical and mechanical resonances in single sensing platforms, their performances are significantly enhanced. In particular, we use nano-optomechanical disks, which simultaneously support high quality optical and mechanical modes. First, we apply the simultaneous or dual optical and mechanical sensing technique for monitoring environmental changes. Then, we employ it for detecting individual bacteria, accessing to its optical and mechanical properties.

P22: Ultrathin-film cavity metastructures for high quality absorbers and tunable structural colors

Fernando Chacon Sanchez, Rosalia Serna
IO-CSIC (Spain)

Traditionally dielectric cavities were used to achieve structural colors. Recently, the use of sub-quarter wave cavities with high-refractive index lossy media has shown excellent results based on an abrupt phase change on the interfaces. Here we present a hybrid approach to achieve quasi-perfect wide band absorbers and tunable structural colors by integrating dielectric cavities and high-refractive index media, while keeping a sub-quarter-wave thickness. The structures are based on high-quality ultrathin Bi films (10nm) and built on Si without back-metal mirror.

P23: Excitation of lattice resonances with structured light

Juan Ramon Deop Ruano[1], Lauren Zundel[2], Rosario Martinez-Herrero[2], Alejandro Manjavacas[1]
[1] *IO-CSIC (Spain),* [2] *University of New Mexico (USA)*

Periodic arrays of metallic nanoparticles support collective lattice resonances . These modes produce stronger and more spectrally narrow responses than the plasmonic resonances supported by the individual nanoparticles. Most of the past theoretical research has studied the excitation of lattice resonances under plane wave illumination. However, it is well known that plane waves are an ideal limit of a propagating electromagnetic field. Here, we provide a complete characterization of the response of arrays under different types of structured light beams.

P24: Optical response of arrays of graphene nanodisks

Juan Ramon Deop Ruano[1], Stephen Sanders[2], Alessandro Alabastri[2], Wilton Kort-Kamp[3], Diego Dalvit[3], Alejandro Manjavacas[1]
[1] *IO-CSIC (Spain),* [2] *Rice University (USA),* [3] *Los Alamos National Laboratory (USA)*

Graphene nanodisks are a promising platform for nanophotonics due to their exceptionally strong and tunable plasmonic responses. When placed in a periodic array configuration, the response of the whole system can be very different from that of the individual constituents. Here, we provide a comprehensive analysis of the response of arrays of graphene including a fully analytical model that predicts the strength and the spectral width of their optical response.

P25: Silver Nanoparticle Arrays for Wavelength Taylored Enhancement of Raman Scattering

Nadzeya Khinevich[1], Mindaugas Juodėnas[1], Asta Tamulevicienė[1], Tomas Tamulevicius[1], Martynas Talaikis[2], Gediminas Niaura[2], Sigitas Tamulevicius[1]

[1]*Kaunas University of Technology (Lithuania),* [2]*Vilnius University (Lithuania)*

Chemically synthesized silver nanoparticles of different average sizes (70 nm - 130 nm) were deposited into regular lattices on PDMS templates by the CAPA method. The fabricated arrays exhibited SLR. The effect of the nanoparticle size on the SLR peak position and the SERS activity related to the excitation wavelength and SLR peak position overlap was investigated. The overlapping positions at 532 nm excitation wavelength, the enhancement factor reached 108, and the detection limit for 2-naphthalenethiol molecules - 10-8 M

P26: Interaction of complex beams with strongly anisotropic ENZ metamaterials

Vittorio Aita[1], Diane Roth[1], Anastasiia Zaleska[1], Alexey V. Krasavin[1], Luke H. Nicholls[1], Nikita A. Shevchenko[2], Francisco J. Rodriguez-Fortuño[1], Anatoly V. Zayats[1]

[1]*King's College London (United Kingdom),* [2]*University of Cambridge (United Kingdom)*

We theoretically and experimentally investigate the interactions of cylindrical vortex beams (CVBs) with a strongly anisotropic plasmonic metamaterial, concentrating on radially and azimuthally polarised beams, under weak and tight focusing regimes. Extinction properties of the metamaterial show sensitivity to different polarisation states and a strong dichroism resulting in variations of the beam modal structure and polarisation. Experimental results show good agreement with theoretical predictions, proving the promising potential of anisotropic metamaterials for complex vector beams shaping.

P27: The spin-orbit coupling-free three-dimensional topological insulator in photonics *online*

Minkyung Kim[1], Zihao Wang[2], Yihao Yang[2], Junsuk Rho[1], Baile Zhang[2]

[1]*POSTECH (Korea),* [2]*Nanyang Technological University (Singapore)*

A three-dimensional (3D) photonic topological insulator endowed with self-guided topological surface states at its external boundary is presented. By fully abolishing spin-orbit coupling, which has been considered indispensable for topological insulators, the unique quadratic surface dispersion of the topological crystalline insulating phase first proposed by Fu [1] is experimentally demonstrated. This work paves the way towards the 3D cladding-free photonic manipulation.

P28: Non-invasive Point-of-Care nanobiosensing of cervical cancer as an auxiliary to pap-smear test *online*

Mitali Basak[1], Monika Sachdev[2], Dipankar Bandyopadhyay[1]

[1]*Indian Institute of Technology Guwahati (India),* [2]*Endocrinology Division, Central Drug Research Institute Lucknow (India)*

The present work focuses on the development of a point of care testing unit for non-invasive screening of cervical cancer from the urine sample of the targeted patient. Here, a plasmonic immunobiosensor has been fabricated using gold nanoparticles immobilized with antibodies specific to a potential biomarker of cervical cancer, Protein-Phosphatase-1-gamma-2. The developed device is capable to identify the positivity of the test from crude urine sample of the affected patient.

P29: Acoustic helical dichroism in chiral structures *online*

Qing Tong, Shubo Wang

City University of Hong Kong (China)

We demonstrate acoustic helical dichroism, i.e., differential absorption of acoustic vortices carryingopposite orbital angular momentum (OAM), in a one-dimensional lattice formed of chiral resonators. Thephenomenon originates from the OAM band gaps and non-Hermitian exceptional points under the breaking of

P30: Arbitrary order exceptional point in coupled spinning cylinders *online*

Zheng Yang[1], Hongkang Shi[2], Yuntian Chen[2], Shubo Wang[1]

[1]*City University of Hong Kong (China),* [2]*Huazhong University of Science and Technology (China)*

In this talk, I will report a robust method to realize arbitrary order exceptional points (EPs) by employing spinning motion of resonators. The proposed method does not rely on selective excitation of chiral modes and is robust against spin-flipping perturbations. We show that higher-order EPs in the proposed system are accompanied by enhanced optical isolation, which may find applications in designing novel optical isolators, nonreciprocal optical devices, and topological photonics.

P31: Chiral discrimination by polarization singularities of a metal sphere *online*

Shiqi Jia, Jie Peng, Yuqiong Cheng, Shubo Wang
City University of Hong Kong (China)

In this talk, we will report a method of detecting small chiral particles by using the C lines (i.e., lines of polarization singularities) in the scattering field of a metal sphere. We will show the absorption dissymmetry of deep-subwavelength helices at different positions on the C lines, which can be much larger than that induced by circularly polarized plane wave excitation. We will also discuss the effect of the helix's anisotropic properties on the absorption dissymmetry.

P32: Electronically Reconfigurable Compact Tri-band Metamaterial based Band stop Filter for Wireless Applications *online*

Khyati Chavda[1], A. K. Sarvaiya[2]
[1]*GTU (India),* [2]*Government Engineering College (India)*

A compact reconfigurable tri-band band stop filter (BSF) with good selectivity and sharp rejection is designed for wireless application. A microstrip feed line loaded with eight Novel shape hexagonal metamaterial unit cells of various sizes and switches as PIN diode used in proposed filter. The filter's structure is distinguished by fifteen different operating modes of operation. The filter designed in this paper is a compact as size of filter 0.28λg x0.17λgx 0.011λg

10:50 - 12:40 — Room 1

Session 1A2

Symposium II: New trends in nanophotonics and advanced materials

Organized by: Junsuk Rho, Hakjoo Lee and Namkyoo Park

Chaired by: Junsuk Rho, Hakjoo Lee and Namkyoo Park

10:50 : Keynote talk
Keynote Talk of Javier Garcia de Abajo

Garcia de Abajo
ICFO-Institut de Ciencies Fotoniques (Spain)

Keynote Talk of Javier Garcia de Abajo

11:20 : Invited talk
Non-Markovian Effects for Hybrid Plasmonic Systems in Strong Coupling Regime

Tigran V. Shahbazyan
Jackson State University (USA)

We study the role of non-Markovian effects in the emission spectrum of a quantum emitter resonantly, coupled to a surface plasmon as the system transitions to strong coupling regime. We use a quantum approach to, interacting plasmons that incorporates the effects of host material's optical dispersion and losses in the coupling, parameters to show that the non-Markovian effects strongly affect the emission spectra in the strong coupling, regime by shifting the spectral weight towards the lower frequency polaritonic band.

11:40 : Invited talk
Manipulation of multiple OAM modes by phase-engineered metasurfaces

Yueyi Yuan[1], Shah Nawaz Burokur[2], Kuang Zhang[1]
[1]*Harbin Institute of Technology (China),* [2]*University Paris Nanterre (France)*

A phase-engineered non-interleaved metasurfaces is proposed for multiple vortex bean generation under circularly polarized incidence. Different from traditional scheme based on phase interleaving for multiple functionalities, four vortex beam wavefronts carrying independent orbital angular momentum (OAM) can be created through all four circular polarization (CP) transmission channels by combining versatile phase modulation methods. Theoretical simulations are conducted and effectively verified the feasibility of the proposed theory for artificial manipulation of CP manipulation in microwave region.

12:00 : Invited talk
Hydrogen Evolution Reactions under Plasmon Excitation
Hiro Minamimoto, Daiki Sato, Kei Murakoshi
Hokkaido University (Japan)

The visible-light driven hydrogen evolution reaction is one of the important reactions for the sustainable society. Recently, various photocatalytic systems, such as molecular catalysts, semiconductors, or plasmonic systems, have been established. In this study, we have established the visible light driven efficient hydrogen evolution under plasmon excitation. Through the examination of isotopic effects, we have successfully clarified the unique and interesting molecular processes which were quite different from the commonly proposed ones.

12:20 : Invited talk
A flexible terahertz imaging sheet for multi-view visualization and inspection *online*
Yukio Kawano
Chuo University (Japan)

We present flexible and stretchable terahertz imaging sheets utilizing broadband photo-absorption of carbon nanotubes. This technology has enabled multi-view terahertz imaging and its applications to non-destructive inspections without using bulky systems.

10:50 - 12:40 — Room 2

Session 1A3

Acoustic and elastic phononic crystals, metamaterials and other structured media

Organized by: Marco Miniaci, Vicente Romero-Garcia, Vincent Pagneux, Maxime Lanoy, Jean-Philippe Groby and Noé Jiménez

Chaired by: Marco Miniaci, Vicente Romero-Garcia, Vincent Pagneux, Maxime Lanoy, Jean-Philippe Groby and Noé Jiménez

10:50 : Invited talk
Emergent phenomena in locally resonant acoustic metamaterials due to subharmonic energy exchange
Varvara Kouznetsova[1], Priscilla Silva[1], Valentina Zega[2], Michael Leamy[3], Marc Geers[1]
[1]*Eindhoven University of Technology (The Netherlands),* [2]*Politecnico di Milano (Italy),* [3]*Georgia Institute of Technology (USA)*

This work investigates the emergent phenomena in non-linear locally resonant elasto-acoustic metamaterials. The energy exchange between the propagative and subharmonic evanescent wave modes is studied, which has been shown to originate from the autoparametric resonance promoted by the non-linearity in the resonator. The phenomenon is analysed semi-analytically (using the multiple scales method), numerically, and experimentally.

11:10 : Invited talk
Metamaterial structures with Willis coupling for wave waves
Yan Meng[1], Yiran Hao[1], Sebastien Guenneau[2], Shubo Wang[3], Jensen Li[1]
[1]*Hong Kong University of Science and Technology (China),* [2]*Imperial College London (United Kingdom),* [3]*City University of Hong Kong (China)*

Willis coupling has been recently realized for acoustic waves and elastic flexural waves as the analogy of bianisotropy originally in electromagnetism. For further extension, we investigate its formulation in water waves and other kinds of elastic waves. Possible designs and numerical formulation in extracting the effective media with Willis coupling will also be discussed.

11:30 : Invited talk

Controlling MHz acoustic waves with plant-derived phononic materials

Maroun Abi Ghanem[1], **Samuel Raetz**[2], **Olivier Hamant**[3], **Thomas Dehoux**[1]
[1] *Universite Claude Bernard Lyon 1 (France)*, [2] *Le Mans Universite (France)*, [3] *ENS de Lyon (France)*

We study surface acoustic wave (SAW) propagation in plant-derived materials composed of decellularized plant cells scaffolds. Laser-based opto-acoustic techniques are used to excite and measure MHz acoustic waves in these biocomposites. We demonstrate that these bio-derived structures behave as an organic phononic material, with the presence of bandgaps due locally-resonant phenomena.

11:50 : Keynote talk

3D wavefront shaping with soft sub-wavelength acoustic lenses

Thomas Brunet, Yabin Jin, Olivier Lombard, Raj Kumar, Olivier Poncelet, Olivier Mondain-Monval
University of Bordeaux (France)

In this talk, I will report a class of flat (or quasi-flat) acoustic lenses with sub-wavelength thicknesses,engineered from soft porous silicone rubbers, for broadband underwater 3D wavefront shaping of ultrasound.The functionalities of these soft gradient-index (or high-index) metasurfaces will be illustrated through variousultrasonic experiments in a large water tank, thus demonstrating acoustic focusing and vortex beam generation.

12:20 : Invited talk

Spider-inspired phononic sensor for damage detection and localization *online*

Pawel Kudela[1], **Maciej Radzienski**[1], **Katarzyna Majewska**[1], **Magdalena Mieloszyk**[1], **Nicola Pugno**[2], **Wieslaw Ostachowicz**[1], **Marco Miniaci**[3]
[1] *Polish Academy of Sciences (Poland)*, [2] *University of Trento (Italy)*, [3] *University of Lille (France)*

A spider-inspired phononic sensor was conceptualized and examined both experimentally and numerically. It is inspired by spiders' sensitivity to vibrations and ability to localize prey on a web. However, instead of low-frequency vibrations, we are utilizing guided waves. In particular, nonlinearities in sensed signals are attractive as early indicators of damage in a structure. Guided waves are filtered by phononic crystals embedded into the legs of the spider-inspired sensor registering nonlinearities. The damage is localized by using the time-reversal method.

10:50 - 12:30 — Room 3

Session 1A4

Symposium I: Hybrid Nanomaterials and Metastructures for Photonics, Sensing and Energy

Organized by: Jerome Plain, Alexander Govorov, Davy Gerard and Pedro Hernandez Martinez

Chaired by: Jerome Plain, Alexander Govorov, Davy Gerard and Pedro Hernandez Martinez

10:50 : Invited talk

Novel 2D Materials Enabled All-Optical Nonlinear Activation Functions for On-Chip Photonic Deep Neural Networks

A. Karabchevsky
Ben-Gurion University (Israel)

In my talk, I will discuss the challenges and novel approaches for implementing an all-optical neural nonlinear activation function based on utilising unique light-matter interactions with new class of 2D materials towards the realization of all-optically implemented deep neural networks.

11:10 : Invited talk

Towards Efficient and Active Nonlinear Metasurfaces

Mikko Huttunen, Timo Stolt, Jussi Kelavuori, Anna Vesala
Tampere University (Finland)

Collective responses known as surface lattice resonances (SLRs) have recently emerged as an interesting approach to realize high-Q factor metasurface resonators. Here, we show how SLRs can be utilized to realize flat resonators with Q-factors exceeding 2400 and how such resonances can be controlled via ambient temperature of fabricated devices. We will also demonstrate how SLRs can be realized in CMOS-compatible systems based on aluminium-based metasurfaces and discuss the potential of SLR-based metasurfaces for nonlinear optics.

11:30 : Invited talk

Generation of hot electrons in plasmonic nanoparticles with complex shapes

Eva Yazmin Santiago Santos[1], Lucas V. Besteiro[2], Xiang-Tian Kong[2], Miguel A. Correa-Duarte[3], Zhiming Wang[1], Alexander O. Govorov[1]

[1]Ohio University (USA), [2]University of Electronic Science and Technology (China), [3]Universidade de Vigo (Spain)

The generation of hot electrons in plasmonic nanoparticles is an intrinsic response to light, which strongly depends on the nanoparticle shape, material, and excitation wavelength. In this study, we present a formalism that describes the hot-electron generation for gold nanospheres, nanorods and nanostars. Among them, the nanostars are the most efficient, with an internal energy efficiency of approximately 25 $\%$, owing to multiple factors, including the presence of hot spots.

11:50 : Invited talk

Reconfigurable dielectric nanoresonators for dynamic manipulation of light wavefronts at visible frequencies

Ramon Paniagua Dominguez, Parikshit Moitra, Xuewu Xu, Tobias Mass, Shampy Mansha, Rasna Maruthiyodan Veetil, Xinan Liang, Damien Eschimese, Anton Baranikov, Arseniy Kuznetsov

Institute of Materials Research and Engineering, Agency for Science, Technology and Research (Singapore)

In this talk we will present our latest results on dynamic manipulation of light wavefronts using reconfigurable nanocavities. In particular, we will present how interfacing dielectric nanoantennas with liquid crystals can serve this purpose, and present alternative approaches to achieve multi-spectral operation and devices with memory based on Fabry-Perot nanocavities and phase change materials, respectively.

12:10 : Invited talk

Photoluminescence Engineering with Nanoantenna Phosphors

Shunsuke Murai, F. Zhang, K. Aichi, K. Tanaka

Kyoto University (Japan)

We combined a phosphor plate with titania (TiO2) nanoantennae to harness the photoluminescence into a specific direction predefined by the antenna design. A notable ($textgreater$ 10 times) enhancement in forward radiation intensity is demonstrated. We describe the mechanism using a simple analytical model.

10:50 - 12:30 — Room 4

Session 1A5

Symposium IV: Chirality, magnetism, and magnetoelectricity: Separate phenomena and joint effects in metamaterial structures

Organized by: Eugene Kamenetskii

Chaired by: Eugene Kamenetskii

10:50 : Invited talk

Manipulating the guidance of circularly polarized fields by magneto-electric coupling effects in metasurfaces

Zuojia Wang[1], Liqiao Jing[1], Hao Yan[2]

[1]Zhejiang University (China), [2]Shandong Universi (China)

We demonstrate the polarization shaping abilities of metasurfaces on circularly polarized field. By tailoring the magneto-electric coupling effects in meta-atoms, we can achieve beam deflectors for circularly polarized fields bounded at moving free electrons, nonreciprocal phase shifters for spoof surface plasmon polaritons, as well as nonreciprocal absorbers for circularly polarized propagating waves. The underlying mechanism is explained by the coupled mode theory established for magneto-electric metastructures. Our findings may offer an alternate approach to lightweight, reconfigurable, and deployable metadevices.

11:10 : Invited talk
Magnetic skyrmion Hall effects
Yan Zhou
The Chinese Univerisity of Hong Kong (China)

Recently, magnetic skyrmions - topologically non-trivial spin nanostructures, have been endowed with great expectations as promising candidates for next-generation spintronic device applications. However, there is a major roadblock for skyrmionics device applications - the skyrmion Hall effects, which may lead to skyrmions annihilation at the sample edge. In this talk, Dr. Yan Zhou will discuss his recent work of eliminating/suppressing the skyrmion Hall effects, which may overcome the main bottleneck of practical applications of skyrmionic racetrack memory and logic devices.

11:30 : Invited talk
Semiconductor topological nanophotonics incorporating light emitters
Yasutomo Ota[1], Yasuhiko Arakawa[2], Satoshi Iwamoto[2]
[1]*Keio University (Japan),* [2]*The University of Tokyo (Japan)*

Topological photonic crystals made of compound semiconductors are a fascinating platform to develop topological nanophotonic devices with active functionalities. In this contribution, will discuss recent progress in IIIV-semiconductor topological nanophotonics incorporating optical gain media and quantum emitters. We will review several ways to realize topological nanocavities and topological slow light waveguides, both of which can significantly enhance light-matter interactions with embedded light emitters. These photonic structures enable the realization of topological nano/microlasers and quantum light sources capable of robust operation.

11:50 : Invited talk
Emergence/control of topological spin textures in various spin systems *online*
Yutaka Akagi
The University of Tokyo (Japan)

Recently, topological spin textures such as Skyrmions have attracted both scientific and technological interest. Firstly, we demonstrate the photocontrol of spin-scalar-chiral state in spin-charge coupled systems with spatial inversion symmetry. We also show that the sign of the scalar chirality can be selected by circular polarization. Secondly, we discuss general magnetic Skyrmions of spin nematic phases in localized spin systems with S=1. Examples include fractional Skyrmions with 1/3 topological charge, which is a generalization of the so-called meron.

12:10 : Invited talk
Large Spin Current Rectification with Magnetic Resonance *online*
Masahiro Sato[1], Hiroaki Ishizuka[2]
[1]*Chiba University (Japan),* [2]*Tokyo Institute of Technology (Japan)*

Photogalvanic effects, especially, those in non-centrosymmetric crystals, have gathered attention. Recently, we have theoretically proposed their magnetic versions, namely, photogalvanic spin currents in magnetic insulators. In this conference, we discuss a new mechanism of photogalvanic spin current through magnetic resonance, focusing on van der Waals magnets, Cr trihalides (CrI3 and CrBr3). We demonstrate that the resulting spin current is several orders of magnitude larger than those of previous works. The magnetic-resonance mediated spin current would open new routes of opto-spintronics.

10:50 - 12:30 — Room 5

Session 1A6

Challenges of Phase Change Materials and Plasmonics for Nanophotonics

Organized by: Maria Losurdo, Yael Gutiérrez, Kurt Hingerl, Christoph Cobet, Mircea Modreanu and Fernando Moreno

Chaired by: Maria Losurdo, Yael Gutiérrez, Kurt Hingerl, Christoph Cobet, Mircea Modreanu and Fernando Moreno

10:50 : Invited talk
VO2 based dielectric metasurfaces and metamaterials for reconfigurable optical systems applications
Jimmy John[1], Aditya Tripathi[2], Sergey Kruk[2], Yael Gutierrez[3], Helmut Karl[4], Fernando Moreno Gracia[5], Yuri Kivshar[2], Zhen Zhang[6], Shriram Ramanathan[6], Hai Son Nguyen[1], Lotfi Berguiga[1], Pedro Rojo Romeo[1], Regis Orobtchouk[1], Sebastien Cueff[1]
[1]INSA de Lyon (France), [2]Australian National University (Australia), [3]CNR-NANOTEC (Spain), [4]Universitat Augsburg (Germany), [5]Universidad de Cantabria (Spain), [6]Purdue University (USA)

We demonstrate two strategies for creating highly tunable VO2-based building blocks for metamaterial-based optical system. First strategy is based on VO2 nanocrystals embedded in SiO2, wherein we show the multipole resonances supported by VO2 NCs can be actively tuned by its insulator-to-metal transition. Second strategy is on the integration of a VO2 layer coupled to a dielectric metasurface consisting of silicon resonators, the interaction between these resonances and the incident light can be tuned depending upon the transition of VO2.

11:10 : Invited talk
Spin-momentum locking in chiralitonic metasurfaces
Fernando Loren[1], G. L. Paravicini-Bagliani[2], L. Martin-Moreno[1], C. Genet[2]
[1]SIC-Universidad de Zaragoza (Spain), [2]Universite de Strasbourg (France)

We revisit the optical properties of a chiralitonic metasurface. We focus on the spin-orbit coupling as a result of the local rotation of the coordinate system induced by the rotation of the nanoapertures. The most striking result is that the widely-used spin-momentum locking is not exact in spin. It is exact in momentum but approximate in spin. The results are experimentally confirmed with Mueller polarimetry measurements, which allows to capture the full polarization, energy and momentum response of the metasurface.

11:30 : Invited talk
Dynamic response of reversibly switched ultra-low loss phase change materials
Daniel Lawson, Daniel Hewak, Otto Muskens, Ioannis Zeimpekis
University of Southampton (United Kingdom)

Antimony-based chalcogenides such as Sb2Se3 and Sb2S3 are rapidly emerging materials for photonic applications owing to their ultra-low optical losses at telecommunication wavelengths in both crystalline and amorphous phases. In this work, we investigate their dynamic response from nanoseconds to milliseconds under optical pumping to study their optical performance during phase transitions induced by direct pulsed optical switching. Our aim is to provide fundamental insights for the optimization of the material family and its employment in photonic applications.

11:50 : Invited talk
Extraordinarily transparent compact metallic metamaterials
Vincenzo Giannini
CSIC (Spain)

Metals are highly opaque, yet we show numerically and experimentally that densely packed arrays ofmetallic nanoparticles can be more transparent to infrared radiation than dielectrics such as germanium,even for arrays that are over 75 % metal by volume. Despite strong interactions between the metallicparticles, these arrays form effective dielectrics that are virtually dispersion-free, making possible thedesign of optical components that are achromatic over ultra-broadband ranges of wavelengths from afew microns up to millimetres or more.

12:10 : Invited talk
Neural network assisted design of scattering properties in plasmonic nanostructures

Sergio Gutierrez Rodrigo
CSIC-Universidad de Zaragoza (Spain)

We demonstrate the use of neural networks (NN) to improve the design of plasmonic nanostructures (PN). The scattering properties of a PN calculated by a slow numerical method is subrogated by a trained NN. The NN results are almost indistinguishable from those calculated with the numerical solver, but up to 106 times faster. We illustrate the capabilities of this approach by optimizing infrared light absorption of a Transition Edge Sensor, which could be bring interesting applications for single photon detection.

10:50 - 12:30 — Room 6

Session 1A7

Extreme meta-photonics

Organized by: Nasim Mohammadi Estakhri and Inigo Liberal

Chaired by: Nasim Mohammadi Estakhri and Inigo Liberal

10:50 : Invited talk
Quantum optics in extreme media
Iñigo Liberal
Public University of Navarre (Spain)

Metamaterials with extreme characteristics (e.g., near-zero constitutive parameters, atomically-thin geometry, ultra-fast temporal variations, extreme anisotropy, etc) represent a fertile playground for controlling quantum light-matter interactions. In our talk, we will review our latest result in the control of quantum radiative processes mediated by metamaterials with extreme characteristics.

11:10 : Invited talk
Effect of Dielectric Losses in the Sensing Performance of THz All-Dielectric Quasi-BIC Metasurfaces
Jose Antonio Alvarez Sanchis, Borja Vidal Rodriguez, Ana Diaz Rubio
Universitat Politecnica de Valencia (Spain)

We study the effect of losses on the resonances of an all-dielectric metasurface with ideally high-quality factor in the THz frequency range, considering realistic materials. In addition, we compare the resonances in this structure with the extraordinary optical transmission resonance supported by a metallic structure, reaching the conclusion that the sensing performance of the former can be surpassed by the latter.

11:30 : Invited talk
Fundamental radiative processes and momentum consideration inside near-zero index media
Michael Lobet[1], Inigo Liberal[2], Larissa Vertchenko[3], Andrei Lavrinenko[3], Nader Engheta[4], Eric Mazur[5]
[1]*University of Namur (Belgium),* [2]*Universidad Pública de Navarra (Spain),* [3]*Technical University of Denmark (Denmark),* [4]*University of Pennsylvania (USA),* [5]*Harvard University (USA)*

Fundamental radiative processes are important light-matter interactions encountered in photonics. Here, we theoretically work out those processes inside unbounded media with a vanishingly small refractive index. Our formalism also includes the effect of the spatial dimensionality as well as the class of NZI materials. Spontaneous emission enhancement/inhibition is shown to be dependent on the refractive index, the impedance and the dimensionality of the material. Furthermore, momentum considerations inside NZI materials are discussed and related to the Abraham-Minkowski debate.

11:50 : Invited talk
Epsilon-near-zero Metamaterials for Microwave Devices
Yue Li
Tsinghua University (China)

Metamaterials, or artificially structured composites, have triggered exciting opportunities to control electromagnetic waves. The epsilon-near-zero (ENZ) metamaterials, whose effective permittivity are close to zero, have drawn intensive interests over the past two decades. Here, we demonstrate the concept and exotic properties of ENZ metamaterials, and reveal their unique applications in microwave engineering. We envision the ENZ metamaterials can enrich the theory framework of artificially structured media and affect the applications in a wide range of fields.

12:10 : Invited talk
Metasurfaces, Multipoles and Symmetries *online*
Karim Achouri, Ville Tiukuvaara, Olivier Martin
EPFL (Switzerland)
The majority of metasurface modelling techniques only consider dipolar polarizations. While this usually provides excellent modelling accuracy within the paraxial limit, we will show that it leads to significant errors for large incidence angles and/or large unit cell period-to-wavelength ratios. To overcome this limitation, we derive an extension of our previously developed dipolar metasurface model to include multipolar contributions. Combined with reciprocity, structural symmetries and spatial dispersion, this model provides a significant accuracy improvement and new opportunities for wave transformations.

10:50 - 12:30 — Room 7

Session 1A8

Symposium II: New trends in nanophotonics and advanced materials

Organized by: Junsuk Rho, Hakjoo Lee and Namkyoo Park

Chaired by: Junsuk Rho, Hakjoo Lee and Namkyoo Park

10:50 : Invited talk
Topological optical fields generated by topological structures *online*
Shubo Wang[1], Jie Peng[1], Ruo-Yang Zhang[2], Shiqi Jia[1], Wei Liu[3]
[1] *City University of Hong Kong (Hong Kong),* [2] *The Hong Kong University of Science and Technology (Hong Kong),* [3] *National University of Defense Technology (China)*
In this talk, I will discuss optical properties solely decided by the overall topology of structures and are irrelevant to their material constituents or specific geometries. I will show that there is a subtle and inextricable connection between the topology of optical fields and the topology of optical structures.

11:10 : Invited talk
Metastructured Photonic Devices for Tailoring Spatial Structures of Light *online*
Jian Wang
Huazhong University of Science and Technology (China)
Metastructured photonic devices, such as metamaterials and metasurfaces, are promising candidates for robust light manipulation with enhanced functionalities. In this talk, we review recent progress in tailoring spatial structures of light with metastructured photonic devices: 1) plasmonic metasurfaces on thin metal film for twisting/vectoring light, 2) dielectric metasurfaces on silicon platform enabling twisted light generation/detection/(de)multiplexing/lasing, 3) meta-facet fiber for structuring light, 4) Silicon-based ultra-compact broadband polarization diversity orbital angular momentum (OAM) generator, 5) 3D-metastructures by direct femtosecond laser writing technique.

11:30 : Invited talk
Inverse design enables simple, single-celled metasurfaces for multifunctionalities *online*
Sunae So, Junsuk Rho
Pohang University of Science and Technology (Korea)
Here, we discuss a novel inverse design method to design multifunctional metasurfaces using a gradient-descent optimization. Using the inverse design method, we present simple and single-celled metasurfaces for high numerical aperture metalens and full-color holograms in multi-plane projections. Finally, we experimentally demonstrate the designed metasurfaces, and up to nine distinct metasurface-generated hologram images are achieved with high fidelity.

11:50 : Invited talk

Ultraviolet violet applications utilizing high refractive index subwavelength structure with ultra-thin thickness *online*

Yuusuke Takashima, Kentaro Nagamatsu, Masanobu Haraguchi, Yoshiki Naoi
Tokushima University (Japan)

High refractive index subwavelength structures can provide very attractive optical characteristics due to its unique light propagation. The highly polarized emitter and near-unity absorber have been demonstrated around deep to near UV wavelength by the effect of interference in high contrast grating and multilayers.

12:10 : Invited talk

Magnetic topological photonic crystals *online*

Baile Zhang
Nanyang Technological University (Singapore)

The field of topological photonics was initiated with a design of magnetic photonic crystal followed by its experimental demonstration at microwave frequencies. Magnetic photonic crystals provide a unique platform with broken time reversal symmetry for many emerging phenomena that are difficult in other platforms. Here I will introduce some of our recent studies in magnetic topological photonic crystals with simple demonstrations.

10:50 - 12:30 — Room 8

Session 1A9

Symposium II: New trends in nanophotonics and advanced materials

Organized by: Junsuk Rho, Hakjoo Lee and Namkyoo Park

Chaired by: Junsuk Rho, Hakjoo Lee and Namkyoo Park

10:50 : Invited talk

Advanced hybrid plasmonic nano-sources of light: on the importance of controlling the spatial distribution of the active medium

Dandan Ge[1], Minyu Chen[2], Sylvie Marguet[3], Christophe Couteau[2], Ali Issa[2], Safi Jradi[2], Renaud Bachelot[2]
[1] *Tokyo Institute of Technology (Japan),* [2] *Universite de Technologie de Troyes (France),* [3] *Universite Paris Saclay (France)*

The talk deals with the possibility to control the spatial distribution of the active medium in hybrid nanoplasmonics.

11:10 : Invited talk

Tunable metasurface with gap and collective surface plasmon modes

Anatoliy Pinchuk[1], Oleg Yeshchenko[2]
[1] *University of Colorado Colorado Springs (USA),* [2] *National University of Kyiv (Ukraine)*

Tunable metasurface made of a monolayer of gold nanoparticles on a glass substrate in close proximity to a thin aluminum film is studied numerically and experimentally. We observe three angle and polarization dependent peaks in the extinction spectra of the metasurface. By using a FDTD method we confirm the position of both the collective surface plasmon and the gap modes. Changing the polarization of the incident light leads to a shift of the wavelength of the peaks.

11:30 : Invited talk

Directing the propagation of light with particles for near-infrared sensors

Kevin Conley[1], Vaibhav Thakore[2], Fahime Seyedheydari[1], Mikko Karttunen[2], Tapio Ala-Nissila[1]
[1] *Aalto University (Finland),* [2] *The University of Western Ontario (Canada)*

Nano- and microparticles particles embedded in compact layers interact with light in diverse ways. We investigate the scattering by semiconductor, metal, or oxide particles to direct near-infrared light without excessive heating. Optical responses under irradiation by solar and blackbody emitters are calculated. Reflectance efficiency factors of over 80 % are predicted in 200 μm thick compact layers with only 1 % volume fraction. The computational results are validated with experiments and implemented in near-infrared sensing applications.

11:50 : Invited talk

Constructing active metasurfaces and dynamically tunable metadevices

Ruwen Peng, Mu Wang

Nanjing University (China)

In this work, we present several active metasurfaces and dynamically tunable metadevices based on the following approaches: 1) from thermal tuning to electrical tuning based on phase change materials, 2) real-time mechanical tuning, and 3) dynamically adjusting the ambient environments of the materials and devices. The investigations here can be applied in constructing novel dynamically-tuning metasurfaces and metamaterials, and are expected to promote the further development of new-generation active optoelectrionic devices.

12:10 : Invited talk

Chiral Metasurfaces of Nanohelices with Giant Intrinsic Chiro-Optical Activity

Thu H. H. Le[1], Hisako Sato[2]

[1] *National Institute of Advanced Industrial Science and Technology (AIST) (Japan),* [2] *Ehime University (Japan)*

This study reports the fabrication of metasurfaces composed of metal nanohelices that exhibit giant intrinsic chiro-optical properties in mid-infrared (IR) regime. Our fabrication method exploits the stress-driven self-folding of metal thin films to generate helical structures with tunable diameters, controllable handedness and alignment directions. This approach allows the high-throughput fabrication of 3-dimensional nanostructures for mass-production of metasurfaces in wafer-scale. The fabricated metasurface opens new perspectives for practical applications of chiral metamaterials in chiroptical spectroscopies and chiral chemistry.

Lunch

12:30 - 14:00

14:00 - 16:00 — Room 1

Session 1A10

Symposium II: New trends in nanophotonics and advanced materials

Organized by: Junsuk Rho, Hakjoo Lee and Namkyoo Park

Chaired by: Junsuk Rho, Hakjoo Lee and Namkyoo Park

14:00 : Invited talk

Physical mechanisms of nanostructuring ferromagnetic thin films and hybrid multilayers using single ultrashort laser pulses

Stephan Lempereur[1], Pavel Varlamov[1], Alexey Lomonosov[1], Ilias Fendi[1], Ian Aupiais[1], Yannis Laplace[1], Michele Raynaud-Brun[1], Tat Loon Chng[1], Svetlana Starikovskaja[1], Alexandr Alekhin[2], Anh Dung Nguyen[2], Olivier Noel[2], Evgenii Modin[3], Paolo Vavassori[3], Denys Makarov[4], Vasily Temnov[1]

[1] *Ecole Polytechnique (France),* [2] *Le Mans Universite (France),* [3] *CIC nanoGUNE-BRTA (Spain),* [4] *Helmholtz-Zentrum Dresden-Rossendorf (Germany)*

Irradiation of ferromagnetic thin films and metal/ferromagnet bilayers with ultrashort laser pulses through an optically transparent substrate results in the formation of closed spallation or delamination cavities possibly enclosing ultrahigh vacuum. Their physical properties are investigated by the optical interferometric, magneto-optical, atomic force and SEM microscopies and ultrafast pump-probe techniques. The topology of these cavities can be controlled through the laser pulse duration and/or the internal structure of irradiated films. Their acoustic and magneto-optical properties will be revealed as well.

14:20 : Invited talk

Dielectric and Plasmonic Silicon Nanoantennas

Zhaogang Dong

*A*STAR (Singapore)*

In this talk, we will present our recent research results on the nanostructured silicon optical nanoantennas with Mie resonance at visible regime, such as mix antenna array for fluorescence enhancement, imaging of the inaccessible bound-states-in-the-continuum (BIC) mode, quasi BIC resonance for the strong enhancements of cathodoluminescence emission and achieving the ultra-highly saturated red color pixels, as well as the interband plasmonic characteristics of silicon nanostructures at ultra-violet (UV) regime.

14:40 : Invited talk

Optical Metasurfaces for Engineered 3D Polarization Profiles

Xianzhong Chen, Yuttana Intaravanne, Chunmei Zhang
Heriot-Watt University (United Kingdom)

The unprecedented capability of optical metasurfaces has provided an unusual approach for arbitrary manipulation of polarization profiles. Light beams with 3D polarization structures have recently attracted big attention due to their peculiar optical features and extra degrees of freedom for carrying information. Here we experimentally demonstrated a metasurface approach to generate 3D polarization structures. The efficacy of this approach was exemplified through the demonstration of 3D polarization knots. Our demonstration may find applications in beam engineering and integrated optics.

15:00 : Invited talk

Near-field analysis of dipole emission near an all-dielectric metasurface by means of dual-tip scanning near-field optical microscopy

Angela Barreda[1], Najmeh Abbasirad[1], Dennis Arslan[1], Michael Steinert[1], Stefan Fasold[1], Carsten Rockstuhl[2], Frank Setzpfandt[1], Thomas Pertsch[1], Isabelle Staude[1]
[1]*Friedrich Schiller University Jena (Germany),* [2]*Karlsruhe Institute of Technology (Germany)*

Over the last years, all-dielectric metasurfaces have been designed to enhance the emission of quantum emitters located in the surrounding of the metasurface or inside the nanoparticles of which the metasurface is composed. Here, we analyze, through dual-tip scanning near-field optical microscopy, the near-field intensity distribution in an all-dielectric metasurface excited by a dipole. This work finds applications in the development of single-photon sources for quantum communication purposes.

15:20 : Invited talk

Chiral sensing with semiconductor nanophotonics

Alberto G. Curto
Ghent University and imec (Belgium)

Detecting molecular chirality is crucial in biochemistry. It is, however, limited by low sensitivity at low concentrations. I will discuss our progress to push the limits of chiral sensing by exploiting semiconductor nanophotonics.

15:40 : Invited talk

Nanoporous gold as an active plasmonic metamaterial

Alexander Yu Petrov, Maurice Pfeiffer, Xinyan Wu, Manfred Eich
Hamburg University of Technology (Germany)

Nanoporous gold is a sponge-like material obtained by dealloying process with ligaments dimensions down to 10 nm range. The large surface to volume ration of this metamaterial gives possibility to strongly alter its optical properties by surface functionalization, so called chemical interface damping. We show that reversible surface oxidation of nanoporous gold can be used to switch its color.

14:00 - 16:00 — Room 2

Session 1A11

Symposium I: Hybrid Nanomaterials and Metastructures for Photonics, Sensing and Energy

Organized by: Jerome Plain, Alexander Govorov, Davy Gerard and Pedro Hernandez Martinez

Chaired by: Jerome Plain, Alexander Govorov, Davy Gerard and Pedro Hernandez Martinez

14:00 : Invited talk

Linear and nonlinear photonics in bottom-up assemblies of nanoparticles

Andrea Morandi, Romolo Savo, Jolanda Simone Muller, Andrea Scheidegger, Paolo Fischer, Artemios Karvounis, Ngoc My Hanh Duoeng, Rachel Grange

ETH Zurich (Switzerland)

Nanocrystals can be assembled with bottom-up techniques into three dimensional photonic structures with specific functionalities. Here, we present spherical micro resonators built from randomly oriented non-centrosymmetric nanocrystals that generate broadband and efficient second-harmonics even in the presence of scattering. Besides, we show all-dielectric assemblies coupled with NV centers that display enhanced photon emission rate. Our assemblies represent a playground for photonics: from fundamental investigation of the interplay between nonlinearity and disorder to the production of scalable quantum sources.

14:20 : Invited talk

Tailoring the visual appearance of a surface by using plasmonic particles onto a stratified substrate

Adrian Hereu[1], Adrian Agreda[1], Etienne Duguet[1], Kevin Vynck[2], Philippe Lalanne[1], Glenna L. Drisko[1], Mona Treguer-Delapierre[1]

[1]*Institut de Chimie de la Matiere Condensee de Bordeaux (France),* [2]*Universite Claude Bernard Lyon 1 (France)*

Mastering visual appearance by controlling the composition of matter is a major challenge in diverse areas such as vehicle design, cosmetics, or luxury goods. Considerable efforts are currently made to develop scalable fabrication techniques to produce new coatings offering exotic visual effects. In this communication, we will show how to exploit the rich optical properties of disordered assemblies of resonant nanoparticles in optical stacks to generate new visual effects in reflection. The influence of two structural parameters will be discussed.

14:40 : Invited talk

All-organic biomimetic photonic structures tailored by near-zero index organic materials

Miguel Castillo[1], Carla Estevez-Varela[2], William P. Wardley[3], Rosalia Serna[4], Isabel Pastoriza[2], Sara Nunez-Sanchez[2], Martin Lopez Garcia[1]

[1]*INL- International Iberian Nanotechnology Laboratory (Portugal),* [2]*Universidade de Vigo (Spain),* [3]*University of Exeter (United Kingdom),* [4]*IO-CSIC (Spain)*

In this paper, we present an all-organic photonic platform inspired by the optical properties and geometrical arrangements of photosynthetic membranes in nature. Using thin polymer films doped with J-aggregate cyanine dyes we demonstrate how to create a unique photonic structure in which properties such as photonic bandgap and enhanced absorption by slow-light are modified by near-zero-index optical properties of the dye-doped polymer thin films.

15:00 : Invited talk

Nonexponential Photoluminescence Decay Kinetics of Colloidal Quantum Dots: Long-Time Behaviour

Ana Luisa Simões Gamboa, Evgeny Bodunov

ITMO University (Russia)

We present new results on the analysis of the nonexponential photoluminescence decay kinetics ofcolloidal quantum dots using a model that considers a Poisson distribution of the number of charge carrier trapsper nanocrystal, detrapping of charge carriers, and a single trap depth. Further we introduce a new model thatassumes instead an energetic distribution of traps that is a decreasing exponential function of energy and predictsa power-law photoluminescence decay kinetics at long times. We compare the two models.

15:20 : Invited talk

Metallic nanostructures embedded in dielectrics for Surface Enhanced Raman signals

Sophie Camelio[1], David Babonneau[1], Sophie Rousselet[1], Frederic Pailloux[1], Emmanuel De Los Santos Vazquez[1], Maxime Bayle[2], Bernard Humbert[2]
[1] *Institut Pprime (France),* [2] *Institut des Materiaux Jean Rouxel (France)*

The presentation reports on Surface Enhanced Raman substrates, reusable and washable, consisting on Periodic Lines of Ag Nanoparticles Embedded in Dielectric (PLANEDSERS) that can be used for SERS applications in analytical chemistry with a good level of repeatability, and with a detection of a concentration range between 10-6 to 10-3 M for non-resonant molecules.

15:40 : Invited talk

3D Chiral Metamaterials for Biosensing

M. Manoccio, M. Esposito, A. Passaseo, Vittorianna Tasco
CNR Nanotec (Italy)

This contribution will discuss the experimental application of 3D chiral metamaterials as high sensitivity biosensors, exploiting circular dichroism in transmission. 3D metamaterials with chiral features can be realized by highly accurate and highly localized bottom-up nanofabrication approach. Large chiroptical effects can be engineered, originating from the single element optical resonances, but collective interactions in arrayed configurations can play a significant role, further enhancing these effects. Capability of biomarker detection in the femtomolar range is demonstrated even in complex biofluid matrix.

14:00 - 16:00 — Room 3

Session 1A12

Symposium IV: Chirality, magnetism, and magnetoelectricity: Separate phenomena and joint effects in metamaterial structures

Organized by: Eugene Kamenetskii

Chaired by: Eugene Kamenetskii

14:00 : Invited talk

Optical and mechanical wave manipulation in an optomechanical chiral metasurface

Alessandro Pitanti
CNR - Istituto Nanoscienze (Italy)

We report on a minimal dielectric optomechanical membrane metasurface with chiral patterning. Low frequency membrane modes combined with optical chirality are used for polarization modulation and fast polarimetry. Excitation of high frequency mechanical GHz modes reveals a more complex landscape, where both mechanical and optical asymmetric Bloch waves can interact. From the mechanical side, surface acoustic waves can be manipulated according to their excitation frequency in a combination of symmetric and asymmetric, ordinary and negative refraction at the metasurface edges.

14:20 : Invited talk

Emergent chiral interaction and ultrafast optical generation of antiferromagnetic spin-spiral

Sumit Ghosh
PGI and IAS Forschungszentrum Julich and JARA (Germany)

By combining quantum evolution of states with classical magnetization dynamics we managed to capture both fast sub-picosecond dynamics governed by electronic interactions as well as the slow magnetization dynamics that can survive for several picoseconds leading to a steady chiral formation. We identify the emergent interactions appearing at different timescales and also estimate the lifetime of quasi-stable chiral configurations.

14:40 : Invited talk

Photochemical imaging of chiral near-fields near plasmonic nanostructures

T. Aoudjit, A. Horrer, R. Bachelot, J. Plain, Davy Gerard

Universite de Technologie de Troyes (France)

We report on the use of a photosensitive polymer to directly image the optical near-field around metallic chiral nanostructures.

15:00 : Invited talk

Annihilation of topological solitons in magnetism with spin-wave burst finale and electronic spin pumping over ultrabroadband frequency range

Branislav Nikolic
University of Delaware (USA)

This talk introduces recently developed multiscale quantum-classical hybrid formalism where time-dependent nonequilibrium Green functions describe quantum-mechanically conduction electrons while they interact with dynamical noncollinear magnetic textures of localized magnetic moments described by the classical Landau-Lifshitz-Gilbert equation.

15:20 : Invited talk

Pico-electrodynamics inside matter

Zubin Jacob
Purdue University (USA)

The concept of photonic frequency (ω) - momentum (q) dispersion has been extensively studied in artificial dielectric structures such as photonic crystals and metamaterials. Here, we develop a Maxwell Hamiltonian theory of matter combined with the quantum theory of atomistic polarization to obtain the electrodynamic dispersion of natural materials interacting with the photon field. Our findings demonstrate that natural media can host a variety of yet-to-be discovered waves and topological phases with effective wavelengths in the pico-electrodynamics regime.

15:40 : Invited talk

A theory of skyrmion crystal formation

Xiangrong Wang
The Hong Kong University of Science and Technology (China)

A generic theory about skyrmion crystal (SkX) formation in chiral magnetic thin films is presented. We show that a chiral magnetic film can have many metastable states with an arbitrary skyrmion density up to a maximal value when the relative Dzyaloshinskii-Moriya interaction strength is large enough. We reveal critical role of a magnetic field in SkX formation and explain why a film prefers a stripy (helical) state such that SkXs become metastable at low temperature.

14:00 - 16:00 — Room 4

Session 1A13

Challenges of Phase Change Materials and Plasmonics for Nanophotonics

Organized by: Maria Losurdo, Yael Gutiérrez, Kurt Hingerl, Christoph Cobet, Mircea Modreanu and Fernando Moreno

Chaired by: Maria Losurdo, Yael Gutiérrez, Kurt Hingerl, Christoph Cobet, Mircea Modreanu and Fernando Moreno

14:00 : Invited talk

Fast and nanoscale-controllable insulator-to-metal transition of VO2 enabled by plasmonic nanoantennas

Luca Bergamini[1], Bigeng Chen[2], Daniel Traviss[2], Yudong Wang[2], Cornelis H. de Groot[2], Jeffrey M. Gaskell[3], David W. Sheel[3], Nerea Zabala[1], Javier Aizpurua[4], Otto L. Muskens[2]
[1]*FCT-ZTF (Spain)*, [2]*University of Southampton (United Kingdom)*, [3]*University of Salford (United Kingdom)*, [4]*CSIC-UPV/EHU (Spain)*

The VO2 attracts wide interest for its insulator-to-metal transition when heated-up above the relatively low critical temperature of 68°C. Plasmonic nanoantennas are known to concentrate light at the nanoscale around their surface when resonantly illuminated in the Vis-NIR. Here we show how this nanoantennas plasmonic feature can be used to steer and control a fast and nanoscaled insulator-to-metal transition in a VO2 film. We investigated the effect of both an array and a single nanoantenna, which is the smallest unit-block.

14:20 : Invited talk

Bound states in the continuum and related phenomenology in resonant metasurfaces

Diego R. Abujetas[1], Jose A. Sanchez-Gil[2]

[1]Fribourg University (Switzerland), [2]IEM-CSIC (Spain)

We explore the emergence of bound states in the continuum (BICs) in metasurfaces consisting of dipolar meta-atoms, through a coupled electric and magnetic dipole theoretical formulation. Robust symmetry-protected BICs at the Gamma point are investigated through different mechanisms in various kinds of arrays of interest throughout the electromagnetic spectrum, all exhibiting a variety of dipolar resonances. BIC-induced phenomenology leading to applications such as mirrorless lasing and high-Q electromagnetically-induced transparency will be also discussed.

14:40 : Invited talk

Exploiting Mie resonances in VO2 nanoantennas for achieving optically tunable metasurfaces in the visible range

Peter Kepic[1], Filip Ligmajer[1], Martin Hrton[1], Haoran Ren[2], Leonardo de Souza Menezes[3], Stefan Alexander Maier[4], Tomas Sikola[1]

[1]Brno University of Technology (Czech Republic), [2]Macquarie University (Australia), [3]Ludwig-Maximilians University Munich (Germany), [4]Germany (Germany)

We study the optical properties of VO2 nanodiscs in the visible range. These nanostructures present strong Mie resonances not only in the known high-temperature, plasmonic phase, but also in the low-temperature phase, in which the material's behavior is predominantly dielectric. A large extinction modulation is observed when the nanodiscs go upon phase transition. The nanodiscs present large potential for being used as building blocks of a metasurface which can be tuned by shining a CW laser on it.

15:00 : Invited talk

Localized Surface Plasmon Resonance in Perovskite Thin Film Embedding Metallic Nanoparticles

Laura Calio, A. Bayles, S. Carretero-Palacios, A. Jimenez-Solano, G. Lozano, M. E. Calvo, Hernan Miguez

ICMS-CSIC (Spain)

The theoretical design of light surface plasmon resonance (LSPR) effects in perovskite based optoelectronic devices is discussed, by exploring different size, shape and concentration of metallic nanoparticles embedded in perovskite thin film. Also, direct experimental evidence obtained for perovskite film embedding silver nanocubes is unambiguously demonstrated, showing absorption enhancement at well-defined spectral ranges. A reliable measure of the magnitude of the LSPR effects expected for perovskite films is presented, with the aim of reducing environmental impact of lead-based optoelectronic devices.

15:20 : Invited talk

Reconfigurable nano-photonics enabled by electrically and optically active phase-change materials.

Nikolaos Farmakidis, Harish Bhaskaran

Oxford University (United Kingdom)

Photonic circuits have the potential to transform the way we process information through data multiplexing and parallelisation of computational tasks. Yet, the ability to electrically program, reconfigure and store information in conventional dielectric photonics remains challenging. Here we explore hybrid structures combining electrically and optically active phase-change materials, with nanoplasmonic components which are designed to enhance light-matter interactions and confine optical fields to dimensions compatible with CMOS nanoelectronics.

15:40 : Invited talk

Tuning phases in topological materials: fundamental aspects and application to nanophotonics *online*

Johann Toudert[1], Rosalia Serna[2], Jan Siegel[2]

[1]ENSEMBLE3 (Poland), [2]IO-CSIC (Spain)

Topological materials, such as semi-metals and topological insulators, display outstanding electronic band structure and optical properties, which can be tuned by adjusting the material's composition and structure. This makes them great candidates for applications in nanophotonics. Herein, after introducing their specific electronic structure and optical properties, we explain how they enable designing nanophotonic devices beyond the state of the art. We discuss how to harness crystal phase tuning in such materials for switchable nanophotonic solutions.

14:00 - 15:35 — Room 5

Session 1A14

Extreme meta-photonics

Organized by: Nasim Mohammadi Estakhri and Inigo Liberal

Chaired by: Nasim Mohammadi Estakhri and Inigo Liberal

14:00 : Invited talk
Non-conventional phase matching in low-index materials
Larissa Vertchenko, Andrei Lavrinenko
Technical University of Denmark (Denmark)

The possibility to confine light in extremely small scales without compromising the level of losses has led to an increasing interest in all-dielectric platforms for nanophononics applications. Materials with effective refractive index near-zero (NZI) are known to exhibit peculiar phenomena such as, high transmission through distorted waveguides and enhancement of effective nonlinearities. In this work, we report on our advances in investigating the third harmonic generation conversion in a NZI material.

14:20 : Massively Radiant Upconversion Luminescence Driven by Strongly-Coupled Bound States in the Continuum
Chiara Schiattarella[1], Silvia Romano[1], Luigi Sirleto[1], Vito Mocella[1], Ivo Rendina[1], Vittorino Lanzio[2], Fabrizio Riminucci[2], Stefano Cabrini[2], Liangliang Liang[3], Xiaogang Liu[3], Gianluigi Zito[1]
[1]National Research Council (Italy), [2]Lawrence Berkeley National Laboratory (USA), [3]National University of Singapore (Singapore)

A giant enhancement of upconversion luminescence is demonstrated in an all-dielectric metasurface supporting bound states in the continuum (BICs) engineered with lanthanide-doped nanocrystals. The strong-coupling occurring between a Friedrich-Wintgen BIC and a leaky wave partner at the edge of the photonic superstructure allows in-plane pump feeding of the high-Q mode without resorting to loss-tailoring strategies and generating supercollimated radiation with a radiance enhancement factor of ∼108. This mechanism overcomes the constraint of forbidden radiation coupling in BIC-sustaining photonic systems.

14:35 : Invited talk
Space-time metamaterials: dragging and amplifying light *online*
Paloma A. Huidobro[1], Emanuele Galiffi[2], Mario G. Silveirinha[1], John Pendry[3]
[1]University of Lisbon (Portugal), [2]City University of New York (USA), [3]Imperial College London (United Kingdom)

An homogenization theory of space-time metamaterials will be presented. This framework will unveil regimes of synthetic motion yielding different physical properties such as light dragging or non-reciprocal and chiral amplification mechanisms.: An homogenization theory of space-time metamaterials will be presented. This framework will unveil regimes of synthetic motion yielding different physical properties such as light dragging or non-reciprocal and chiral amplification mechanisms.

14:55 : Invited talk
Investigation of Overcoming the Chu Lower Bound on Quality Factor for Antennas Tuned with Highly Dispersive Lossy Material
Younes Radi, Ahmed Mekawy, Andrea Alù
City University of New York (USA)

In this talk, we will introduce a new concept using which one can enhance the bandwidth of electrically small inductive or capacitive antennas beyond what is possible using conventional approaches in a very simple and compact platform without any need for active elements.

15:15 : Invited talk

Wave Scattering in Dynamical Media *online*

Emanuele Galiffi[1], Shixiong Yin[1], Paloma Arroyo Huidobro[2], John Pendry[3], Andrea Alu[1]
[1] *City University of New York (USA),* [2] *Instituto Superior Tecnico (Portugal),* [3] *Imperial College London (United Kingdom)*

In this talk we report on recent theoretical explorations in the context of time-varying media, aiming at offering a few perspectives on the peculiarities of wave scattering from abrupt, continuous, periodic, chiral and dispersive temporal inhomogeneities, as well as their implications for distinct forms of wave amplification, localization, nonreciprocity, frequency modulation and harmonic generation.

14:00 - 16:00 — Room 6

Session 1A15

Acoustic and elastic phononic crystals, metamaterials and other structured media

Organized by: Marco Miniaci, Vicente Romero-Garcia, Vincent Pagneux, Maxime Lanoy, Jean-Philippe Groby and Noé Jiménez

Chaired by: Marco Miniaci, Vicente Romero-Garcia, Vincent Pagneux, Maxime Lanoy, Jean-Philippe Groby and Noé Jiménez

14:00 : Invited talk

Complex resonance samples of coupled Helmholtz resonators

Svetlana Kuznetsova, Yves Auregan, Vincent Pagneux
Le Mans Universite (France)

Complex resonances of Helmholtz resonators coupled to a waveguide are studied. The scatteringmatrix approach is used to obtain the trajectories of the complex resonance poles with the variation of thedistance between the resonators. For two resonators they are shaped as Cassini ovals. Fano-type peaks in thetransmission spectrum and the occurrence of the Dicke effect are observed. Variation of the distance between theresonators is shown to be capable of the tuning of the resonant properties.

14:20 : Invited talk

Experimental demonstration of nonreciprocal propagation in a piezoelectric phononic crystal with spatio-temporal modulation of electrical conditions

Sarah Tessier, C. Croënne, F. Allein, J. Vasseur, B. Dubus
Universite de Lille (France)

This work concerns the experimental study of the propagation of elastic waves in a piezoelectric phononic crystal made of several identical piezoelectric elements separated by thin electrodes. We analyze the effect of spatio-temporal modulation of electrical conditions on wave propagation. The experimental results show the presence of directional band gaps on the dispersion curves for certain modulation speeds.

14:40 : Invited talk

Non-reciprocity of fundamental dynamic modes in gyroscopic elastic systems with boundaries

Michael Nieves[1], G. Carta[2], V. Pagneux[2], M. Brun[2]
[1] *Keele University (United Kingdom),* [2] *University of Cagliari (Italy)*

We study both Rayleigh and Lamb waves produced by a point force applied along the boundaries of an elastic microstructured half-space and strip, respectively, attached to arrays of gyroscopes. The analytical method for determining the dynamic response of such media is presented. While the dispersive features of these systems possess the usual symmetries, remarkably, the symmetry of the associated dynamic response with respect to the loading is broken. Numerical illustrations demonstrating these atypical elastodynamic responses are given.

15:00 : Invited talk
On the impact of air in double-leaf panels with structural metamaterial cores
Vanessa Cool, Claus Claeys, Lucas Van Belle, Wim Desmet, Elke Deckers
KU Leuven (Belgium)

In the search for lightweight and compact partitions with both favorable vibro-acoustic characteristics and a load-carrying capacity, an increasing trend towards double-leaf panels with structural metamaterial cores is emerging. Generally, these partitions are designed and analyzed by only considering the attenuation along the structural path, disregarding the influence of the air inside. This work investigates the impact of the air in these partitions on their performance, which reveals that the acoustic path needs to be included during the design phase.

15:20 : Invited talk
Elastic body waves control via the Topological Rainbow Effect
Bogdan Ungureanu[1], M. P. Makwana[2], R. V. Craster[2], S. Guenneau[2]
[1]*LAUM (France),* [2]*Imperial College London (United Kingdom)*

We propose a form of topological guidance for flexural waves in thin perforated elastic plates, which can be viewed as an approximate model for surface Rayleigh waves propagating through an array of boreholes drilled in soft soil atop bedrock. We do so by considering a square perforation within a square unit cell that is then extended periodically upon a square lattice, and when combined with the rainbow effect offers a pragmatic route to energy harvesting.

15:40 : Invited talk
Zero-mass metamaterial for subwavelength acoustic imaging
Thibaut Devaux[1], E. Bok[2], J. J. Park[2], S. H. Lee[2], O. B. Wright[3]
[1]*Universite de Tours (France),* [2]*Yonsei University (Korea),* [3]*Hokkaido University (Japan)*

By using a zero-mass metamaterial, we demonstrate the possibly of achieving subwavelength acoustic images based on the extraordinary acoustic transmission (EAT) phenomenon. A sub-wavelength diameter membrane is mounted on the extremity of an air-filled tube, allowing the experimental imaging of features with a lateral size 25 times smaller than the acoustic wavelength. Finite-element simulation and theoretical model confirm the role of the acoustic inertance in obtaining subwavelength resolution. 2D topography images are presented with different samples. Applications include nondestructive testing.

14:00 - 16:00 — Room 7

Session 1A16

Functional metamaterials

Organized by: Tatjana Gric, Edik Rafailov and Maria Farsari

Chaired by: Tatjana Gric

14:00 : Invited talk
Hot carriers from interband and intraband transitions in metallic nanoparticles
Johannes Lischner
Imperial College London (United Kingdom)

Hot electrons generated from the decay of localized surface plasmons in metallic nanostructures have the potential to transform photocatalysis, photodetection and other optoelectronic applications. However, the understanding of hot-carrier generation in realistic nanostructures, in particular the relative importance of interband and intraband transitions, remains incomplete. Here we report theoretical predictions of hot-carrier generation rates in spherical nanoparticles of the noble metals silver, gold and copper with diameters up to 30 nanometers obtained from a novel atomistic linear-scaling approach.

14:20 : Invited talk

Enhancement of Optical Nonlinearities in Two-dimensional Layered Materials

Zhipei Sun
Aalto University (Finland)

I will present our recent advances on the enhancement of various optical nonlinearities in different two-dimensional layered materials.

14:40 : Invited talk

Towards New Regimes in Cavity Optomechanics with Photonic Bound States in the Continuum in Photonic Crystal Membranes

Jamie M. Fitzgerald, Sushanth Kini Manjeshwar, Witlef Wieczorek, Philippe Tassin
Chalmers University (Sweden)

We will present an optomechanics platform based on photonic bound states in the continuum and show that this platform is very flexible and makes it possible to reach different regimes of cavity optomechanics, e.g., with linear or quadratic coupling of either dispersive or dissipative type. Bound states in the continuum enable to build compact optomechanical devices, resulting in linear optomechanical coupling strengths that are orders of magnitude larger than conventional out-of-plane systems and comparable to values observed for in-plane geometries.

15:00 : Invited talk

Why James Bond ordered his Martinis shaken, not stirred (Computer simulations in the theory of composites)

Vladimir Mityushev, Natalia Rylko
Cracow University of Technology (Poland)

The talk is devoted to constructive formulas for the effective constants of 2D multi-phase composites. The effective constants are obtained as linear combinations of structural sums expressed in terms of geometrical distribution of inclusions with the contrast parameters weights. Such an approach leads to a rigorous theory of representative volume element (RVE) when a class of dispersed composites is determined by its set of structural sums.

15:20 : Invited talk

Colloidal Aluminum Nanoparticles for UV plasmonics

Jerome Plain[1], Marion Castilla[1], Silvere Schuermans[1], Gil Markovich[2], Uri Hananel[2], Davy Gerard[1], Jerôme Martin[1], Julien Proust[1]
[1]UTT (France), [2]Tel-Aviv University (Israel)

We present a new and simple route to synthetize aluminum nanoparticles showing a plasmon resonance in the UV range.

15:40 : Invited talk

Complete measurement of chirality using achiral metasurfaces *online*

Sotiris Droulias
Foundation for Research and Technology (FORTH) (Greece)

Metasurfaces are ideal platforms for enhancing the inherently weak chiroptical signals of natural optically active molecules, as they can provide the necessary strong resonances for coupling the probing radiation with the chiral molecules. In this work, we derive analytically, and verify numerically, expressions that provide insight into the enhancement mechanism, we explain why circular dichroism measurements in metasurfaces with chiral inclusions must be interpreted with care and we propose a scheme for the unambiguous determination of an unknown chirality.

14:00 - 15:30 — Room 8

Session 1A17

Plasmonics and nano-optics

14:00 : Enhanced optical effects in doped plasmonic materials fabricated by crystal growth techniques

Piotr Piotrowski[1], R. Nowaczynski[1], K. Sadecka[2], B. Surma[2], M. Raczkiewicz[2], P. Paszke[1], J. Toudert[2], N. Kongsuwan[3], O. Hess[4], D. Pawlak[1]

[1] *University of Warsaw (Poland),* [2] *ENSEMBLE (Poland),* [3] *Quantum Technology Foundation (Thailand),* [4] *Imperial College London (United Kingdom)*

Here, we demonstrate optically active volumetric materials obtained with micro-pulling down method. By applying NanoParticle Direct Doping Method, nanocomposites with plasmonic properties are fabricated, which allows us to observe enhanced optical features

14:15 : Scattering-type scanning near-field optical microscopy and spectroscopy with 10 nm resolution with vis, NIR, MIR and THz wavelengths

Philip Schaefer, S. Mastel, A. Cernescu, A. Huber

ALX (neaspec) (Germany)

Scattering-type Scanning Near-field Optical Microscopy and Spectroscopy is the revolutionizing technology that allows the nanoscale real-space optical analysis of sub-wavelength excitations in 2D-materials and metamaterials. Confining an incident light beam to the apex of a metallic AFM tip allows the local excitation as well as the local detection of phonon polaritons, exciton polaritons and surface plasmons. Operating at midinfrared (MIR) wavelengths permits also the chemical analysis of various nanostructured materials with 10 nm resolution.

14:30 : Probing nanoscale polymer redox using plasmonics

Yuling Xiong, Qianqi Lin, Kunli Xiong, Jeremy Baumberg

University of Cambridge-NanoPhotonics group (United Kingdom)

We integrate poly(3,4-ethylenedioxythiophene) (PEDOT) into plasmonic nanocavities to systematically study its redox mechanisms via in-situ spectro-electrochemistry. Both dark-field and surface-enhanced Raman scattering (SERS) are tracked during repeated redox cycles for PEDOT thicknesses from 2-20 nm. Surprisingly our data shows systematic changes in these spectra for sub-10nm polymer thicknesses, showing how extreme anisotropies and inverted orientations are produced for conducting polymer chains close to the interface.

14:45 : On hot carriers generation in strongly coupled Nanoparticle - molecule systems

Katarzyna Kluczyk-Korch, Maria Bancerek, Rania Zaier, Tomasz Antosiewicz

University of Warsaw (Poland)

Strongly coupled systems exhibit hybridization of electronic energy levels and following appearance of new resonance frequencies. Hot carriers are preferably generated for excitation frequencies matching the new resonances. The hot carrier energy distribution deviates from the one corresponding to the non-interacting system, indicating existence of new decay paths, due to nanoparticle - molecule hybridized states. This suggests a possibility of manipulation of the energy of the generated hot carriers via strong interaction with the molecules.

15:00 : Boron doped diamond-based sensing platform for SERS

Sini Nanadath Shibu[1], Samvit G. Menon[1], Xiaojun Hu[2], Tomasz J. Ochalski[1]

[1] *Munster Technological University (Ireland),* [2] *Zhejiang University (China)*

In this work, we report the fabrication of a diamond-based versatile molecular sensing platform for the detection of organic molecules. In the case of semiconductors, electromagnetic effects are involved or cooperate with the chemical enhancement to amplify the overall Surface-Enhanced Raman Scattering response. Diamond is a dielectric substrate with a wide bandgap, high chemical stability, and biocompatibility. Boron-doped diamond substrates with surface functionalization can manipulate the resonant energy levels for the target molecules to achieve enhancement of sample-surface interaction.

15:15 : All-optical control of phase singularities using strong light-matter coupling

Philip Thomas, Kishan Menghrajani, Bill Barnes

University of Exeter (United Kingdom)

We utilise cavity-free strong coupling, where electromagnetic modes sustained by a material are strong enough to strongly couple to the material's own molecular resonance, to create phase singularities in a simple thin film of organic molecules. We show that the use of photochromic molecules allows for all-optical control of phase singularities. We suggest that this opens a new application for strong light-matter coupling and a new, simplified, more versatile means of manipulating phase singularities.

Coffee Break

Session 1P2

Poster session II

16:00 - 16:40

Chaired by:

P1: Fabrication of Hybrid Nanostructures Based on The Polymer Template of Two Photon Polymerization

BoRui Li[1], **Safi Jradi**[1], **Serge Ravaine**[2], **Ali Issa**[1]
[1] *Universite de Technologie de Troyes (France),* [2] *University of Bordeaux (France)*

In this article, we report on fabrication of hybrid micro-nanostructures based on the polymer template. One strategy involves functionalizated photopolymers selectively attract nanoparticals on the surface, allowing their reliability and uniformity even within complex 3D structures. One strategy involves metal material fills polymer pre-patterning voids on conductive substrate by eletrodeposition method.

P2: Trimer Su-Schrieffer-Heeger model and application to acoustics

Adamantios Anastasiadis[1], **Georgios Styliaris**[2], **Rajesh Chaunsali**[3], **Georgios Theocharis**[1], **Fotios Diakonos**[4]
[1] *Universite du Mans (LAUM) (France),* [2] *Max-Planck-Institut fur Quantenoptik (Germany),* [3] *Indian Institute of Science (India),* [4] *University of Athens (Greece)*

The trimer Su-Schrieffer-Heeger model is the simplest extension of the well-known Su-Schrieffer-Heeger model model. Due to the absence of inversion and chiral symmetry, ordinary Zak's phase cannot be used to establish bulk-edge correspondence. Here we utilize the sublattice Zak's phase instead, which has been successfully employed towards a bulk-edge correspondence, and explore possible applications to acoustics with the use of waveguides with alternating cross-sections.

P3: Radiative Properties of Surface Doped Black Silicon

Sreyash Sarkar[1], **Elyes Nefzaoui**[2], **Frederic Marty**[2], **Georges Hamaoui**[2], **Philippe Basset**[2], **Tarik Bourouina**[2]
[1] *University of Luxembourg (Luxembourg),* [2] *Universite Gustave Eiffel (France)*

In this study we aim to characterize the radiative properties of the surface of an innovative metamaterial, Black Silicon, that can be employed for IR applications requiring enhanced radiation absorptance such us IR photodetectors, solar thermal applications, solar photovoltaics, and solar thermo-photovoltaics.

P4: Structured nano-grating into a Silicon Nitride (SiN) membrane for atom physics experiments

Nathalie Fabre[1], **Charles Garcion**[1], **Julien Lecoffre**[1], **Karine Blary**[2], **Francisco Perales**[1], **Quentin Bouton**[1], **Martial Ducloy**[1], **G. Dutier**[1]
[1] *Universite Sorbonne Paris Nord (France),* [2] *Universite Lille 1 (France)*

Nano-gratings enable matter-wave diffraction similarly to light in optics and allows to explore the Casimir Polder interactions when atoms come close to the surface. This atom-surface interaction, originating from the quantum fluctuations of the vacuum, enlarges drastically the envelop of the diffraction pattern. Here, we focus on the fabrication method to achieve over a million of nano-slits etched into SiN membrane. We report an extreme sensitive measurement of the CP interactions and discuss the applications in regards to metrology.

P5: Tailoring the Spectral Response of Multilayered Chiral Mid-Infrared Metamaterials

Hannah Barnard, Geoff Nash
University of Exeter (United Kingdom)

A simulation and experimental study of multilayered chiral metamaterial stacks, optically active in the important mid-IR region of the spectrum. We demonstrate the ability to tune the spectral response based on layer configuration.

P6: Accidental Degeneracies and Band Inversion with a Microwave Metasurface

Joshua Glasbey, A. P. Hibbins, J. R. Sambles
University of Exeter (United Kingdom)

Here we explore a bi-layer metasurface that exhibits accidental degeneracies in the lowest order bands for certain geometries. These accidental degeneracy points can be opened, creating a band gap, in both an inverted and non-inverted state.

P7: Superdirective Helical Dimers Fabricated using 3D printed Molds with Liquid Metal Injection

Jenner Gudge-Brooke[1], Alistair Hibbins[1], Roy Sambles[1], Alex Powell[1], Nathan Clow[2]
[1] *University of Exeter (United Kingdom),* [2] *DSTL (United Kingdom)*

Antennas made of two coupled helical elements have been shown to have very high directivity while being much smaller than their radiative wavelength. We replicate this system using a method of fabrication involving a 3D printed dielectric mold which is then filled with liquid metal at a low temperature (61 °C) in order to facilitate more complex designs in the future.

P8: Phase-Change Extraordinary Optical Transmission Metasurfaces for Active Filtering and Modulation from the Visible to Terahertz Regimes

Euan Humphreys, Jacopo Bertolotti, David Wright
University of Exeter (United Kingdom)

Periodic arrays of sub-wavelength-scale holes in plasmonic metal films can designed to provide resonant transmission/reflectance peaks via the extraordinary optical transmission (EOT) effect. The addition of phase-change materials (PCMs) to such devices can provide a degree of tuneability, cycles of heating and quenching shifting the peak position and/or amplitude depending on the phase-state of the PCM layer. This opens up new application potential in the fields of active filtering and sensing (e.g. for multispectral imaging), displays and optical modulation.

P9: Grazing incident waves on a material are usually completely reflected

Dean Patient, Simon Horsley
University of Exeter (United Kingdom)

In this work, we show that removing the reflection of waves in this delicate limit can be achieved by adopting quantum mechanical techniques to factorise the Helmholtz equation into raising and lowering operators. Doing so allows the design of dielectric profiles that support optical analogues of half-bound states, which will not reflect grazing incidence waves.

P10: Amplitude-only spatial light modulation using phase-change meta-films

Joe Shields, Carlota Ruiz de Galarreta, Harry Penketh, Jacopo Bertolotti, David Wright
University of Exeter (United Kingdom)

Current spatial light modulator (SLM) technology offers off-the-shelf spatial phase control of light, but amplitude control is much more limited. The development of amplitude-only modulators would enable devices to perform full-wavefront control. Here we present an approach to the realization of such modulators, using a phase-change material based approach. Fabricated devices allow for the control of the amplitude, with near zero effect on the phase of the reflected wave, offering a potential route to ultra-fast, solid-state wavefront control.

P11: Phase-Change Metasurfaces for the Active Control of Lens Numerical Aperture

George Braid[1], Carlota Ruiz de Galarreta[2], Andrew Comley[3], Jacopo Bertolotti[1], David Wright[1]
[1] *University of Exeter (United Kingdom),* [2] *IO-CSIC (Spain),* [3] *Atomic Weapons Establishment (United Kingdom)*

Lens numerical aperture (NA) control has applications in many fields, such as photography, imaging, and laser processing. Active metasurfaces offer the prospect for dynamic control of numerical aperture, in a flat, compact and low-cost format. Here, we design and simulate an active focusing meta-mirror using phase-change materials to provide this control. Designs for use in both the infrared (3000 nm) and visible (632.8 nm) are shown.

P12: Latent symmetries and their application in wave physics

Malte Rontgen[1], Maxim Pyzh[1], Christian V. Morfonios[1], Vincent Pagneux[2], Peter Schmelcher[1]
[1] *University of Hamburg (Germany),* [2] *Universite du Mans (France)*

In this talk, I will give an overview over the emerging topic of latent symmetries.Although they are in general not apparent from a geometric inspection of the system, they still have a powerful impact.This includes the induction of local symmetries on the system's eigenstates or even degeneracies in the eigenvalue spectrum.Their study thus allows to gain knowledge about the system's structure that remains hidden from a direct observation.The concept is exemplified through several wave-physical examples.

P13: Photolithography utilizing on up-conversion luminescence in Tm3+ and Yb3+ doped NaYF4 nanoparticles mixed with SU8 photoresist with/without organic compounds

Jurgis Grube, K. Vitols, V. T. Viksna, J. Teterovskis, J. Pervenecka, E. Tropins, J. Butikova, A. Vembris
University of Latvia (Latvia)

This work demonstrates a method which is essential to build up an experimental setup for the up-conversion luminescence photolithography system. Core-shell structured NaYF4 nanoparticles (core NaYF4 doped with Tm3+ and Yb3+) mixed with negative SU8 photoresist with/without organic compounds allows to expose photosensitive material in volume. This is highly perspective for the fabrication of various types of microstructures from such hybrid systems as organic-chromophores/nanoparticles/SU8, without damaging the light sensitive organic compound, demanded in photonic applications.

P14: Volumetric lithographic recording of three-dimensional microstructures in SU8 negative photoresist using up-conversion luminescence activated in rare-earth ion nanoparticles with a core-shell structure doped in SU8

Julija Pervenecka, E. Tropins, J. Grube, K. Vitols, V. T. Viksna, J. Teterovskis, A. Vembris, J. Butikova, G. Krieke, M. Springis
University of Latvia (Latvia)

We demonstrate success of our made innovative approach for lithographic recording high-resolution three-dimensional microstructures from the volume of negative photoresist SU8. That become possible in hybrid inorganic/photoresist systems, where are made by activating up-conversion luminescence in Yb3+ and Tm3+ nanoparticles doped into a photoresist. That is highly perspective in fabrication in photonic applications demanded microstructures from hybrid systems of organic-chromophores/UCNPs/SU8, made without damaging light sensitive organic compound, have practically unlimited thickness of layer, tunable wavelength of nanoparticles activation and emission.

P15: Generation of Diffraction Free Topological Beams Based on Nanophotonics

Ping Yu
University of Missouri (USA)

A method to generate diffraction free orbital angular momentum (OAM) beams is proposed using a specially designed nanophotonic structure in a momentum space. The structure includes amplitude modulation and phase modulation in series in nanoscale, and the structure is used in a reflection geometry. By designing the phase and amplitude modulation patterns, diffraction free beams with orthogonal topological charges can be generated. The developed structure shows a potential in applications of fiber-based telecommunication and quantum communication.

P16: Tailoring of electric dipoles for highly directional propagation in parity-time symmetric waveguides

Alice De Corte, Bjorn Maes
University of Mons (Belgium)

Electric dipoles are often used as accurate models for electromagnetic sources in integrated photonic structures. We tailor an electric dipole source to create a contrast between wave propagation on both sides of the dipole in parity-time-symmetric waveguides. The unique features of parity-time symmetry enable the creation of various types of contrasting behavior, which can be exploited in integrated photonics applications.

P17: A semi-analytical model for unidirectional guided resonances based on multimodal interference

Thomas Delplace, Bjorn Maes
University of Mons (Belgium)

Recently, optical bound states in the continuum (BICs) have been produced in photonic crystal slabs. A variation, unidirectional guided resonances (UGRs), has been reported, where the symmetry is broken, leading to leakage in a specific direction. We explore a microscopic semi-analytical model to understand these resonances, by extending a multimodal interference approach of BICs.

P18: Adaptive magnonic networks for nanoscale reservoir computing

Dmitrii Raskhodchikov, S. O. Demokritov, W. Pernice

University of Muenster (Germany)

We are realizing nanoscale adaptive magnonic networks in a complex system comprised of a large number of coupled spin-waveguides with embedded memory functionality, which transform the input of electrical data into spatiotemporal patterns in a high-dimensional space using nonlinear interference of spin-waves.

P19: Mid-Infrared Transparent Solar Reflector Using High-Index Material for Thermochromic and Thermo-Radiative Cooling Metasurfaces

Ken Araki, Richard Zhang
University of North Texas (USA)

Thermochromic and thermo-radiative cooling metasurfaces require broadband high reflection in visible-to-near infrared region to block the direct sunlight. The sunlight absorption can be prevented by implementing the structure that creates high contrast in refractive index using Si and Ge. The near-wavelength High Contrast Grating and prism array provides less solar absorption but full transparency in mid-infrared region. Similar electromagnetic field responses are observed for both structures to enhance reflectance greater than 0.99. Simultaneous VIS-NIR reflection and MIR transparency is achieved.

P20: Polypropylene-Based Array-HIS Antenna for mmWave Imaging Applications

Alicia Florez Berdasco, Maria Elena de Cos Gomez, Fernando Las-Heras Andres
University of Oviedo (Spain)

A compact and environmentally friendly uniplanar wearable antenna for an assistance system to support visually impaired people is presented. The antenna operates in the mmWave ISM frequency band (24.05-24.25 GHz). Polypropylene was selected as the antenna substrate due to its low-cost, flexibility and environmental advantages. A HIS metasurface has been designed to combine with the basic array antenna. Different unit-cell arrangements have been analyzed and compared. The resulting array-HIS antenna outperforms the basic array antenna in radiation properties and bandwidth.

P21: Role of metal-nanostructure features on tip-enhanced photoluminescence of single molecules

Marco Romanelli, Giulia Dall'Osto, Stefano Corni
University of Padova (Italy)

Tip-enhanced photoluminescence (TEPL) is a recently developed tool useful to investigate single molecule response down to sub-molecular level. This technique takes advantage of the metal nanostructures ability to enhance an electromagnetic radiation due to the generation of localized surface plasmons. We propose a theoretical analysis of TEPL, coupling the quantum mechanical description of the target molecule, Zinc-Phthalocyanine, with a continuum description of two nanostructures that mimic the nanocavity usually employed in STM microscopes.

P22: Observation and Modelling of Thermo-Optically Induced Transparency

Simone Iadanza[1], Marco Clementi[2], Sebastian A. Schulz[3], Giulia Urbinati[4], Changyu Hu[5], Dario Gerace[4], Matteo Galli[4], Liam O'Faolain[1]
[1] *Munster Technological University (Ireland),* [2] *EPFL (Switzerland),* [3] *University of St. Andrews (United Kingdom),* [4] *University of Pavia (Italy),* [5] *University College Cork (Ireland)*

The thermo-optic dynamics of optically pumped on-chip integrated microcavities is being investigated and modelled and a novel form of induced transparency observed. The presented phenomenon provides a group delay as high as 0.5 μs in a silicon-on-insulator (SOI) photonic crystal cavity at room temperature.

P23: Enhancing functionalities of plasmonic devices by design techniques

Cornel Cobianu[1], Marin Gheorghe[1], Gonzalo Santos[2], Yael Gutierrez[3], Mircea Modreanu[4], Fernando Moreno[2], Maria Losurdo[3]
[1] *NANOM MEMS (Romania),* [2] *Universidad de Cantabria (Spain),* [3] *CNR-NANOTEC (Italy),* [4] *University College Cork (Ireland)*

The plasmonic photodetectors are an attractive novel approach as their photocurrent can be over one order of magnitude higher than in conventional devices. However, this enhanced sensitivity is unfortunately accompanied by a strong selectivity to wavelength, incidence angle, and polarization, which limits their use in wideband photonic applications. We are discussing in this paper an original design and modeling methodology of the interdigitated surface plasmon enhanced photodetectors which will allow wideband detection and minimization of the light polarization effect.

P24: Efficiency and scalability of optical neural networks

Michal Matuszewski, Andrzej Opala
Polish Academy of Sciences (Poland)

Photonic information processing benefits from high speed, parallelization, low communication losses, and high bandwidth. Fully functional photonic neurons, including spiking neurons, as well as neural networks, have been already realized in laboratories. We show why using the exceptionally strong interactions, such as in polariton systems in place of standard nonlinear optical phenomena can help allow to achieve exceptionally high performance in terms of computational speed, energy efficiency, and latency.

P25: Silicon Nitride-based dielectric waveguides integrating monolayer graphene for near-infrared wavelength tuning

Artem Vorobev[1], G. V. Bianco[1], G. Bruno[1], A. D'Orazio[1], L. O'Faolain[2], M. Grande[1]
[1]*Polytechnic University of Bari (Italy),* [2]*Munster Technological University (Ireland)*

The combination of Silicon Nitride-based waveguides integrating monolayer graphene could be exploited for wavelength and phase shift in tunable devices. In this paper, we investigate three different configurations operating in the NIR. The numerical results show the possibility to obtain wavelength shift in the order of few hundred to several thousand picometers for a waveguide length of 50 μm. These results could pave the way for the realization of tunable resonant structures and tunable lasers based on external cavity.

P26: Glass poling and Electric field assisted dissolution for micro and nano structuring of metal thin films

Vesna Janicki, Ivana Fabijanic, Boris Okorn, Tamilselvi Selvam, Jordi Sancho-Parramon
Ruder Boskovic Institute (Croatia)

This work presents a short summary of glass poling and electric field dissolution as techniques that can be employed for fabrication of micro and nanostructures not only consisting of metal nanoparticles, but of conductive metal films as well. Although the use of alkali containing glass is pre-condition for these two processes, it is not necessary that the resulting structure is supported exclusively on glass.

P27: Efficient Second-Harmonic Generation in a Gallium Phosphide Metasurface

G. Q. Moretti[1], S. A. Maier[2], Andrea Bragas[1], G. Grinblat[1]
[1]*Universidad de Buenos Aires (Argentina),* [2]*Ludwig-Maximilians-Universitat Munchen (Germany)*

A metasurface of Gallium Phosphide on glass with an emphasis on a robust design, enables high-qualityfactor (Q) modes arising from the concept of quasi bound states in the continuum (QBICs). The high enhancementof the incident electric field is used to compute the nonlinear second harmonic (SH) fields in a non-perturbativeapproach, yielding a theoretical maximum conversion efficiency of 0.5 %.

P28: A Scalable Approach to Visible TiO2 Metalenses using Nanoimprint Lithography and High Refractive Index Nanoparticle Inks

Vincent J. Einck, Mahsa Torfeh, Andrew McClung, Dae Eon Jung, Mahdad Mansouree, Amir Arbabi, James Watkins
University of Massachusetts (USA)

We describe a rapid, reliable, and scalable additive manufacturing process for "printing"visible metalenses using a variation of nanoimprint lithography (NIL) and metal oxide nanoparticle-based inks. Nanostructures with aspect ratios larger than eight and critical dimensions smaller than 60 nm were produced yielding all-inorganic structures with a refractive index of n = 1.9. As demonstrations, we fabricated metalenses with numerical apertures (NAs) of 0.2 and focusing efficiencies over 50 % as well as wave guide gratings.

P29: Circularly polarized luminescence from nanopatterned semiconductor nanocrystals

Vivian Ferry
University of Minnesota (USA)

This talk will discuss strategies to realize circularly polarized photoluminescence from nanocrystals coupled to plasmonic arrays. The nanocrystals are patterned into nanostructures using direct write electron beam lithography. We show that the use of these patterns creates structures with simultaneously high photoluminescence intensity and degrees of circular polarization.

P30: Propagation of sound in viscous layered medium

Dmitrii Shymkiv, Arkadii Krokhin

University of North Texas (USA)

Propagation and attenuation of sound through a layered periodic phononic crystal with viscous constituents is theoretically studied. Using the Navier-Stokes equation, the dispersion of sound for fluid-fluid and fluid-solid layered structures is analytically obtained. Frequency and angular dependence of attenuation is analyzed and the anomaly related to acoustic manifestation of Borrmann effect is explained.

P31: Generation and Manipulation of Optical Ring Vortex Beams *online*

Yuttana Intaravanne[1], **Jin Han**[2], **Xianzhong Chen**[1]
[1] *Heriot-Watt University (United Kingdom)*, [2] *Kunming University of Science and Technology (China)*

A facile metasurface approach is demonstrated to generate and manipulate ring vortex beams. The generation of ring vortex beams is realized by combining the functionalities of an axicon, a vortex beam generator, and a beam deflector onto a single reflective metasurface. The superposition of multiple ring vortex beams is used to detect the polarization state of incident light. The unique property of the developed device renders this technology very attractive for polarization detection and quantum science-related applications.

P32: Designing robust flat-optics for flexible substrates and their performance under stress *online*

Fedor Getman, Arturo Burguete Lopez, Qizhou Wang, Maksim Makarenko, Andrea Fratalocchi
KAUST (Saudi Arabia)

We present an inverse design platform that enables the fast design of flexible flat-optics thatmaintain high performance under deformations and are tolerant to fabrication errors. Theplatform is based on evolutionary large-scale optimizers, and neural network predictors. Wedemonstrate both the of the design methods and the experimental performance of fabricateddevices, over a 200nm bandwidth in the visible under mechanical deformations

P33: Optical Filtering Properties in Quasi Periodic and Hybrid Periodic/Quasi Periodic One-Dimensional Photonic Crystals *online*

Mohammad Alanzi
King Abdulaziz City for Science and Technology (Saudi Arabia)

All dielectric Fibonacci quasi-periodic and hybrid periodic/quasi periodic photonic crystal has been numerically studied. Omnidirectional reflection properties in the infrared region is compared and discussed. Our results show the promise of using hybrid photonic hetero structure for extending the omnidirectional reflection, which has various application in photovoltaic and sensing devices.

P34: Propagation of pulsed and continuous waves in a time-varying string *online*

Ruben Pico Vila, Javier Redondo, Victor Jose Sanchez Morcillo
Universitat Politecnica d Valencia (Spain)

Time-varying elastic media show unusual wave propagation properties. A simple but generic 1D system is a taut string where wave propagation velocity is modulated in time by changing one of its constitutive parameters. It is shown that a wave propagating in such a spatially uniform medium is split into two scattered waves when an abrupt temporal interface is induced by an external action. Scattering coefficients are formulated in a transfer matrix scheme to predict the propagation of the waves.

P35: Low frequency acoustic beam focusing using an acoustic metamaterial lens with cross-shape units *online*

Feng Qin, Bruce W. Drinkwater, Jie Zhang
University of Bristol (United Kingdom)

We propose an acoustic metamaterial lens to focus acoustic beams at 40 kHz. The lens is built by cross-shape unit cells with different refractive indices that were calculated by retrieval method. The layout of unit cells is based on the time delay of a requested acoustic beam focusing. The lens performance was assessed by its achieved focusing ability and energy transmission rate. This lens shows the potential application for defect detection with the benefit of consistent and efficient acoustic coupling.

P36: Comparison of Effectiveness of Shielding Periodic Metal Structures on Dielectric Substrate *online*

Valdeth S. Sousa, L. K. Kretly, G. M. B. Silva, M. G. Villalva
University of Campinas (Brazil)

The study was to verify the parameters and possible adaptation for application of structures for EMC VEHICULAR. The study compared the shielding effectiveness of a metallic panel with holes and a metallic panel with dots, both on a dielectric substrate in a frequency range 0 - 1.5 GHz.

16:40 - 18:45 — Room 1

Session 1A18

Symposium II: New trends in nanophotonics and advanced materials

Organized by: Junsuk Rho, Hakjoo Lee and Namkyoo Park

Chaired by: Junsuk Rho, Hakjoo Lee and Namkyoo Park

16:40 : Keynote talk
Keynote Talk of Federico Capasso
Federico Capasso
Harvard University (USA)

Keynote Talk of Federico Capasso

17:10 : Invited talk
Tailoring polarization changes in all-dielectric metasurfaces by using quasi bound states in the continuum
Jose Luis Pura[1], Ruhinda Kabonire[1], Diego R. Abujetas[2], Jose A. Sanchez-Gil[1]
[1]*IEM-CSIC (Spain),* [2]*Fribourg University (Switzerland)*

The possibility of inducing polarization changes in all-dielectric metasurfaces by using quasi bound states in the continuum (quasi-BICs) is explored. A simple square array of dielectric disks is analyzed as a proof of concept. The results reveal that a $\pi/2$ phase shift is induced in the reflected radiation within the narrow bandwidth of a transverse-electric (TE) quasi-BIC state, enabling the conversion of linear to circularly polarized light and vice-versa.

17:30 : Invited talk
Probing leaky and guided exciton-polaritons in resonant planar structures
Anton Samusev
ITMO University (Russia)

Planar periodic structures such as metasurfaces and photonic crystal slabs strongly coupled to an exciton resonance attract particular attention since they provide vast opportunities for on-demand engineering of the dispersion of guided and leaky polariton resonances. In this regard, experimental characterization and control of the over modes' dispersion is of great importance. In this talk, I will show both what new physical phenomena appear in such systems and how these effects can be directly observed in the experiment.

17:50 : Free electron heating for photomodulation in the infrared
Euan Hendry
University of Exeter (United Kingdom)

Transparent conductive oxides such as Indium Tin Oxide (ITO) have been found to have exceptionally strong optical nonlinearity at frequencies near where the permittivity changes sign (referred to as the epsilon near zero, ENZ, frequency). Here, we study the pump dependent properties of the plasmon resonance in the ENZ region in ITO. We demonstrate a free electron heating mechanism, which results in a shift in the plasmon resonance frequency of 20 THz for relatively small pump intensity ∼70 GW cm-2.

18:05 : Invited talk
Metasurfaces to Control Multiple Aspects of Visual Appearance
Adrian Agreda[1], Tong Wu[1], Adrian Hereu[2], Mona Treguer-Delapierre[2], Glenna L. Drisko[2], Kevin Vynck[3], Philippe Lalanne[1]
[1]*Institut d'Optique Graduate School (France),* [2]*Institut de Chimie de la Matiere Condensee de Bordeaux (France),* [3]*Universite Claude Bernard Lyon 1 (France)*

Metasurfaces have flourished over the last few years thanks to their extraordinary capabilities to manipulate

light. In fact, the rich color tuning possibilities offered by metasurfaces have been largely confirmed. In this work, we go beyond purely chromatic properties of metasurfaces and focus on their complete visual appearance. We theoretically model and experimentally demonstrate unusual and novel visual effects by exploiting the large number of degrees of freedom available.

18:25 : Invited talk

Compact Representations of Terahertz Polarization in Semiconductor Nanoparticles *online*

Z. Hu[1], Z. Wang[2], Y. Li[3], Thomas Wong[2]
[1]*Keysight Technologies (USA),* [2]*Illinois Institute of Technology (USA),* [3]*Qorvo (USA)*

Space-charge interactions in semiconductor nanoparticles (SNP) lead to surface plasmon resonance occurring in the terahertz frequency range. Collective response of mobile charges in SNPs and their derivatives can be accounted for by the total induced dipole moment, which has complex relation to the material parameters and the geometry of the nanostructure. Effective field formulation and equivalent circuits are employed to arrive at compact representations to characterize the collective response of SNP and their derivatives.

16:40 - 18:40 — Room 2

Session 1A19

Symposium IV: Chirality, magnetism, and magnetoelectricity: Separate phenomena and joint effects in metamaterial structures

Organized by: Eugene Kamenetskii

Chaired by: Eugene Kamenetskii

16:40 : Invited talk

Three-dimensional antiferromagnetic architectures

Oleksandr V. Pylypovskyi
Helmholtz-Zentrum Dresden-Rossendorf (Germany)

Emergent geometry-driven responses in curvilinear antiferromagnets offer new possibilities to tailor chiral and anisotropic properties of the ground state and non-collinear textures. This includes a possibility to tailor weak ferromagnetism and Dzyaloshinskii-Moriya interaction by means of selection of sample's shape.

17:00 : Invited talk

Topological effects in plasmonic metasurfaces

Yuri Gorodetski
Ariel Photonics center (Israel)

Light-matter interactions in chiral structure can induce strong polarization selectivity. Specifically, an optical activity in a form of polarization rotation and a circular dichroism may be controlled by the the mirror symmetry breaking of the unit-cell . We design and experimentally investigate plasmonic metasurfaces with spatially varying chiral geometry and demonstrate how this may lead to a geometric phase. Our structure produces a polarization-dependent diffraction of linear states. We examine the diffraction orders and show that their topological nature.

17:20 : Invited talk

Optical Chirality Enhancement through Scalable Nanoantenna Designs

Bjoern Reinhard
Boston University (USA)

Rationally designed nanoantennas can enhance optical chirality density and intensify light-matter interactions. It remains, however, challenging to generate resonant structures in the ultraviolet (UV) spectral range where important molecular absorptions lie. This presentation summarizes our recent efforts to engineer strong near-field chirality in the UV through scalable nanoantennas.

17:40 : Invited talk

Waveguides for chiral quantum optics

Nir Rotenberg
Queen's University (Canada)

We report on the functionality of different photonic crystal waveguides as quantum chiral light-matter interfaces. In particular, we motivate the different metrics by which such an interface can be measured and then systematically study the performance of the different structures, including photonic crystal waveguides with broken symmetries or topological natures. Finally, we consider the connection of these metrics to quantum devices that rely on chiral light-matter interactions.

18:00 : Invited talk

Flat bands in one-dimensional chiral magnonic crystals

Silvia Tacchi[1], Jorge Flores-Farias[2], Daniela Petti[3], Felipe Brevis[1], Andrea Cattoni[4], Rodolfo Gallardo[2], Edoardo Albisetti[3], Giovanni Carlotti[1], Pedro Landeros[2]
[1]Università di Perugia (Italy), [2]Universidad Tecnica Federico Santa Maria (Chile), [3]Politecnico di Milano (Italy), [4]Universite Paris-Saclay (France)

Spin waves represent the collective excitations of the magnetization within a magnetic material, providing characteristic dispersion curves that can be manipulated by design and external stimuli. Spin waves exhibit strongly localized flat bands in arrays of magnetic nanowires and quantum spin systems, which is demonstrated experimentally and theoretically for a chiral magnonic crystal. It is further revealed that magnon modes are detectable only in one direction, allowing for unidirectional steering of spin waves.

18:20 : Invited talk

Mode attraction and exceptional points in periodically driven systems *online*

Igor Proskurin, Jephthah Iyaro, Robert Stamps
University of Manitoba (Canada)

We discuss how mode-attraction picture of hybridization between energy levels of a periodically driven system can appear for linear excitations around dynamics stationary states. We develop a general formalism based on a master equation for open systems and provide an example in the context of cavity magnonics, where we show that magnetic excitations in systems driven far from the equilibrium may show level attraction with cavity photons.

16:40 - 18:20 — Room 3

Session 1A20

Challenges of Phase Change Materials and Plasmonics for Nanophotonics

Organized by: Maria Losurdo, Yael Gutiérrez, Kurt Hingerl, Christoph Cobet, Mircea Modreanu and Fernando Moreno

Chaired by: Maria Losurdo, Yael Gutiérrez, Kurt Hingerl, Christoph Cobet, Mircea Modreanu and Fernando Moreno

16:40 : Invited talk

Nonthermal Photoinduced Phase Transition

Mario Graml, K. Hingerl, C. Cobet
Johannes Kepler University (Austria)

We review and adapt the well-established ideas by Ginzburg [1] to model ultra-fast, non-thermal phase transitions for the EU's Horizon 2020 research and innovation program PHEMTRONICS.

17:00 : Invited talk

Design and Characterization of Electrically Programmable Phase Change Photonic Devices

Nicholas Nobile[1], John Erickson[1], Carlos Rios Ocampo[2], Yifei Zhang[3], Juejun Hu[3], Feng Xiong[1], Nathan Youngblood[1]
[1]University of Pittsburgh (USA), [2]University of Maryland (USA), [3]Massachusetts Institute of Technology (USA)

We present methods for designing and characterizing foundry-compatible waveguide-integrated microheaters for electrically programmable phase-change photonic devices. In the first part of this talk, computational modeling approaches will be applied to various microheater designs (metallic, resistive, and diode-based microheaters) and insights for optimizing switching speed and energy efficiency will be presented. In the second part of this talk, recent experimental work on optically mapping the dynamic thermal response of these microheaters will be presented and compared with our computational models.

17:20 : Invited talk

Ultrafast manipulation of light with nanorod plasmonic metamaterials

Alexey Krasavin, Luke Nicholls, Andres Neira, Francisco Rodríguez-Fortuño, Mazhar Nasir, Gregory Wurtz, Anatoly Zayats

King's College London (United Kingdom)

Plasmonic metamaterials open a new avenue for engineering of enhanced optical nonlinearity largely surpassing that of optical materials composing them, or indeed any other natural material. In this talk we overview our recent results on achieving ultrafast intensity and polarization control in plasmonic nanorod metamaterials, which are highly sensitive to the nonlinear changes in the epsilon-near-zero regime. Combining this approach with Kerr-type metallic nonlinearities based on free-electron energy dynamics, we demonstrate ultrafast all-optical switching with femtosecond response times.

17:40 : Invited talk

Controlling electric and magnetic resonances of individual meta-atoms with Phase-Change Materials

Andreas Hessler, Thomas Taubner

RWTH Aachen University (Germany)

Phase-Change Materials (PCMs) enable local addressing of individual meta-atoms in metallic and low-loss dielectric metasurfaces. Here, we focus on tuning of electric dipole (ED) and magnetic dipole (MD) resonances. We introduce the non-volatile PCM In3SbTe2 (IST) whose optical properties change from dielectric to metallic upon crystallization in the whole infrared spectral range. With multiple optical writing steps, we demonstrate reconfiguration of complex antenna shapes like split ring resonators and spectrally tune their MD resonances, while keeping their ED resonances fixed.

18:00 : Invited talk

Nonvolatile Phase-change Materials for Reconfigurable Nanophotonic Devices

Sajjad Abdollahramezani, Ali Adibi

Georgia Institute of Technology (USA)

The large variation of the optical properties of nonvolatile phase-change materials enables new classes of reconfigurable nanophotonic and metaphotonic devices with subwavelength feature sizes. This talk is dedicated to demonstration of hybrid material and device platforms that enable such reconfigurable devices. The fundamental properties of such devices and their ability for dynamic wavefront engineering as a major functionality for enabling state-of-the-art applications like switching, structural color, and ranging will be discussed.

16:40 - 18:40 — Room 4

Session 1A21

Symposium I: Hybrid Nanomaterials and Metastructures for Photonics, Sensing and Energy

Organized by: Jerome Plain, Alexander Govorov, Davy Gerard and Pedro Hernandez Martinez

Chaired by: Jerome Plain, Alexander Govorov, Davy Gerard and Pedro Hernandez Martinez

16:40 : Invited talk

Plasmonic and Photonic Catalytic Metasurfaces

Emiliano Cortes

Ludwig-Maximilians-Universitat Munchen (Germany)

For millions of years, nature has used the sun as its primary energy source to split water and produce energy-rich chemical compounds from CO2. Inspired on this, artificial photosynthesis gained momentum in the last decades aiming to mimic this process. However, we are still looking for ideas and materials in order to transduce photons-into-chemical energy. Here, I will show our recent attempts in using plasmonic/photonic structures - from single particles to metasurfaces - in order to optimize the photons-to-molecules cycle.

17:00 : Invited talk

Near-field excitation and manipulation: from Janus multipoles to near-field coldspots

Michela Picardi, Sinuhe Perea-Puente, Alexander Vernon, Francisco Jose Rodriguez-Fortuno

King's College London (United Kingdom)

Polarisation properties of near-fields can be exploited to achieve near-field directionality from subwavelength sources: recent works explored dipolar sources like circular and Janus dipoles, later extended to circular multipoles. In this work we generalize the concept to combinations of electric and magnetic dipoles and quadrupoles, such as Janus multipoles, and near-field directionality in lossy waveguides. We also propose the use of polarized illumination of nanoparticles to create and manipulate near-field coldspots, whose topology and surrounding polarisation properties we explore.

17:20 : Invited talk

Structural colors with unconventional materials

P. Lyu, T. Gong, M. A. Duncan, Marina Leite

UC Davis (USA)

We present two classes of materials for structural colors. The first is based on Mg and MgO, both are earth-abundant and biodegradable. Vivid hues are attained by changing the dielectric spacer thickness. All shades can disappear on demand by etching both materials in water. The second system is based on refractory metals. We fabricate the primary colors for printing and analyze in detail how refractory metals and their oxides enable pixels resistant to 600 oC, while maintaining angle-insensitive optical response.

17:40 : Invited talk

Enhancing Foerster-Type Nonradiative Energy Transfer by Tuning the Complex Dielectric Medium Permittivity *online*

Pedro Hernandez Martinez, Abdulkadir C. Yucel, Hilmi Volkan Demir

Nanyang Technological University (Singapore)

We systematically studied the FRET mechanism by tuning the background medium's complex permittivity. The FRET rates of donor-acceptor pairs for point-like, quantum dot, and nanoplatelet nanostructures were derived. The change in FRET rates with respect to the relative permittivity of the background medium was characterized. The analysis reveals that the FRET rate becomes singular when the permittivity approaches zero and a fixed shifted non-zero value for the point-like and all other nanostructures, respectively.

18:00 : Invited talk

Ultrafast Spectroscopy Approaches to Enable Sensing and Imaging of Nanoscale Processes *online*

Gary Wiederrecht

Argonne National Laboratory (USA)

Ultrafast spectroscopy is a well-established means to monitor energy flow and dissipation in a wide range of structures. It can, however, be a time-consuming spectroscopy which limits its utility for sensing and imaging applications. In this talk, I describe recent efforts to accelerate ultrafast spectroscopies, particularly applied to nanoscale structures. The efforts are found to apply to a wide range of light-matter interactions, including photoinduced processes in plasmonic nanostructures and solar energy conversion materials.

18:20 : Invited talk

Plasmonic Chiral Photoheating using DNA-Nanocrystal Assemblies *online*

Oscar Avalos-Ovando[1], L. V. Besteiro[2], A. Movsesyan[1], G. Markovich[3], T. Liedl[4], K. Martens[4], Z. Wang[5], M. A. Correa-Duarte[2], A. O. Govorov[1]

[1]*Ohio University (USA),* [2]*Universidade de Vigo (Spain),* [3]*Tel Aviv University (Israel),* [4]*Ludwig-Maximilians-University (Germany),* [5]*University of Electronic Science and Technology (China)*

Plasmonic nanocrystals generate heat efficiently in the presence of electromagnetic radiation. Here, we use a chiral DNA-assembled nanorod pair as a model system for chiral plasmonic photo-heating, and we study the subsequent chiral photo-melting of its components. We show that both the enantiomeric excess and circular dichroism can be controlled with chiral light. The chiral asymmetry factors of the calculated photothermal and photo-melting effects exceed the values typical for the chiral molecular photochemistry at least 10-fold.

16:40 - 17:15 — Room 5

Session 1A22

Functional metamaterials

Organized by: Tatjana Gric, Edik Rafailov and Maria Farsari

Chaired by: Tatjana Gric

16:40 : Invited talk
Statistical Analysis of NIR to Visible Upconversion Luminescence from Single NaYF4:Yb3+,Tm3+ Nanoparticles on Plasmonic Nanowire Composites
K. Y. Chiok[1], **A. Haghizadeh**[1], **A. Baride**[2], **S. May**[2], **Steve Smith**[1]
[1] *SD Mines (USA)*, [2] *University of South Dakota (USA)*

We use single particle spectroscopic imaging to assess the plasmonic enhancement of NIR-to-visible upconversion luminescence (UCL) from single β-NaYF4:Yb3+:Tm3+ upconverting nanoparticles (UCNPs) supported on substrates consisting of random arrangements of Ag nanowires (NWCs) and Au nano-cavity arrays. By examining the effects at the single particle level, and accumulating a statistical sampling of single particle emitters, we obtain a statistical description of UCL emission enhancement and compare energy and time resolved emission to FDTD simulations and nonlinear coupled rate equation analysis.

17:00 : Periodically nanostructured single- and multi-layers for angular selectivity of light
Lina Grineviciute[1], **Julianija Nikitina**[1], **Darius Gaileviciute**[2], **Kestutis Staliunas**[3]
[1] *Center for Physical Sciences and Technology (Lithuania)*, [2] *Vilnius University (Lithuania)*, [3] *ICREA (Spain)*

This study was aimed to investigate the growth process of thin films on a nanostructured surface. Optical characterization revealed the presence of Fano-like resonance phenomenon in such single-layer structure, surrounded by a lower refractive index media. Moreover, we demonstrate a 5 μm thick photonic multilayer structure composed of alternating high- and low-index materials, providing angular selectivity of light. The proposed 2D photonic structure can be considered as a promising component for intracavity spatial filtering even in high power microlasers.

17:25 - 18:40 — Room 5

Session 1A23

Metasurfaces and flat optics, FSS and HIS

17:25 : Polarization Conversion Metalens for millimeter waves
Maria Ruiz-Fernández-de-Arcaya[1], **Cristina Yepes**[1], **Alexia Moreno-Peñarrubia**[1], **Jorge Teniente**[1], **Sergei Kuznetsov**[2], **Bakhtiyar Orazbayev**[3], **Miguel Beruete**[1]
[1] *Public University of Navarre (Spain)*, [2] *Novosibirsk State University (Russia)*, [3] *Nazarbayev University (Kazakhstan)*

This paper presents the theoretical and simulation results of a system formed by a thin metalens and a horn antenna with right-handed circular polarization (RHCP), working in the millimeter-wave band at 87 GHz. The metalens unit cells are composed of two H-shaped aluminum elements printed on both faces of a thin polypropylene slab, and combined thereafter with a horn antenna to test its properties. The structure presents an excellent behavior at the working frequency.

17:40 : Thin-film PZT MEMS for tunable metasurfaces: Offering large displacements at low voltages

Christopher Dirdal, Paul Conrad Vaagen Thrane, Firehun Tsige Dullo, Jo Gjessing, Anand Summanwar, Jon Tschudi
SINTEF Smart Sensors and Microsystems (Norway)

The metasurface research field is currently investigating many modalities of tunability which will help to unlock the full potential of the unprecedented field control offered by the technology platform. We demonstrate the use of thin-film piezoelectric PZT for twice the state-of-the-art out-of-plane displacement at a quarter of the required voltage: 7.2μm piston movement under a voltage application of 23V. Using this functionality, we demonstrate a tunable dielectric metasurface lens with a focal shift of 250μm at a wavelength of 1.55μm.

17:55 : Optical Metasurfaces for Generating Composite Optical Vortex Beams
Hammad Ahmed[1], Yang Ming[2], Yuttana Intaravanne[1], Muhammad Afnan Ansari[1], Xianzhong Chen[1]
[1]*Heriot-Watt University (United Kingdom),* [2]*Changshu Institute of Technology (China)*

Composite optical vortex beams (COVBs) have attracted considerable interest owing to their peculiar optical features and extra degree of freedom for carrying information. Optical metasurfaces have shown much promise for generating these COVBs due to their unprecedented capability in the arbitrary control of light's amplitude, phase and polarization at a subwavelength scale. Recently, we have proposed and experimentally demonstrated a facile metasurface approach to generating COVBs based on the superposition of multiple circularly polarized vortex beams with different topological charges.

18:10 : Metasurface filter design using quasi-normal mode theory
Mohammed Benzaouia, John D. Joannopoulos, Steven G. Johnson, Aristeidis Karalis
Massachusetts Institute of Technology (USA)

For the scattering matrix of a lossless reciprocal multi-resonance system, we develop a phenomenological quasi-normal mode theory (QNMT), whose applicability supersedes coupled mode theory (CMT), by directly using the system true modes instead of requiring identification of the üncoupled"modes. For the QNMT parameters, we then derive analytical criteria, satisfied for most common two-port scattering spectra. We use them to design microwave metasurfaces implementing accurate standard (Chebyshev, elliptic) filters configured for polarization-preserving transmission, reflective polarization conversion, and diffractive .ªnomalousreflection.

18:25 : Scalable Fano-Resonant Metasurface Hybrids for Tunable Structural Color
Mark Griep[1], Ben Cerjan[2], Sravya Nuguri[3], Burak Gerislioglu[2], Daniel Shreiber[1], Stephan Link[2], Peter Nordlander[2], James Watkins[3], Naomi Halas[2]
[1]*DEVCOM ARL (USA),* [2]*Rice University (USA),* [3]*UMass Amherst (USA)*

In this work we demonstrate how the combination of a plasmonic Fano-resonance metasurface and Bragg reflector substrates can contribute to the generation of narrowband visible colors. Active tuning of reflected colors is achieved by stretching the array in the x- and y- directions and the reflector in z- shifts colorimetric response of both elements. The combination of these two types of photonic structures allows for substantially increased flexibility in design and color-space tuning.

16:40 - 18:40 — Room 6

Session 1A24

Symposium II: New trends in nanophotonics and advanced materials

Organized by: Junsuk Rho, Hakjoo Lee and Namkyoo Park

Chaired by: Junsuk Rho, Hakjoo Lee and Namkyoo Park

16:40 : Invited talk
Spectral flow of a localized elastic mode
Marco Miniaci[1], Florian Allein[1], Raj Kumar Pal[2]
[1]*Universite de Lille (France),* [2]*Kansas State University (USA)*

The introduction of structural defects in otherwise periodic media is well known to grant exceptional space control and localization of waves in various physical fields, including elasticity. We theoretically predict and experimentally demonstrate the spectral flow of a localized mode across a bulk frequency gap by modulating a single structural parameter at any chosen location in the structure.

17:00 : Invited talk
Nonlinear Exciton-Polaritons in Chiral Microcavities
Sergei Tikhodeev
Lomonosov Moscow State University (Russia)

In this talk the exciton-polariton multistabitity in chiral microcavity under resonant pump will be demonstrated. It appears that even at linearly polarized pump one can expect sharp transitions from linear to circular-polarized photoluminescence in such chiral modulated microcavities.

17:20 : Invited talk
Study of Photoluminescence Mechanisms of Quantum Dots Embedded in Nanostructures Supporting Mie Resonances
Viktoriia Rutckaia[1], Mihail Petrov[2], Vadim Talalaev[1], Frank Heyroth[1], Dominik Schulze[1], Alexey Novikov[3], Mikhail Shaleev[3], Joerg Schilling[1]
[1] *Martin-Luther University (Germany),* [2] *ITMO University (Russia),* [3] *Russian Academy of Science (Russia)*

Mechanisms of photoluminescence enhancement such as excitation efficiency, Purcell effect and outcoupling efficiency are studied both theoretically and experimentally in a system comprising quantum dots embedded in silicon Mie-resonators.

17:40 : Invited talk
Enabling plasmonically generated hot-electrons transfer using DNA: The hydrodehalogenation reaction of Bromoadenosine
Sergio Kogikoski Junior, Anushree Dutta, Ilko Bald
Universitat Potsdam (Germany)

Using hot charge carriers far from a plasmonic nanoparticle surface is very attractive for many applications in catalysis and nanomedicine and will lead to a better understanding of plasmon-induced processes, such as hot-charge-carrier- or heat-driven chemical reactions. Herein we show that DNA can transfer hot electrons generated by a silver nanoparticle over several nanometers to drive a chemical reaction in a nonadsorbed molecule on the surface.

18:00 : Invited talk
Templated colloidal assembly of 2D Photonic Architectures
Jose Mendoza-Carreño, Ylli Conti, Pau Molet, Leonardo Scarabelli, Agustin Mihi
ICMAB-CSIC (Spain)

Template-assisted self-assembly is a scalable nanofabrication technique in which elastomeric pre-patterned stamps are used to induce long range order from a colloidal dispersion used as ink. Metal colloids or perovskite nanocrystals are used herein to fabricate high quality and large area 2D photonic crystals supporting narrow lattice resonances and chiral metasurfaces in which circularly polarized luminescence is observed.

18:20 : Invited talk
Magnetophotonics with spin and orbital angular momenta *online*
Vladimir Belotelov
Lomonosov Moscow State University (Russia)

It is experimentally found that when a light beam carrying orbital angular momentum passes through a magnetic film a topological Faraday effect appears: polarization rotation acquires an additional term dependent on the topological charge, radial number and beam radius.

16:40 - 18:35 — Room 7

Session 1A25

Acoustic and elastic phononic crystals, metamaterials and other structured media

Organized by: Marco Miniaci, Vicente Romero-Garcia, Vincent Pagneux, Maxime Lanoy, Jean-Philippe Groby and Noé Jiménez

Chaired by: Marco Miniaci, Vicente Romero-Garcia, Vincent Pagneux, Maxime Lanoy, Jean-Philippe Groby and Noé Jiménez

16:40 : Invited talk

On the application of periodic electrical boundary conditions as a means of achieving tunable RF SAW devices

Ricardo Alcorta Galván, Charles Croënne, Bertrand Dubus, Brigitte Loiseaux, Etienne Eustache, Matthieu Bertrand, Anne Christine Hladky-Hennion

Universite de Lille (France)

A single port SAW resonator is designed, due to its simplicity, a method for extracting the reflection coefficient of its mirrors is developed. Through this method, the mirror response as a function of different periodic electrical boundary conditions is studied and tunable Bragg band gaps as well as bands of high reflection coefficient due to local resonances of the mirror electrodes are shown.

17:00 : Invited talk

Asymmetric Elastic Wave Propagation in Spatiotemporally Modulated Nonlinear Granular Phononic Crystal

Florian Allein[1], Georgios Theocharis[2], Nicholas Boechler[3]

[1]*Universite de Lille (France),* [2]*Le Mans Universite (France),* [3]*University of California San Diego (USA)*

We study the propagation of transverse-rotational waves in a granular phononic crystal in which the shear stiffnesses are spatiotemporally modulated by a longitudinal propagating wave. Asymmetric wave propagation is investigated as well as one-way conversion and transmission. The combination of different polarized waves and the potential of strongly nonlinear behavior opens the way for the construction of novel nonlinear mechanical metamaterials.

17:20 : Invited talk

High Quality Resonances in Quasi-Periodic Distributions of Scatterers

Marc Marti-Sabate[1], Sebastien Guenneau[2], Daniel Torrent[1]

[1]*Universitat Jaume I (Spain),* [2]*Imperial College (United Kingdom)*

We present a systematic study of the different modes that can present clusters of scatterers arranged in quasi-periodic distributions of scatterers. Although we focus our study in flexural waves, our approach can be applied to any kind of classical waves.

17:40 : Invited talk

Shannon entropy as an indicator of avoided crossings in graded acoustic superlattices

Jose Sanchez-Dehesa

Universitat Politecnica de Valencia (Spain)

Shannon's information entropy is here applied to characterize the avoided crossing appearing in the resonant Zener-like phenomenon appearing in ultrasonic graded superlattices consisting of alternating layers of water and a fluid-like metamaterial. The gradient in the thicknesses of the water cavities produces effects similar to the electric field does in an electronic superlattice. It is found that Shannon entropy manifests the informational exchange of the involved states as the gradient is varied across the values where the avoided crossing occurs.

18:00 : Invited talk

Coupled-resonator elastic metamaterial: a paradigmatic model for molecular and condensed matter physics

Rafael Mendez-Sanchez[1], Diego Cortes-Reyna[1], Angel Martinez-Arguello[1], Enrique Flores-Olmedo[2], Gabriela Baez[2]

[1]*Universidad Nacional Autonoma de Mexico (Mexico),* [2]*Universidad Autonoma Metropolitana-Azcapotzalco*

(Mexico)

A coupled-resonator elastic metamaterial (CREM) that satisfies the tight-binding model, is presented. The CREM is composed of resonators connected through finite phononic crystals (FPC). When a normal-mode frequency of the resonator falls within the gap of the FPC the normal-mode wave amplitude localizes in the resonators since the connectors act as quasi-one-dimensional elastic Bragg reflectors. When several resonators are connected through FPCs, the waves of the resonators couple weakly to each other, and the elastic-waves tight-binding regime emerges.

18:20 : Nonreciprocal Acoustical Tesla Valve

Yuqi Jin[1], Teng Yang[1], Ezekiel Walker[2], Tae-Youl Choi[1], Arup Neogi[1], Arkadii Krokhin[1]
[1]*University of North Texas (USA),* [2]*Echonovus Inc. (USA)*

We fabricated a passive nonreciprocal acoustic device with the geometry originally proposed by Nikola Tesla to provide unidirectional flow of viscous fluid. Measured acoustic transmission through Tesla valve exhibits essential nonreciprocity, which agrees with numerical modelling. Due to broken P symmetry of the valve, there is asymmetry in transmission if the valve if filled by ideal (inviscid) fluid. In the case of viscous fluid, additive to asymmetry truly nonreciprocal contribution appears in the transmission, which is related to viscous dissipation.

16:40 - 18:25 — Room 8

Session 1A26

Plasmonics and nano-optics

16:40 : Spatio-spectral electron energy loss spectroscopy as a tool to resolve nearly degenerate plasmon modes in dimer plasmonic antennas

Michal Horak, Andrea Konecna, Tomas Sikola, Vlastimil Krapek
Brno University of Technology (Czech Republic)

Electron energy loss spectroscopy is often utilized to characterize localized surface plasmon modes supported by plasmonic antennas. However, the spectral resolution of this technique is rather mediocre. We address this issue by employing the spectral and spatial distribution of the loss probability simultaneously. We propose several spatio-spectral metrics and demonstrate their ability to resolve nearly degenerate modes supported by a dimer of plasmonic discs.

16:55 : Plasmonic response of topological insulator Bi2Se3

Gaurav Pal Singh, Neha Sardana
Indian Institute of Technology Ropar (India)

Topological insulators (TIs) are new-age materials having an electronic gapless conducting surface and an insulating bulk. TIs can potentially improve the conventional surface plasmon resonance (SPR) sensors. The plasmonic response of TI (Bi2Se3) with varying thickness was studied in sandwich coupling with Au layer and Au gratings. The thickness of the TI was optimized, and the effect of the change in grating width was reported by calculating the sensitivity of the system.

17:10 : Enhancing free electron nonlinear response of heavily doped semiconductors via surface charge depletion

Federico De Luca, Cristian Ciraci
Istituto Italiano di Tecnologia (Italy)

We study surface modulation of the equilibrium charge density of heavily doped semiconductors as a method to control and enhance the free electron nonlinear response of these materials. Using a hydrodynamic perturbative approach, we predict a two order of magnitude increase of free electron third-harmonic generation.

17:25 : Quality factor enhancement in finite vertically nonsymmetric subwavelength gratings

Weronika Glowadzka, Tomasz Czyszanowski
Lodz University of Technology (Poland)

Infinite subwavelength gratings are known for its infinite quality factor feature. When the structure becomes finite, its Q-factor decreases rapidly. To date, it was shown that high Q-factors are only possible in designs where the refractive index contrast between membrane and substrate is high. In this work we present two different approaches to enhance quality factor of Fano resonance in low refractive index contrast vertically nonsymmetric subwavelength gratings. The calculations are carried out using arsenide-based materials as an example.

17:40 : Infrared nanoplasmonic properties of hyperdoped embedded Si nanocrystals in the few electrons regime

Meiling Zhang[1], Jean-Marie Poumirol[1], Nicolas Chery[1], Clement Majorel[1], Remi Demoulin[2], Etienne Talbot[2], Herve Rinnert[3], Christian Girard[1], Fuccio Cristiano[1], Peter R. Wiecha[1], Vincent Paillard[1], Arnaud Arbouet[1], Fabrice Gourbilleau[2], Caroline Bonafos[1]
[1]*Universite de Toulouse (France),* [2]*Universite de Normandie (France),* [3]*Universite de Lorraine (France)*

Using Localized Surface Plasmon Resonance (LSPR) as an optical probe we demonstrate the presence of free carriers in phosphorus doped silicon nanocrystals embedded in silica. We demonstrate that LSP resonances can be supported with only about 10 free electrons per nanocrystal, and the appearance of an avoided crossing behavior linked to the hybridization of the LSP and the silica matrix phonon modes. Finally, the scattering time dependence versus carrier density allows us to discriminate different scattering process.

17:55 : Plasmonic Optomechanical Switch

Irene Castro, Antonio Garcia-Martin, Daniel Ramos
CSIC (Spain)

In this work we theoretically demonstrate the use of a two-level optomechanical system actuated by plasmon-mediated optical forces as a reconfigurable nanophotonic switch. We have simulated a nanostructured suspended gold membrane allowing the normal excitation of a Surface Plasmon Polariton by patterning an air nanohole array. By placing the membrane in a close proximity of a reflecting substrate, we observe a mode splitting which provides two stable mechanical states accessible by tunning the illuminating wavelength.

18:10 : Soft Plasmonics: Investigating the surface plasmon effects and nonlocality in planar electrolyte systems

Preethi Ramesh Narayan, Christin David
Friedrich-Schiller-Universitat Jena (Germany)

We discuss the surface plasmon activity and nonlocal interactions between the ionic systems and active planar solid interfaces induced by optical excitation, using a multi-fluid model. These plasmonic effects are studied under various ionic system parameters and optical conditions which are highly tunable.

Wednesday 20th July, 2022

08:30 - 09:40 — Room 1

Session 2A1

Plenary Session II

08:30 : Plenary talk
Plenary Talk of Alexandra Boltasseva
Alexandra Boltasseva
Purdue University (USA)

Plenary Talk of Alexandra Boltasseva

09:05 : Plenary talk
Picophotonics
Nikolay Zheludev
University of Southampton (United Kingdom)

Optical imaging and metrology of nanostructures exhibiting Brownian motion is possible with resolution beyond thermal fluctuations and speed to resolve their dynamics. This opens the case for picophotonics (atomic scale photonics), the science of interactions of picometer-scale objects and events with light.

Coffee Break

Session 2P1

Poster session III

9:40 - 10:20

Chaired by:

P1: Harvesting of infrared solar energy by thermoplasmonic nanoantenna for enhanced photovoltaic-thermoelectric systems
Sebastien Hanauer[1], Ines Massiot[1], Adnen Mlayah[1], Franck Carcenac[1], Jean-Baptiste Doucet[1], Emmanuelle Daran[1], Ihar Faniayeu[2], Alexander Dmitriev[2]
[1]*LAAS-CNRS (France)*, [2]*University of Gothenburg (Sweden)*

Our work aims at using thermoplasmonic nanoantennas to create a photothermal interface able to effectively absorb infrared radiation from the sun and generate heat. This interface could then be integrated to increase the efficiency of hybrid photovoltaic-thermoelectric systems. Numerical simulations were used to identify an optimal design by studying the impact of the material, geometry and dimensions on the optical and thermal properties of the nanoantenna. First demonstrators of nanostructured photothermal interfaces were then fabricated and characterized.

P2: Single-element gas sensor based on high-contrast grating VCSEL with Fano effect
Magdalena Marciniak, Weronika Glowadzka, lukasz Piskorski, Tomasz Czyszanowski
Lodz University of Technology (Poland)

We propose a new design for a single-element gas detector, based on a VCSEL with high contrast grating (HCG) as top mirror. HCG supports Fano resonance that is characterised by a sharp variation in the power reflectance spectrum of mirror and enables high sensitivity to the modification of the surroundings. The presence of gas in the proximity of the mirror deteriorates the Fano resonance and reduces quality factor of the VCSEL which affects its threshold condition and modifies electrical characteristics.

P3: Fine tuning the optical properties of single Au nanoparticles by plasmon-driven growth in closed-loop control

Luciana P. Martinez[1], Julian Gargiulo[2], Mariano Barella[1], Ianina L. Violi[1], Fernando D. Stefani[1]
[1] *Instituto de Nanosistemas (INS) (Argentina),* [2] *Ludwig Maximilians Universitat (Germany)*

We present the control of plasmon-driven growth of Au nanoparticles by live monitoring their photoluminescence emission in a closed-loop. We find that the final emission maximum of single nanoparticles can be tuned with a precision of 2-3 nm, and that the tuning is also reflected in their scattering maximum. In comparison to controlling the growth by irradiation time and/or reaction conditions, the closed-loop control delivers superior reproducibility and a 3-to-4-fold higher precision in the final properties of the nanoparticles.

P4: Generation of optical vortex by plasmonic metalens for beam shaping

Chun Hui Wei, Chin Kai Chang
National Cheng Kung University (Taiwan)

Metalens which consist of two concentric elliptical nanohole arrays in silver film are proposed to generate an optical vortex for beam shaping by incident light with circular polarization. The generated optical filed from metalens can be altered by rotation of elliptical nanohole. The metalens will generate a tiny spot with a favorable depth of focus as major axis of elliptical nanohole in the inner concentric array is perpendicular to the major axis of elliptical nanohole in the outer concentric array.

P5: Optimization of the cryogenic etching process for metalenses development

Angela Baracu[1], Andrei Avram[1], Adrian Dinescu[1], Oana Rasoga[1], Paul Thrane[2], Firehun Tsige Dullo[2], Christopher Dirdal[2]
[1] *National Institute for Research and Development in Microtechnologies-IMT Bucharest (Romania),* [2] *SINTEF Microsystems and Nanotechnology (Norway)*

Metasurfaces are promising alternative to bulky, heavy and expensive optical components. High aspect ratio structures can be obtained by planar silicon processing techniques such as EBL and DRIE. This paper presents the optimization of the cryogenic etching process for metalenses development. We obtained silicon nanopillars arrays (metalenses) with perfect vertical profile of nanopillars and smooth sidewalls. The developed structures were manufactured on 4-inches silicon wafers, therefore they can be directly used as metalenses or as master wafers for UV-NIL processing.

P6: Different approaches of UV-Nanoimprint Lithography in order to reach 30 nm residual layer for IR metasurface lenses fabricated on silicon substrates

Oana Rasoga[1], A. Obendorfer[2], Adrian Dinescu[3], Christopher Andrew Dirdal[4], Irina Zgura[1], Carmen Breazu[1], Angela Mihaela Baracu[3], Andrei Marius Avram[3], Paul Conrad Vaagen Thrane[4], Marcela Socol[1], Anca Stanculescu[1]
[1] *National Institute of Materials Physics (Romania),* [2] *EVGroup (Germany),* [3] *IMT Bucharest (Romania),* [4] *Smart Sensors and Microsystems (Norway)*

In this study we try to reduce the thickness of the residual layer, specific for the nanoimprint lithography processes, using different resists and UV-NIL machines. The results show that passing from the classical UV-nanoimprint machine with rigid mask to an automated one that uses a flexible backplane, the meta-atoms with height of 1.2 μm can be reproduced with more accurate fidelity.

P7: Design and optimization of broadband optical antennas

Henna Farheen[1], Lok-Yee Yan[2], Till Leuteritz[2], Siqi Qiao[2], Florian Spreyer[1], Christian Schlickriede[1], Viktor Quiring[1], Christof Eigner[1], Thomas Zentgraf[1], Stefan Linden[2], Jens Forstner[1], Viktor Myroshnychenko[1]
[1] *Paderborn University (Germany),* [2] *Universitat Bonn (Germany)*

We present the numerical and experimental realization of broadband optical traveling-wave antennas made from low-loss dielectric materials, which exhibit highly directive patterns. The high directivity comes from the interplay between two dominant TE- and leaky-modes present in the antenna director. These antennas possess near unity radiation efficiency at the operational wavelength of 780 nm, maintaining a broad bandwidth. We envision that our all-dielectric approach demonstrates a new class of antennas that are excellent candidates for optical-communication and sensing.

P8: Luneburg lens antenna system in Gap Waveguide technology at 60 GHz

Dayan Perez-Quintana[1], Christos Bilitos[2], Jorge Ruiz-Garcia[2], David Gonzalez-Ovejero[2], Miguel Beruete[1]
[1] *Public University of Navarra (Spain),* [2] *Universite de Rennes (France)*

In this paper, a flat lens antenna using Gap Waveguide (GW) technology working in the millimeter waves band is designed. The metamaterial lens is fed using a Groove Gap Waveguide (GGW) horn antenna in order to achieve a planar wavefront at broadside. Both devices, metalens and GGW antenna achieve excellent radiation results when combined together. Due to the fully metallic composition, the structure presents more robustness, low loss, and adaptability to a flat surface, apt for millimeter wave application.

P9: Circular Polarization Antennas in Ridge Gap Waveguide at V-Band

Dayan Perez-Quintana, Iñigo Ederra, Miguel Beruete
Public University of Navarra (Spain)

In this paper, three compact antennas using the ridge gap waveguide (RGW) technology working in the millimeter-wave band and generating circular polarization (CP) in either a wide or a narrow band are numerically and experimentally analyzed. The widest bandwidth achieved in CP is 14.48 %, with respect to the central frequency and the highest gain is around 18.4 dB. These designs are a strong alternative for medium/high gain CP antennas in a planar layout.

P10: Identifying Nanoscale Deformation within Key Plasmonic Materials in Response to Thermal Stress

Tiernan McCaughery, R. Bowman
Queen's University (United Kingdom)

Plasmonic materials have gathered increased attention due to their sub-diffraction limited heat generation. However, the nanoscale deformation which these materials exhibit at elevated temperatures has stopped plasmonic materials from being more widely used for such heat generation within certain applications. This work outlines a method which can indirectly identify nanoscale deformation in plasmonic materials through a toolkit which can easily be fabricated and integrated into CMOS device production as part of wider research investigating thermally stable plasmonic materials.

P11: Design of Plasmonic Materials Using the Real-Space Real-Time TDDFT+U Method

Ryan Duddy, Lorenzo Stella, Myrta Gruning
Queen's University Belfast (Ireland)

Real-space real-time TDDFT+U is proposed as a method of calculating the bulk and thin-film dielectric function of titanium nitride as a potential plasmonic material outside of the commonly used Nobel metals. The linear scaling with system size, mixed boundary conditions and the Hubbard U makes the presented approach computationally feasible for the study of titanium nitride thin films.

P12: Investigation into the Optical and Plasmonic Properties of Titanium Nitride - A promising alternative material to Gold and Silver

Arthur Lipinski, Achyut Maity, C. Lambert, R. M. Bowman, W. R. Hendren
Queen's University Belfast (United Kingdom)

This work focuses on investigating the optical and plasmonic properties of titanium nitride (TiN) thin films. These materials offer much better thermal stability than the conventional plasmonic materials such as gold (Au) and silver (Ag). The optical properties of the thin plasmonic films are determined using Spectroscopic Ellipsometry (SE) and plasmonic measurements are done using Spectral Attenuated Total Reflectance (ATR).

P13: Bringing Ab-Initio Design Into the Lab: Temperature Dependence of Plasmonic Response

Daniel Murphy, M. Gruning, L. Stella
Queens University Belfast (United Kingdom)

The next generation of hard drive technologies for Seagate Technologies, heat assisted magnetic recording (HAMR) relies on the novel combination of plasmonics and material design. The NFT is subjected to intense environmental conditions. This work uses ab-initio techniques to discover new materials for plasmonic applications. Using density functional theory, many-body perturbation theory and including electron-phonon interactions, the effect of temperature the plasmonic performance will be evaluated through a range of temperatures in a fully ab-initio way.

P14: A Design Automation and Simulation Flow for Lens Systems containing Multi-Layer Metasurfaces

Jan Bos[1], Rob Scarmozzino[2], Mayank Bahl[2], Evan Heller[2], Chenglin Xu[2]
[1]*Synopsys Inc. (The Netherlands),* [2]*Synopsys Inc. (USA)*

A design automation flow has been developed using inverse design techniques adapted for systems containing cascaded metasurfaces with arbitrary configurations of parameterized meta-atoms. The optimized layout is obtained automatically based on specified target functions. The performance of the optimized metalens system can then be validated by different simulation approaches. Several design examples will be presented to demonstrate the capability and usability of this powerful design flow.

P15: Acoustic imaging assisted by unsupervised learning approach

Jiawei Xi, Yongzhong Li, Casey Ka Wun Leung, Tan Li, Wing Yim Tam, Jensen Li
The Hong Kong University of Science and Technology (China)

We demonstrate extraction of spatially dependent material parameters by using unsupervised neural network in learning the data structure of the wave propagating data from a given wave equation. A 2D spring mass model is used to image mass or modulus distribution, as a simplified model for acoustic imaging. The approach facilitates the discovery of spatially dependent differential equation coefficients and can be applied to different waves, without prior knowledge of scattering mechanism and is applicable to inverse scattering with metamaterials.

P16: Elastic coiling-up space

Geunju Jeon, Joo Hwan Oh
Ulsan National Institute of Science and Technology (Korea)

Coiling-up space is one of the major design methods of acoustic metamaterial that utilizes a labyrinthine structure to achieve high-refractive index. Accordingly, coiling-up space has been widely used in acoustic metamaterials and metasurfaces. Despite its usefulness, however, elastic coiling-up space has never been studied nor realized so far owing to its tensor-based physics. In this study, we theoretically derived the specific conditions that enable the elastic coiling-up space and successfully realized it with experimental supports.

P17: Strong coupling of Bloch surface waves and excitons in ZnO up to 430 K

Sebastian Henn, Marius Grundmann, Chris Sturm
Uni Leipzig (Germany)

We report on observation of Bloch surface wave polaritons (BSWP) in samples consisting of a distributed Bragg reflector with a thin ZnO top layer. By extracting mode energies from polarization-resolved reflectivity measurements, it was possible to detect BSWP up to 430 K. Within a coupled oscillator model corresponding Rabi splittings between 100-192 meV at 294 K are derived. Combining stable polaritons at high temperatures with the low-loss nature of Bloch surface waves is useful for on-chip polaritonic devices.

P18: Single-layer Metasurface and Antenna Arrangement for Wearable Millimeter Wave Radar Applications

Maria Elena de Cos Gomez, Humberto Fernandez alvarez, Fernando Las-Heras Andres
Universidad de Oviedo (Spain)

Two metasurfaces (MTS) and a series end-fed 1x10 array antenna with a modified Dolph-Chebyshev distribution for improved beam-width are designed for imaging applications in 24.05GHz-24.25GHz. Each single-layer MTS-array provides secondary lobes reduction and FTBR increase while preserves Gain, radiation efficiency, SLL and size. Moreover, operation bandwidth is widened, with Gain and radiation efficiency enhancement. The overall devices' size is 86.8 x 12 x 0.762 mm3. The envisioned application is collision avoidance in aid to visually impaired people at medium-long distance.

P19: Observation of higher-order anapole resonances in single silicon disks driven by integrated waveguides

Evelyn Diaz Escobar[1], Angela Barreda[2], Amadeu Griol[1], Alejandro Martinez[1]
[1] *Universidad Politecnica de Valencia (Spain),* [2] *Friedrich Schiller University Jena (Germany)*

Anapole resonances in high-index dielectric nanoparticles arise from the destructive interference between electric (or magnetic) and toroidal dipole moments. So far, the magnetic anapole and the high-order electric anapoles has been solely observed using normal incidence free-space radiation. Here we show that these anapole resonances can also arise in silicon disks being excited by an in-plane oriented waveguide. This work paves the way towards the use of the anapole resonances in on-chip silicon photonics.

P20: Ensembles of PT-dipoles for sound propagation management

Helena Arias Casals[1], Ramon Herrero Simon[1], Muriel Botey[1], Kestutis Staliunas[2]

[1]Universitat Politecnica de Catalunya (Spain), [2]ICREA (Spain)

Among other possible designs, metamaterials constructed from ensembles of meta-dipoles emerged as a flexible platform to redirect wave fields. We present an acoustic PT-dipole constructed from two Helmholtz resonators with different losses for such acoustic metamaterials. We explore dipole ensembles in a two dimensional space to either concentrate the field in a predefined area or create a silent area. Numerical simulations agree with experimental results and confirm the sound directivity created by the PT-dipole ensembles.

P21: Taming turbulence with non-Hermitian potentials with parabolic and fractal dispersion
Salim Benadouda Ivars, Muriel Botey, Ramon Herrero, Kestutis Staliunas
Universitat Politecnica de Catalunya (Spain)

In this work we take advantage of the asymmetric properties of non-Hermitian physics to control turbulence in nonlinear systems. The proposed mechanism consists in the introduction of a complex modulation in space and time. This allows us to affect the excitation cascade increasing turbulence or reducing it depending on the phase shift of the real part and the imaginary part of the temporal modulation. The method is proved for the Complex Ginzburg Landau Equation and its fractional counterpart.

P22: Method for accurate transfer of gold nanoparticles on photonics nanostructures
Javier Abilio Redolat Querol, Alejandro Jose Martinez Abietar, Elena Pinilla Cienfuegos
Universitat Politecnica de Valencia (Spain)

Nanoparticle on a mirror (NPoM) cavities offer unrivalled performance in terms of extreme photon confinement in nm-scale gaps. The easiest way to produce them - drop-casting of Nanoparticles (NPs) on a metallic surface covered by a molecular monolayer - fails when the NPoM cavity has to be created on a nanostructure with finite boundaries. Here we report a method to position single metallic NPs on top of photonic nanostructures covered by a self-assembled monolayer with sub-micron resolution.

P23: Chiral magnetic nanocomposites: toward magneto-chiral dichroism
Gautier Duroux, Lucas Robin, Reiko Oda, Elizabeth Hillard, Emilie Pouget
Universite de Bordeaux (France)

Magnetochiral Dichroism (MChD) is the differential absorption of non-polarized light according to the direction of an external magnetic field. As well as being of interest for novel magneto-optical technologies, MChD is a hypothesis for the origin of the homochirality of life. Requiring a system which is simultaneously chiral and magnetic, MChD has only been rarely observed. Here, we use a composite approach where a magnetochiral response is induced in achiral magneto-optical objects by interaction with a chiral silica nanoplatform.

P24: Diverse interactions of sub-nm spaced plasmonic dimers with 2D materials
Priyanka Suri[1], Eklavy Vashist[1], Biswanath Chakraborty[2], Vinod Menon[3], Ambarish Ghosh[1]
[1]*Indian Institute of Science (India),* [2]*Indian Institute of Technology (India),* [3]*City College of New York (USA)*

Light-matter interaction of two-dimensional materials with metal nanoparticles has been a topic of growing interest owing to several potential applications of the system and the fundamentals involved. Here we explore the possibility of monolayer tungsten diselenide (WSe2) as a strain-induced single-photon emitter by embedding it in a hetero- plasmonic dimer cavity. At the same time, a homo-plasmonic dimer cavity geometry allows us to study the strong light-matter coupling with TMD monolayer and enabling us to realize possible exciton-based devices.

P25: Tuning surface plasmons in Ag-Cu alloy thin films
Bandaru Pravallika, Govind Ummethala, S. R. K Malladi, Shourya Dutta-Gupta
Indian Institute of Technology Hyderabad (India)

The tunability of propagating surface plasmons in optical range is limited by the available materials supporting strong plasmon resonances. Alloying is an alternative viable method for increasing the materials library available for tuning the plasmon resonance. We show that immiscible Ag-Cu alloy provides multiple degrees of freedom to tune the plasmon resonance by controlling the composition, microstructure, and phase morphology of thin films. The implications of various parameters on the microstructure and the plasmon resonance behavior are investigated in detail.

P26: A clamped seismic metamaterial with broadband ultra-low frequency bandgap
Kamal Kishor, M. S. S. A. Ali, P. Rajagopal
Indian Institute of Technology Madras (India)

Metamaterials based seismic isolation concepts have evolved in the last decade. However, due to the larger size of resonators, the practical implementation remains a challenge. This research aims to develop clamped metamaterial with realistic resonator size to achieve a low-frequency bandgap. Numerical simulations are used to determine the shape, geometry, and material of the resonator. The proposed brick metamaterial with a resonator size of 2.5 m is shown to achieve a low-frequency bandgap of 0-23 Hz through the local resonance.

P27: A clamped embedded seismic metamaterial with broadband ultra-low frequency bandgaps

Kamal Kishor, M.S.S.A. Ali, P. Rajagopal
Indian Institute of Technology Madras (India)

Metamaterials based seismic isolation concepts have evolved in the last decade. However, due to the larger size of resonators, the practical implementation remains a challenge. This research aims to develop clamped metamaterial with realistic resonator size to achieve a low-frequency bandgap. Numerical simulations are used to determine the shape, geometry, and material of the resonator. The proposed brick metamaterial with a resonator size of 2.5 m is shown to achieve a low-frequency bandgap of 0-23 Hz through the local resonance

P28: Defect Modes in Elastic Waveguide Metamaterial Rod

Subrahmanyam Gantasala, Sandeep Kumar S. R., Krishnan Balasubramaniam, Prabhu Rajagopal
Institute of Technology Madras (India)

This paper investigates the presence of defect modes in an elastic waveguide metamaterial rod. The proposed waveguide metamaterial rod consists of baffles that are periodically arranged along the direction of wave propagation, thereby creating an ultrasonic bandgap. A defect is created by varying the geometrical parameters of the central baffle. A strong energy localization is observed within the bandgap at defect frequency modes. The existence of these defect modes can be varied by altering the size of the defects.

P29: Experimental analysis of conductive ink pattering process for mass production of microwave absorbing metamaterial

J. S. Han[1], H. J. Park[2], J. -Y. Jeong[1], J. Jung[2], E. -J. Gwak[1], E. -C. Jeon[3], T. -J. Je[1], J. H. Shin[2], D. -S. Choi[1]
[1]*KIMM (Korea),* [2]*KAIST (Korea),* [3]*University of Ulsan (Korea)*

Conductive ink patterning process was developed for mass production of ultra-bandwidth microwave absorbing metamaterial. Effects of patterning parameters including blade type, ink viscosity, pattern depth, and blade speed were experimentally characterized to achieve uniformly filled double square loop array. Based on optimized conductive ink patterning process, ink-filled 200mm x 200mm scale microwave absorbing metamaterial was fabricated.

P30: A General Mathematical treatment for the Existence of Symmetric Transverse Magnetic Surface States at the Interface between Air and Semiconductor Photonic Hypercrystal. *online*

Hasnain Haider, Munazza Zulfiqar Ali
Punjab University (Pakistan)

The existence of electromagnetic surface waves at the interface between air and photonic hypercrystal is investigated theoretically by using a general mathematical treatment. Photonic hypercrsytals are shaped by presenting a periodic variation in hyperbolic metamaterial. Surface waves under investigation are found to show negligible losses and are symmetric for positive and negative wave vectors on the surface. The dispersion curves can be tailored by a proper choice of parameters that is elaborated by curve plotting.

P31: Broadband near-zero-index waveguide *online*

Chih-Zong Deng, Eri Igarashi
SONY (Japan)

Dirac-cone-based zero-index materials (ZIM) consisting of dielectric with air-hole array have been demonstrated to overcome the difficulties in ZIM such as ohmic losses and low integrability. However, Dirac-cone-based ZIMs suffer from narrow bandwidth in the near-zero-index (NZI) region. The proposed broadband NZI waveguide, which can sustain multiple Dirac-cone resonances, achieves the broadband (105 nm in the telecommunication region) NZI behavior, which is around 2 times larger than that of the reported Dirac-cone-based ZIMs.

P32: Direct linear polarization measurement using a grayscale imaging metasurface *online*

Yue Cao, Z. G. Dong
Southeast University (China)

We present an ultrathin metasurface composed of silver nanorods, which can arbitrarily manipulate the optical intensity of linearly polarized illumination by modulating the nanorod orientations. It can be used to display high-resolution grayscale images in sub-wavelength scales with a specific polarization state of linear light. We especially generate elaborate grayscale images to directly measure the polarization angle of the linearly incident light by extracting the angle of the brightest area of the grayscale images.

P33: Spin-decoupled omnidirectional anomalous refraction based on a single metasurface *online*

Lili Tang, Zheng-Gao Dong
Southeast University (China)

Spin-decoupled metasurfaces can only spatially split and deflect beams in coplanar directions not in non-coplanar, limiting further applications. Here, a single metasurface is proposed to experimentally and numerically demonstrate the spin-decoupled omnidirectional anomalous refraction. The results indicate that the three-dimensionally omnidirectional dual-beam refractions are attributed to arbitrary engineering of spin-independent phase gradients along any in-plane orientations of the single metasurface. It is believed that the proposed spin-decoupled omnidirectional metasurfaces are promising candidates for multifunctional applications in compact spin-based nanophotonic systems.

P34: Generation of microwave and THz radiations by surface plasmon waves propagating in lightning and spark discharges *online*

Nikolai Petrov, Galina Petrova
Russian Academy of Sciences (Russia)

The mechanism of high-frequency (microwave and THz) electromagnetic radiation in lightning and spark discharges is proposed. The existence of fast electromagnetic surface waves propagating along the discharge channel at a speed close to the speed of light in a vacuum is shown. The possibility of generating radio, microwave, and THz radiation caused by a polarization current pulse and the associated field of a surface wave moving with relativistic velocity along a curved discharge channel is shown.

10:20 - 12:20 — Room 1

Session 2A2

Challenges of Phase Change Materials and Plasmonics for Nanophotonics

Organized by: Maria Losurdo, Yael Gutiérrez, Kurt Hingerl, Christoph Cobet, Mircea Modreanu and Fernando Moreno

Chaired by: Maria Losurdo, Yael Gutiérrez, Kurt Hingerl, Christoph Cobet, Mircea Modreanu and Fernando Moreno

10:20 : Invited talk

From phase change nanophotonic to phase change nano-opto-mechanics

Tongjun Liu, Dimitrios Papas, Jinxiang Li, Jun-Yu Ou, Eric Plum, Kevin MacDonald, Nikolay Zheludev
University of Southampton (United Kingdom)

The changing balance of forces at the nanoscale allows nanomachines that can alter optical properties of metamaterials with electromagnetic and acoustic forces and heat. We overview recent results in this field and report new metamaterials with volatile and non-volatile optical bistability previously seen in phase change media and explore optical parametric phenomena and controlling light with light in such media.

10:40 : Invited talk

Prediction of promising phase change materials candidates for active optical devices via DFT calculations

Dilson Juan[1], Yael Gutierrez Vela[2], Gonzalo Santos[1], Pablo Garcia Fernandez[1], Javier Junquera[1], Ma-

ria Losurdo[2], Fernando Moreno[1]
[1] *Universidad de Cantabria (Spain),* [2] *Università degli Studi di Bari (Italy)*

Group-III monochalcogenides compounds are layered van der Waals semiconductors intensively studied for development of optoelectronic applications. Their large optical contrast between crystalline-amorphous phases is among the desirable properties for the new paradigm of reconfigurable devices. In this contribution we will present band and dielectric function simulations of GaX (X=S, Se, Te) using density-functional theory. Although the description of optical response poses a great challenge for single-particle formalisms, insight gained from detailed and orbital contributing is very useful in material engineering.

11:00 : Invited talk
Plasmon-Enhanced photothermal response based on Janus-Nanoheaters
Javier Gonzalez-Colsa[1], Jose M. Saiz[1], Dolores Ortiz[1], Francisco Gonzalez[1], Fernando Moreno[1], Fernando Bresme[2], Pablo Albella[1]
[1] *University of Cantabria (Spain),* [2] *Imperial College London (United Kingdom)*

Combination of materials with radically different physical properties in the same nanostructure gives rise to the so-called Janus effects,allowing phenomena of contrasting nature to occur in the same architecture. Here we will report on how Janus-based nanoheaters possess superior photothermal conversion features and directional heating capacities that can be exploited in highly demanded applications such as photothermal cancer therapies, drug-delivery or heat-gradient-free metasurfaces to control transitions in phase change films without the need of local resistive heaters and external electronics.

11:20 : Invited talk
Anapolar excitation for an enhanced thermo-optical response
Javier Gonzalez-Colsa[1], Juan D. Olarte-Plata[2], Fernando Bresme[2], Pablo Albella[1]
[1] *University of Cantabria (Spain),* [2] *Imperial College London (United Kingdom)*

High Refractive Index (HRI) nanostructures are ideal platforms to generate strong electric and magnetic field modes applicable in a wide range of applications such as biosensing or opto-thermal conversion. In this work, we perform a theoretical analysis of anapolar excitations in disk-ring hybrid nanostructures to enhance the temperature generated by a plasmonic resonator. We also present this mode as a simple mechanism to shift the thermal response of these structures to the NIR range.

11:40 : Invited talk
Merging Phase-Change and Metamaterial Concepts for Novel Devices to Control and Manipulate Light
C. David Wright
University of Exeter (United Kingdom)

Phase-change materials (PCMs) are used very successfully for optical and electrical memories. Such success arises due to large electro-optical contrast between their amorphous and crystalline states, non-volatility, fast switching and large cycling endurance. These same properties can also be exploited to deliver a form of active dielectric, which, combined with metamaterials concepts, leads to novel devices for the control of light: LiDAR, displays, holography, imaging, sensing, photonic computing and more. Here we discuss development of some of these novel devices

12:00 : Invited talk
Tailoring Phase Change Materials for Nanophotonic Applications
Matthias Wuttig
RWTH Aachen University (Germany)

Here, we identify systematic stoichiometry trends for these processes in phase change materials, i.e. along the GeTe-GeSe, GeTe-SnTe, and GeTe-Sb2Te3 pseudo-binary lines employing a pump-probe laser setup and calorimetry. We discover a clear stoichiometry dependence of optical properties and crystallization speed along a line connecting regions characterized by two fundamental bonding types, metallic and covalent bonding. Increasing covalency slows down crystallization by six orders of magnitude and promotes vitrification.

10:20 - 12:40 — Room 2

Session 2A3

Symposium II: New trends in nanophotonics and advanced materials

Organized by: Junsuk Rho, Hakjoo Lee and Namkyoo Park

Chaired by: Junsuk Rho, Hakjoo Lee and Namkyoo Park

10:20 : Invited talk
Plasmonic Molecule Manipulation at Room Temperature in Solution
Nobuyuki Oyamada, Hiro Minamimoto, Kei Murakoshi
Hokkaido University (Japan)

In situ electrochemical surface-enhanced Raman scattering measurements proved that the plasmonic structure realized selective molecular optical condensation leading to the formation of unique mixed molecular phases that were distinct from those under thermodynamic equilibrium in nano scale.

10:40 : Invited talk
Flat Bands: Finetuning, Anti-PT, Wannier-Stark, Disorder
Sergej Flach
IBS (Korea)

Certain lattice wave systems in translationally invariant settings have one or more spectral bands that are strictly flat or independent of momentum in the tight binding approximation, arising from either internal symmetries or fine-tuned coupling. These flat bands display remarkable strongly interacting phases of matter. I will discuss recent advance in the finetuning properties of flat band models including All- Bands-Flat ones, weak disorder, Anti-PT flatbands and on Wannier-Stark flatbands.

11:00 : Invited talk
Geometric Phase Dislocations in One-Dimensional Lattices
Tileubek Uakhitov, Abdybek Urmanov, Serik E. Kumekov, Anton Desyatnikov
Nazarbayev University (Kazakhstan)

We demonstrate Zak phase carrying quantized screw-type dislocations winding around degeneracies in parameter space of trimer lattices. Closed adiabatic path in parameter space is characterized by a Chern number equal the negative total winding number of Zak phase dislocations enclosed by the loop.

11:20 : Invited talk
Indoor 3D human surface shapes capture from Wi-Fi signal using 1-bit metasurface
Hanting Zhao, Zhuo Wang, Hongrui Zhang, Menglin Wei, Siyuan Jiang, Lianlin Li
Peking University (China)

This paper introduced a Wi-Fi band metasurface-based perception system that can capture the human pose and position as a 3D mesh format in an indoor scene with rooms partitioned by a 30 cm concrete wall. The system can detect the position and the identification of the Wi-Fi signal transmitter automatically and retrieve the human outline information from two coherent receivers of the system without disturbing the communication functioning of the commercial wi-fi router.

11:40 : Invited talk
Unusual Chemical Reactions Induced by Plasmonic Hot Carriers of Metallic Nanoparticles
Zee Hwan Kim
Seoul National University (Korea)

The plasmon-induced hot carriers, the high-energy electrons and holes of metallic nanoparticles created by the non-radiative decay of plasmon oscillation, is known to induce highly exotic chemical reactions that no other heterogeneous (photo) catalysts can do. However, the underlying reaction mechanism is largely unverified thus far. In this talk, I will present my research group's recent endeavor to uncover the hot carrier and energy transfer mechanisms of hot-electron induced chemical reactions.

12:00 : Invited talk
Metasurfaces with Maxwell's demon-like nonreciprocity
Kin Hung Fung

The Hong Kong Polytechnic University (China)

We show that Maxwell's demon-like nonreciprocity can be supported in a class of non-Hermitian gyrotropic metasurfaces in the linear regime. The proposed metasurface functions like a transmission-only Maxwell's demon operating at a pair of photon energies. Based on the multiple scattering theory, we construct a dual-dipole model to explain the underlying mechanism that leads to the anti-symmetric nonreciprocal transmission. The metasurface's effective medium parameters are also obtained.

12:20 : Invited talk

Femtosecond magnetism in all-dielectric structures for logic operations *online*

A. A. Kolosvetov, M. A. Kozhaev, I. V. Savochkin, V. I. Belotelov, Alexander Chernov
Russian Quantum Center (Russia)

Light manipulation in magnetic nanostructured materials attracts much attention in the context of data processing, spintronic and light modulation applications. In this work we demonstrate that light localization within the magnetic dielectric (bismuth-substituted iron garnet) leads not only to light intensity modulation and an efficient magnon excitation, but also can be utilized for the optical spin-wave logic operation. We perform the experimental coherent optical excitation of interfering magnetostatic spin waves and demonstrate the possibility for the magnon logical gates construction.

10:20 - 12:30 — Room 3

Session 2A4

Symposium I: Hybrid Nanomaterials and Metastructures for Photonics, Sensing and Energy

Organized by: Jerome Plain, Alexander Govorov, Davy Gerard and Pedro Hernandez Martinez

Chaired by: Jerome Plain, Alexander Govorov, Davy Gerard and Pedro Hernandez Martinez

10:20 : Invited talk

Plasmonic Gold Trimers and Dimers with Air-Filled Nanogaps

Svetlana Neretina, Zachary Lawson, Walker Tuff
University of Notre Dame (USA)

We demonstrate a fabrication process of substrate-based aligned gold trimers with sub-5 nm air-filled vertical nanogaps. The devised procedure uses a sacrificial oxide layer to define the nanogap, a glancing angle deposition to impose a directionality on trimer formation, and a sacrificial antimony layer whose sublimation regulates the gold assembly process. The work advances the possibility of developing a low-cost, high-throughput, and scalable nanomanufacturing platform for nanogap fabrication.

10:40 : Invited talk

Anisotropic multicomponent quantum nanoheterostructures

Xue Bai, Finn Purcell-Milton, Yurii Gun'ko
Trinity College Dublin (Ireland)

Copper based ternary and quaternary quantum nanostructures have attracted huge attention over recent years due to their potential applications in photonics, photovoltaics, imaging, sensing and other areas. However, anisotropic nanoheterostructures of this type are still poorly explored to date, despite numerous predictions of the distinctive optical properties of these fluorescent nanostructures. Here, we present a range of new fluorescent multicomponent Cu-In-(Zn)-S/ZnS (CIZS/ZnS/ZnS) nanoheterostructures with unique anisotropic morphologies (e.g. tetrahedrons, nanonails and ïce-cream cone"like") and interesting photonic properties.

11:00 : Invited talk

Metamaterial Absorber-enhanced Light-harvesting and Optofluidics

Peng Yu
Chengdu University (China)

In this talk, we will present an overview of metamaterial absorber-enhanced light-harvestings and their use in the light-energy conversion devices, such as hot electron generation for photochemistry and photothermal effects for optofluidics.

11:20 : Invited talk

Chiro-Optical Microscopic Imaging of Nano- and Micro-Sized Materials and Analyses of Chiro-Optical Functions *online*

Hiromi Okamoto
National Institutes of Natural Sciences (Japan)

Chiro-optical microscopic imaging methods (near-field polarimetry microscopy, far-field high-precision circular dichroism microscopy, etc.) were developed and applied to several nano- and micro-scale materials, including chiral and achiral plasmonic materials, chiral assemblies of achiral plasmonic particles, chiral microcrystals, etc. Unique chiral properties of the materials were revealed for plasmonic materials. The far-field CD microscopy was found to be a powerful tool to identify chirality of microcrystalline materials.

11:40 : Invited talk

Nanophotonic chiral sensing: How does it actually work? *online*

Steffen Both[1], Egor Muljarov[2], Thomas Weiss[3]
[1]*University of Stuttgart (Germany),* [2]*Cardiff University (United Kingdom),* [3]*University of Graz (Austria)*

We present a general and rigorous theory of chiral light-matter interactions in arbitrary optical resonators. Our theory describes the chiral interaction as a perturbation of the resonant states, also known as quasi-normal modes. We observe two dominant contributions: A chirality-induced resonance shift and changes in the modes' excitation and emission efficiencies. Our theory brings new and deep insights for tailoring and enhancing the chiral light-matter interactions. Furthermore, it allows to predict spectra much more efficiently in comparison to conventional approaches.

12:00 : Keynote talk

Hybrid quantum dot/plasmonic systems

Stephen Gray
Argonne National Laboratory (USA)

Several aspects of the spectroscopy and dynamics of quantum dot/plasmonic nanoparticle systems are outlined, including joint experimental and theoretical work on photoluminescence from a hybrid system of CdSe/ZnS quantum dots layered on an array of silver nanoparticles. The array of nanoparticles exhibits a surface lattice resonance and with appropriate design this resonance can be strongly coupled to the quantum dot exciton. It is also shown how the photoluminescence can be observed at surprisingly long distances away from the excitation source.

10:20 - 12:40 — Room 4

Session 2A5

Symposium IV: Chirality, magnetism, and magnetoelectricity: Separate phenomena and joint effects in metamaterial structures

Organized by: Eugene Kamenetskii

Chaired by: Eugene Kamenetskii

10:20 : Invited talk

Nonreciprocal responses in superconductors: diode effect, Meissner effect, and nonlinear optics

Akito Daido[1], Hikaru Watanabe[2], Hiroto Tanaka[1], Yuhei Ikeda[1], Youichi Yanase[1]
[1]*Kyoto University (Japan),* [2]*RIKEN (Japan)*

We show the theoretical framework of various nonreciprocal responses in superconductors. The superconducting diode effect, nonlinear superconducting optics, and nonreciprocal Meissner effect are studied, and observation in parity-breaking superconductors is proposed.

10:40 : Invited talk
Time-resolved microscopy of plasmonic spin quasiparticles
Chen-Bin Huang
National Tsing Hua University (Taiwan)

Skyrmions and merons are stable quasiparticles of interest to fundamental physics, and with potential applications to data storage and quantum computing. Here in this talk, I will demonstrate orbital angular momenta contributed purely through the geometrical chirality leads to the generation of plasmonic spin merons. I will also address various other spin quasiparticles. The experiments are carried out through time-resolved two-photon photoemission electron microscopy.

11:00 : Invited talk
Creating and Manipulating Magnetic Skyrmions
Anjan Soumyanarayanan
National University of Singapore (Singapore)

Magnetic skyrmions present a fascinating research field witnessing rapid progress in fundamental and applied sciences1. Practical technologies require nanoscale skyrmions with ambient stability, and electrical manipulation and detection capabilities Here, we establish a material platform where skyrmion properties can be smoothly tuned by modulating parent interactions2 which induce transitions in key microscopic characteristics3,4. Next, we present a thermodynamic marker associated with skyrmion formation and stability, which evolves with temperature5,6. We conclude with efforts to electrically manipulate skyrmions in nanowire devices7,8.

11:20 : Invited talk
Hot Electrons and Photochemical effects in Chiral Plasmonic Nanostructures
Alexander Govorov[1], Lucas V. Besteiro[2], Oscar Avalos Ovando[1]
[1] *Ohio University (USA),* [2] *Universidade de Vigo (Spain)*

The generation of energetic (hot) electrons and the photo-heating effect are intrinsic properties of any optically excited plasmonic nanocrystal. High-energy hot electrons and phototemperature contribute to kinetic processes observed in plasmonic photodetectors, colloidal nanocrystals, and metastructures. This talk will focus on the theory of hot electron generation and also present related applications for plasmonic photochemistry and chiral plasmonic photocatalysis.

11:40 : Invited talk
Nonreciprocity in Spin Transport
Sadamichi Maekawa
RIKEN (China)

Here, the nonreciprocity in spin transport is discussed together with various examples. The key is that the spin current is a flow of spin angular momentum, in contrast to the electric current. A flow of electrons can have the orbital angular momentum , which is called "vorticity", and may be interconverted with spin current. However, since the vorticity of electron flow is highly nonlinear, the conservation mechanism, i.e., the spin-vorticity coupling, is also nonlinear and, in general, nonreciprocal.

12:00 : Invited talk
Superfluorescence of chiral emitter ensemble interacting with chiral environment *online*
Hajime Ishihara, Hirofumi Shiraki, Nobuhiko Yokoshi
Osaka University (Japan)

Many-body correlation among quantum emitters through radiation generates cooperative emission of light, i.e., superfluorescence that is a burst of directional and coherent light. Recently, our theory have revealed a peculiar enhancement of the correlation among remote emitters sharing the radiation modes in a geometrically specific dielectric environment. This study applies the above theory for proposing the model to demonstrate a chiral selective superfluorescence of the emitter ensemble enhanced due to the localized surface plasmon resonance in metallic structures with chirality.

12:20 : Invited talk
Magnetoelectricity of domain walls with chirality reversals *online*
A. S. Kaminskiy[1], D. P. Kulikova[1], A. I. Yadvichuk[1], R. M. Vakhitov[2], Alexander Pyatakov[1]
[1] *Moscow University (Russia),* [2] *Bashkir State University (Russia)*

The local inversion symmetry breaking in the magnetic domain wall induces the local ferroelectricity. This report illustrates how the sign of the magnetoelectric effect and the electric polarization observed at domain walls depends on their chirality.

10:20 - 12:40 — Room 5

Session 2A6

Symposium III: Advanced passive and active metasurfaces

Organized by: Howard Lee and Pin-Chieh Wu

Chaired by: Howard Lee and Pin-Chieh Wu

10:20 : Invited talk

Complete 2π tunable phase modulation using avoided crossing of resonances

Min Seok Jang

KAIST (Korea)

I present an electrically tunable metasurface design strategy that operates near the avoided crossing of two-resonances, one a spectrally-narrow, over-coupled resonance and the other with a high resonance frequency tunability.This strategy displays an unprecedented upper limit of 4π phase modulation range with insignificant variations inoptical amplitude. A proof of concept metasurface is illustrated using quasi-bound states in the continuum andgraphene plasmon resonances, with results showing a full phase modulation with a uniform reflection amplitude of 0.65.

10:40 : Invited talk

High Performance Mid-infrared Polarization-Resolved Photodetection assisted by Chiral Metasurfaces

Mingjin Dai, Chongwu Wang, Bo Qiang, Fakun Wang, Ye Ming, Song Han, Yu Luo, Qijie Wang

Nanyang Technological University (Singapore)

Polarization-resolved photodetection are highly required for many interesting photonic applications such as imaging and spectroscopy. Here we provide an anisotropic platform relying on designed chiral metasurfaces integrated with two-dimensional (2D) materials to achieve polarization resolved photodetection via photothermoelectric effects in the mid-infrared region, an important "finger-printregion for sensing and imaging applications. Our work provides an alternative strategy for developing next-generation optoelectronic devices, especially for multifunctional photodetectors with bandgap-unlimited working wavelength in the mid-infrared regime.

11:00 : Invited talk

Coupling of Dielectric Nanophotonic Mode and Surface Plasmonic Resonance for Photocatalysis

Wen-Hui Cheng

National Cheng Kung University (Taiwan)

A platform of plasmonic nanoparticles and p-type semiconductor heterojunction is introduced to harvest hot carriers for photocatalytic CO2 reduction without additional bias. Interfacial layer and co-catalysts can further enhance the conversion. The coupling between surface plasmon resonance and dielectric resonance will be discussed.

11:20 : Invited talk

Electromagnetic Multipolar Coupling in Plasmonic Metasurfaces for Flat Optics Applications

Pin-Chieh Wu

National Cheng Kung University (Taiwan)

We proposed that the introduction of toroidal-assisted response can address a state-of-the-art transmission efficiency of plasmonic metasurfaces. The advantage of Fano coupling between toroidal dipole and toroidal quadrupole enables a giant cross-polarization converter with a transmission efficiency of 22.9 % in a single-layer plasmonic metasurface comparable to the theoretical bound. While a hybrid plasmonic meta-atom can be used to realize toroidal-assisted generalized Huygens"sources for forward radiation enhancement, thus achieving a transmission efficiency beyond 50 % at the near-infrared region.

11:40 : Invited talk
Two UV plasmonic devices by high-performance epitaxial Al metasurfaces - an ultrasensitive photodetector and a surface-enhanced resonance Raman spectroscopic (SERRS) biosensor
Abhishek Dubey, Ragini Mishra, Yu-Hung Hsieh, Chang Wei Cheng, Bao-Hsien Wu, Lih-Juann Chen, Shangjr Gwo, Ta-Jen Yen
National Tsing Hua University (Taiwan)

By using epitaxial Al metasurfaces, herein we report two unprecedented plasmonic applications in UV regimes- an ultrasensitive photodetector and a surface-enhanced resonance Raman spectroscopic (SERRS) biosensor. First, we demonstrated ultrasensitive photodetector with a maximum detectivity (1.48 x 1015 cm Hz1/2 W-1) at the on-resonance wavelength of 355 nm. Second, our UV SERRS biosensor not only exhibited high signal to noise ratios, but also recorded an SERRS enhancement factor up to 106 for extremely thin layer of adenine of 1nm thick.

12:00 : Invited talk
Topological Metasurface by Encircling an Exceptional Point
Qinghua Song
Tsinghua International Graduate School (China)

Resonant scattering, guided mode propagation phase, and/or orientation-dependent phase retardations are the three main mechanisms used to date to conceive optical metasurfaces. Here, we introduce an additional degree of freedom to address optical phase engineering by exploiting the topological features of non-Hermitian matrices operating near their singular points. Choosing metasurface building blocks to encircle a singularity following an arbitrarily closed trajectory in parameter space, we engineered a topologically protected full 2π-phase on a specific reflected polarization channel.

12:20 : Invited talk
Gate-Tunable Metasurface-Enhanced Plasmonic Phototransistors *online*
Yu-Jung Lu
Academia Sinica (Taiwan)

We report a gate-tunable phototransistor with ultrahigh photoresponsivity consisting of a monolayer MoS2 photoFET integrated with a plasmonic metasurface. The results demonstrate a systematic methodology for next-generation ultra-compact optoelectronic devices in the trans-Moore era.

10:20 - 12:10 — Room 6

Session 2A7

Bio-Inspired Nanophotonics

Organized by: Debashis Chanda, Hyuck Choo and Radwanul Hasan Siddique

Chaired by: Debashis Chanda, Hyuck Choo and Radwanul Hasan Siddique

10:20 : Invited talk
Angle-Independent Plasmonic Structural Color Paint
Pablo Cencillo, Debashis Chanda
University of Central Florida (USA)

In recent years, several nanoengineered materials have been proposed as alternatives to chemical colorants. However, many suffer from severe angle and polarization-sensitivity, limited color palette, and are incompatible with industrial standards. Here, we present an approach to structural coloration that avoids these limitations by exploiting the strong hybridization of self-assembled plasmonic nanoparticles with an ultrathin cavity. Our approach offers a versatile platform for environmental-friendly, large-scale, and low-cost plasmonic paint that bridges the gap from proof-of-concept science to real-world industrial applications.

10:40 : Invited talk

Structural Color: A Revival

Joel Yang
Singapore University of Technology and Design (Singapore)

Despite its long history, we are now witnessing a revival in structural color research with numerous potential applications. Here, we provide a perspective of structural colors, highlighting some of the major achievements and new discoveries in the field.

11:00 : Invited talk

Using Optical-rotation Structural Colors for Steganography and Photorealistic Nanopainting

Maowen Song, Ting Xu
Nanjing University (China)

We experimentally demonstrate an all-aluminum metasurface that generates tunable plasmonic colors depending on the polarization states of the incident and reflected light. The metasurface produces high-resolution images and can be used to realize kaleidoscopic steganography. Besides, a TiO2 metasurface is proposed to enable full-color generation integrated with ultrasmooth color brightness variations. The reproduced famous artwork "girl with a pearl earring"features photorealistic color presentation and stereoscopic image impression, mimicking the oil painting texture.

11:20 : Structural Color from 3D Printed Single Low-Index Nanopillar

Hao Wang, Qifeng Ruan, Soroosh Daqiqeh Rezaei, Joel Yang
Singapore University of Technology and Design (Singapore)

We observe structural color from single nanopillars made of a low-refractive-index material. These nanopillars were produced using two-photon polymerization lithography. Full color and grayscale were obtained by single nanopillars with different heights and diameters. The generated hue was nearly independent of collection angle, an effect that is consistent with scattering off the nanopillar structures. In addition to full color and grayscale prints, we demonstrate steganography using individual nanopillars.

11:35 : Photonic Color Pixels on a Single Micro-Line by Programmable Topography

Yujie Ke, Qifeng Ruan, Hao Wang, Joel K. W. Yang
Singapore University of Technology and Design (Singapore)

Developing mechnochromic nano-/micro-pixels under global deformation is challenging, while can add one more freedom and enrich the data density for optical information. Herein, we report a method to achieve the color pixels in a single photonic micro-line by dynamically controlling the local surface topography through a strain redistribution principle. The method is effective and applicable to diverse switchable-optical applications.

11:50 : Invited talk

Reconfigurable structural color enabled by the multistate phase change material *online*

Omar A. M. Abdelraouf[1], Xin Cai Wang[1], Weide Wang[1], Jeff Siu Kit Ng[1], Xiao Renshaw Wang[2], Qi Jie Wang[2], Hong Liu[1]
[1]*A*STAR (Singapore)*, [2]*Nanyang Technological University (Singapore)*

Low loss phase change material of Sb2S3 has enabled achieving efficient cavity resonator in the visible spectrum. In this work, we demonstrate fast switchable structural color via a metal-dielectric-metal cavity formed in a multilayer thin-film structure. The multistate of a phase change thin film of Sb2S3 embedded in the multilayer structure can be activated by CW and pulsed laser annealing, which enables ultrafast multi-color display at different states between amorphous, intermediate, and crystalline phases.

10:20 - 12:40 — Room 7

Session 2A8

Acoustic and elastic phononic crystals, metamaterials and other structured media

Organized by: Marco Miniaci, Vicente Romero-Garcia, Vincent Pagneux, Maxime Lanoy, Jean-Philippe Groby and Noé Jiménez

Chaired by: Marco Miniaci, Vicente Romero-Garcia, Vincent Pagneux, Maxime Lanoy, Jean-Philippe Groby and Noé Jiménez

10:20 : Invited talk
Helmholtz resonator analogue for water waves
Leo-Paul Euve[1], Kim Pham[2], Philippe Petitjeans[1], Vincent Pagneux[3], Agnes Maurel[1]
[1]*Universite PSL (France),* [2]*Institut Polytechnique de Paris (France),* [3]*Universite du Mans (LAUM) (France)*

In the context of water waves, we present a theoretical and experimental study of a resonator with deep subwavelength resonance, analogue to the Helmholtz resonator in acoustics. As its acoustic analog, this resonator can be used as the building block of devices able to control the energy flow of the swell. We illustrate its capability to reduce the transmission up to almost zero at a single frequency.

10:40 : Invited talk
Acoustic drills by dynamic high-order Bessel beam mixing
Kestutis Staliunas[1], Gabrielius Kontenis[2], Noe Jimenez[3]
[1]*ICREA (Spain),* [2]*Vilnius University (Lithuania),* [3]*Universitat Politecnica de Valencia (Spain)*

We propose and experimentally demonstrate dynamical acoustic "drill" beams presenting nonstationary intensity distributions that resemble the spinning mechanical drill. The drills appear as the spatiotemporal interference of two Bessel-vortex beams of different topological charges and different carrier frequencies. By mixing a pair of high-order Bessel beams, synthesized using two concentric 3D-printed acoustic holograms, acoustic drills of tuned helicities were experimentally observed.

11:00 : Elastic structures you can talk to: Speech classification with mechanical neural networks
Tena Dubcek[1], Daniel Moreno-Garcia[2], Luis Guillermo Villanueva[2], Dirk-Jan van Manen[1], Johan Robertsson[1], Marc Serra Garcia[3]
[1]*ETH Zurich (Switzerland),* [2]*EPFL (Switzerland),* [3]*AMOLF (Netherlands)*

We report on a passive elastic metastructure that performs binary speech classification. The metastructure is a 7x7 lattice of plate resonators, fabricated using silicon micromachining technology. It can distinguish between pairs of spoken words with an (experimental) accuracy exceeding 90 %. This is possible with novel design methods combining machine learning and reduced-order modelling. We expect to initiate a new research direction in intelligent phononic metamaterials and to enable a new class of zero-power (batteryless) Internet of Things devices.

11:15 : A Graded Metamaterial for Broadband and High-capability Piezoelectric Energy Harvesting
Henrik Thomsen, Bao Zhao, Andrea Colombi
ETH Zurich (Switzerland)

We present a broadband multiresonant graded meta structure for piezoelectric energy harvesting at low-frequency vibrations $textless$100 Hz. The device combines a graded metamaterial with beam-like resonators, piezoelectric patches and a self-powered, switch-less interface circuit with rectifiers. Furthermore, we actively cancel boundary reflections occurring at the ends of the graded meta structure to better analyze the modulation of the propagating wavefield within the structure.

11:30 : Sculpting thermal and acoustic fields by 3D-printed holograms
Noe Jimenez[1], Diana Andres[1], Sergio Jimenez-Gambin[1], Antonios Pouliopoulos[2], Elisa E. Konofagou[2], Jonathan Vappou[3], Jose M. Benlloch[1], Alicia Garcia-Carrion[1], Francisco Camarena[1]
[1]*Universitat Politecnica de Valencia (Spain),* [2]*Columbia University (USA),* [3]*Universite de Strasbourg (France)*

We present the recent advances of acoustic holograms and structured media to engineer the acoustic wavefront to focus ultrasound beams for biomedical applications. We show how acoustic holograms can shape therapeutical acoustic images for the non-invasive treatment of neurological disorders, to produce cavitation patterns for localized drug delivery, and thermal patterns of arbitrary shape for targeted hyperthermia. In this way, acoustic holograms emerge as a disruptive and low-cost approach for biomedical ultrasound applications.

11:45 : Non-Abelian braiding of sound and light

Guancong Ma
Hong Kong Baptist University (China)

We report the experimental realization of non-Abelian braiding of sound and light. Here, the braiding operations are implemented using coupled waveguide arrays, which are adiabatically modulated to enforce a multi-state Berry-phase matrix that swaps modal dwell sites. Braiding of up to three acoustic modes and five photonic modes is successfully observed. The non-Abelian characteristic is observed as sequence-dependent dwell-site distribution at the output of the waveguide arrays.

12:00 : Invited talk

Tunable shape memory auxetics: from 4D printing to numerical simulations *online*

Giulia Scalet[1], Chiara Pasini[2], Nicoletta Inverardi[2], Davide Battini[2], Stefania Marconi[1], Marica Bianchi[3], Fabio Bignotti[2], Ferdinando Auricchio[1], Stefano Pandini[2]
[1]*University of Pavia (Italy),* [2]*University of Brescia (Italy),* [3]*University of Trento (Italy)*

The present work discusses our recent advances on auxetics with tunable shape reconfigurability. To this purpose, 4D printing and multiple shape memory effect are combined. A methodological approach, including a comprehensive experimental and numerical investigation, is proposed. Results are helpful in guiding towards the design of single-material auxetic structures capable of controlled and autonomous in-plane and out-of-plane motions.

12:20 : Invited talk

Employing metamaterial concepts for seismic isolation *online*

Fernando Fraternali, Ada Amendola
University of Salerno (Italy)

This work presents the design, modeling and experimental validation of novel seismic isolators, which mimic the mechanics of human locomotion. We discuss their potential for the design of next-generation, tunable seismic isolators that can be fully or partially manufactured through additive manufacturing.

10:20 - 12:20 — Room 8

Session 2A9

Symposium II: New trends in nanophotonics and advanced materials

Organized by: Junsuk Rho, Hakjoo Lee and Namkyoo Park

Chaired by: Junsuk Rho, Hakjoo Lee and Namkyoo Park

10:20 : Invited talk

Individually Addressable Spatial Light Modulator Based on Active Metasurface with High Directivity

Minkyung Lee, Junghyun Park, Byung Gil Jeong, Sun Il Kim, Hyuck Choo
Samsung Advanced Institute of Technology (Korea)

We have demonstrated a spatial light modulator (SLM) based on individually-addressable channels formed on a metasurface. It deflects light onto the intended directions by modulating refractive indices of individual channels and thereby systematically varying the phase distribution of reflected light. Using this device, we have achieved higher directivity and efficiency than previously reported solid-state SLMs. The strong performance of the technology promises to advance 3D mapping applications such as light detection and ranging (LiDAR) necessary for autonomous driving.

10:40 : Invited talk

Blue InGaN light-emitting diodes: from flexible/on-glass form factor to UHD micro-displays

Jun Hee Choi, Kiho Kong, Jinjoo Park, Eunsung Lee, Joo Hun Han, Jung Hun Park, Nakhyun Kim, Joosung Kim, Dong Chul Shin, Younghwan Park, Sunil Kim, Yongsung Kim
Samsung Advanced Institute of Technology (Korea)

We discuss GaN-based blue light emitters formed on various unconventional substrates and related transfer techniques. Next, we discuss core technologies for ultra-high density (UHD, $textgreater$ 5,000 ppi) micro-displays based on monolithic integration of LEDs, TFTs, and QDs. We anticipate these will pave the way for low-cost, large sized process for UHD micro-displays for augmented reality (AR) glasses.

11:00 : Invited talk
AI-powered metasurface hyperspectral imaging system for food inspection

Suyeon Lee[1], Yeon-Geun Roh[1], Hyochul Kim[1], Hojung Kim[1], Yeonsang Park[2], Unjeong Kim[1]
[1] *Samsung Advanced Institute of Technology (Korea),* [2] *Chungnam National University (Korea)*

Hyperspectral imaging surpasses human vision and provides detailed information such as material composition or biochemical conditions of the test object, especially when empowered by artificial intelligence (AI). We have implemented a compact, AI-powered, camera-type 16-channel hyperspectral imaging system (HIS) which has periodically repeating arrays of 16 different metasurface spectral filters directly fabricated on top of its 5M-pixel CMOS-image sensor. With this AI-powered meta-HIS, we have continuously monitored and successfully classified the edibility of the red meat over 20 days.

11:20 : Invited talk
Full-Colour Wavefront Engineering Using Vertically Stacked, Dispersion-Contrasting Nano-Hole / Nano-Post Metasurfaces

Hyun Sung Park, Hyeonsoo Park, Hae-Sung Kim, Jeong Yub Lee, Eun-Hyoung Cho, Ki-Deok Bae, Woong Ko, Hyuk Choo, Seunghoon Han
Samsung Advanced Institute of Technology (Korea)

We have experimentally demonstrated a polarization-independent, high-quality metalens over theentire visible range by vertically stacking two metasurface layers. The two layers are engineered to exhibitdispersive responses that are distinct from each other, and this leads to the metalens with a broadband,nondispersive phase-modulation capability. The average wavefront error and the focusing efficiency of themetalens over the wavelength range from 400 nm to 700 nm were measured to be 0.04λ and 83 %, respectively.

11:40 : Invited talk
IC-Process-Compatible Single-Layer Broadband Optical Metalens Comprising 15:1 High Aspect-Ratio Metastructures

Hyeonsoo Park, Hyun Sung Park, Se-Um Kim, Hyuck Choo, Seunghoon Han
Samsung Electronics (Korea)

We have demonstrated a broadband optical metalens of near-ideal diffractive performance using IC-compatible processes. To achieve full modulation of the phase and balanced dispersion, we first optimized the high-aspect-ratio, pitch, and diameter of the metastructures. Then, the metalens was fabricated on a silicon wafer using ArF-immersion photolithography and transferred onto a fused-silica wafer for testing. The broadband diffraction efficiency over the wavelength range of 400-700 nm was measured 87.4 %, bringing it closer to realizing commercial-grade metalens-enabled devices.

12:00 : Invited talk
Electrical control of second harmonic generation using intersubband polaritonic metasurfaces

Jaeyeon Yu[1], Seongjin Park[1], Inyong Hwang[1], Gerhard Boehm[2], Mikhail Belkin[2], Jongwon Lee[1]
[1] *Ulsan National Institute of Science and Technology (Korea),* [2] *Technical University of Munich (Germany)*

We report nonlinear intersubband polaritonic metasurfaces capable of electrical control of the local intensity and phase of second-harmonic-generation (SHG). Experimentally, we achieved over 2900 % of SHG intensity modulation depth and beam-steering from electrically induced phase gradient metasurfaces.

Lunch

12:30 - 14:00

14:00 - 15:00 — Room 1

Session 2A10

Conference Tutorials I

14:00 : Tutorial
Tutorial of Mark Brongersma
Mark Brongersma
Stanford University (USA)
Tutorial of Mark Brongersma

15:00 - 16:10 — Room 1

Session 2A11

Symposium II: New trends in nanophotonics and advanced materials

Organized by: Junsuk Rho, Hakjoo Lee and Namkyoo Park

Chaired by: Junsuk Rho, Hakjoo Lee and Namkyoo Park

15:00 : Keynote talk
Hybrid Quantum Photonics
Vladimir Shalaev
Purdue University (USA)
We show that plasmonic enhancement and speedup opens up a means to outpace quantum decoherence1,2 and discuss new opportunities for SiN quantum photonic circuitry enabled by recently discovered single-photon sources3 in this technologically important platform.

15:30 : Invited talk
Confined graphene plasmons for few-electron strongly-coupled systems
Alessandro Tredicucci
Università di Pisa (Italy)
Lateral confinement of the two-dimensional plasmons deeply affects the graphene dielectric function in the mid-to-far-infrared region of the electromagnetic spectrum. Beyond causing appreciable effects in the optical response of polycrystalline samples, which can be controlled by the application of strain, confined 2D plasmons can offer a viable approach to the development of deeply subwavelength cavities, where strong light-matter interaction can be established with intersubband transitions in a semiconductor heterostructure in the few-electron regime.

15:50 : Invited talk
Complete Dynamic Extensions to Maxwell Garnett's Mixing Formula and the Origin of Dependent Scattering in Nanofluids
Augusto Garcia-Valenzuela[1], A. Acevedo-Barrera[1], O. Vazquez-Estrada[2], A. Nahmad-Rohen[1], R. G. Barrera[1]
[1]*Universidad Nacional Autonoma de Mexico (Mexico)*, [2]*Tecnologico Nacional de Mexico / ITS de Tantoyuca (Mexico)*
We derive an analytic approximation to the effective refractive index of nanofluids based on the quasi-crystalline approximation and considering the dynamic dipolar response of the particles at the frequency of light. The new mixing formula embodies the well-known Maxwell Garnett formula but includes all the appropriate dynamic corrections to fully include scattering losses. We present numerical evaluations of the new formula illustrating "dependent-scattering.^{ef}fects, compare with experimental data available in the literature and discuss the physical origin of these effects.

14:00 - 16:00 — Room 2

Session 2A12

Symposium IV: Chirality, magnetism, and magnetoelectricity: Separate phenomena and joint effects in metamaterial structures

Organized by: Eugene Kamenetskii

Chaired by: Eugene Kamenetskii

14:00 : Invited talk

Magnetic spiral phases as skyrmion tracks, spin pumps, and helitronics

Jan Masell

Karlsruhe Institute of Technology (Germany)

Compared to other magnetic phases, magnetic spirals are widely underrepresented as they are often regarded useless for spintronics applications. I briefly review some of our recent progress in "helitronics", i.e., spintronics with helical or spiral magnetic phases. We explored magnetic spirals as natural lanes for guiding skyrmions, studied the multifaceted effects of electric currents on magnetic spirals, and analyzed the spin and electron pumping properties of rotating spin spirals.

14:20 : Invited talk

Kinetic magnetoelectric effect in chiral topological insulators

Ken Osumi, Tiantian Zhang, Shuichi Murakami

Tokyo Institute of Technology (Japan)

In metals without inversion symmetry, a current can induce magnetization, and it is called kinetic magnetoelectric effect or Edelstein effect. We theoretically propose a gigantic kinetic magnetoelectric effect in chiral topological insulators. We interpret our results in terms of topological surface currents. In chiral topological insulators without inversion symmetry, the current flows in a chiral manner along the surface, inducing orbital magnetization. We demonstrate the presence of said effect in a topological insulator, identifying Cu2ZnSnSe4 as a potential candidate.

14:40 : Invited talk

The total helicity of electromagnetic fields and matter

Ivan Fernandez-Corbaton

Karslruhe Institute of Technology (Germany)

The electromagnetic helicity of the free electromagnetic field and the static magnetic helicity are shown to be two different embodiments of the same physical quantity. The total helicity is the sum of two terms: A term proportional to the difference between the number of left-handed and right-handed photons of the free field, and another term that measures the screwiness of the static magnetization density in matter. This unification enables studying the conversion between the two embodiments upon light-matter interaction.

15:00 : Invited talk

Mutual and symmetry-breaking magnetostatic interactions in hybrid, skyrmionics nanostructures

Mateusz Zelent[1], Mathieu Moalic[1], Michal Mruczkiewicz[2], Xiaoguang Li[3], Yan Zhou[4], Maciej Krawczyk[1]

[1] *Adam Mickiewicz University (Poland),* [2] *Slovak Academy of Science (Slovakia),* [3] *Shenzhen Technology University (China),* [4] *The Chinese University of Hong Kong (China)*

We show that egg-shaped like deformed Neel skyrmions can be stabilized by magnetostatic interaction in a hybrid structure composed of a multilayered nanodot hosting a skyrmion and the in-plane magnetized thin stripe made of soft ferromagnetic material. Using micromagnetic simulations we described the skyrmion's symmetry-breaking mutual magnetostatic interactions in this system and unusual skyrmion properties. At the end, we presented a proof-of-concept technique for unconstrained transport of skyrmion along a racetrack composed of hybrid systems.

15:20 : Invited talk

Electric control of magnon phase and magnonic Aharonov-Casher effect

Oleksandr (Alexander) Serha (Serga), Rostyslav Serha, Vitaliy Vasyuchka, Burkard Hillebrands

Technische Universitat Kaiserslautern (Germany)

The study of the possibilities of controlling the characteristics of magnon transport using an electricfield is an exciting and essential direction of modern magnetic science. Previously, such control was carried outusing the influence of the electric field on the medium's magnetization. Here, we report the first experimentalobservation of the magnon Aharonov-Casher effect, which consists of the geometrical accumulation of the phaseof the magnons as they pass through an electric field region.

15:40 : Invited talk
Chirality-driven electronic topology and its interaction with spin and light in DNA-like chiral materials
Binghai Yan
Weizmann Institute of Science (Israel)

I will talk about our recent theoretical and experimental studies on the chirality-driven topological properties of DNA-like chiral materials. The electronic topology is encoded in the orbital nature of the wave function. It leads to intriguing magneto-transport effects and exotic light-matter interaction. Our work reveals that chiral materials, topological electrons, and circularly polarized light exhibit intimate connections at the quantum level.

14:00 - 15:50 — Room 3

Session 2A13

Challenges of Phase Change Materials and Plasmonics for Nanophotonics

Organized by: Maria Losurdo, Yael Gutiérrez, Kurt Hingerl, Christoph Cobet, Mircea Modreanu and Fernando Moreno

Chaired by: Maria Losurdo, Yael Gutiérrez, Kurt Hingerl, Christoph Cobet, Mircea Modreanu and Fernando Moreno

14:00 : Invited talk
Advances in materials and applications for volatile and non-volatile switching in metasurfaces and silicon photonic integrated circuits
Otto Muskens
University of Southampton (United Kingdom)

Advanced materials that can provide volatile or non-volatile switching capabilities are of extreme interest for many applications requiring active control of absorption, emission and flow of light. I will provide an overview of our recent efforts in developing new materials and integration into functional devices, including the newly emerging low-loss phase change material Sb2Se3, infrared metasurfaces using local plasma patterning of Al:ZnO, and atomic layer deposition of W-doped VO2 for non-volatile switching and thermal regulation.

14:20 : Design and modelling of a Reconfigurable core/shell Nanoantenna made of High Refractive Index/Phase Change Material
Gonzalo Santos Perodia[1], Yael Gutierrez Vela[2], Maria Losurdo[2], Fernando Moreno Gracia[1]
[1] *Universidad de Cantabria (Spain),* [2] *Università degli Studi di Bari (Italy)*

High Refractive Index (HRI) dielectric nanoparticles (NPs) can be considered as nanoantennas whose radiation directionality can be controlled depending on the incident wavelength, the surrounding medium, and the NP geometry. Here, a NP with a core-shell configuration is analysed. The core is made of an HRI material and the shell of different phase change materials (PCMs), such GaS and Sb2S3. We show how the scattered light direction can be controlled depending on the PCM phase (amorphous/crystalline).

14:35 : Phase Change Memory Cells with Multiple States: Results, Challenges and Perspectives
Aurelian Catalin Galca, Florinel Sava, Alin Velea
National Institute of Materials Physics (Romania)

Phase change nonvolatile memories rely on the ultrafast and reversible transitions between amorphous and crystalline phases. The increase in the storage capacity can be achieved by reducing the size or by storing multiple states in a recording cell. Multiple logical states can be achieved by stacking different films of chalcogenide materials or by controlling the crystalline to amorphous ratio in a single chalcogenide cell, several results as well as methods to mitigate the identified issues being presented in this work.

14:50 : Interplay between Structure, Dielectric Function and Amorphous-to-Crystalline Phase Change in Sb2S3

Yael Gutierrez[1], Stefano Dicorato[1], Saul A. Rosales[2], Dilson Juan[2], Maria Michelaria Giangregorio[1], Marin Georghe[3], Cornel Cobianu[3], Mircea Modreanu[4], Fernando Moreno[2], Maria Losurdo[1]
[1] *Università degli Studi di Bari (Italy),* [2] *Universidad de Cantabria (Spain),* [3] *NANOM MEMS srl (Romania),* [4] *University College Cork (Ireland)*

Antimony trisulfide, Sb2S3, has been recently proposed as low-loss phase-change material due to its wide band gap value and high refractive index contrast. Nevertheless, optical properties of this material in its amorphous, crystalline, and crystallized phases are still widely scattered. In this work we analyze the interplay between the structure and the dielectric function of this material in its crystalline and amorphous phases as well as its dependence on the crystallization process and its stability when exposed to ambient conditions.

15:05 : Laser Heating, Melting and Quenching

Josef Resl, C. Cobet
Johannes Kepler University Linz (Austria)

Phase transformations in chalcogenide phase change materials depend strongly on the right.ªmountand the dynamics of heating and cooling. This talk will touch on the fundamental principles of (laser) heating,melting, heat conduction and cooling and discuss the underlying macroscopic radiation absorption and heatequations.

15:20 : Chalcogenide phase-change meta-grating for polarization insensitive and large angle beam switching

Arash Nemati, Guanghui Yuan, Jie Deng, Aihong Huang, Weide Wang, Yeow Teck Toh, Jinghua Teng, Qian Wang
*A*STAR (Singapore)*

Controllable beam splitting and switching provide basic beam tuning functionalities in many applications, such as communications, LiDAR, remote sensing, imaging processing. Here, we present a controllable near-infrared beam splitting and switching device based on chalcogenide phase-change metasurface operating in the telecommunication wavelength region. It exhibits polarization-insensitive and large-angle beam switching with a high modulation depth operating in transmission mode.

15:35 : MoO2/MoO3 as Reconfigurable Materia

Maria Losurdo[1], Gonzalo Santos[2], Yael Gutierrez[1], Mircea Modreanu[3], Fernando Moreno[2]
[1] *Università degli Studi di Bari (Italy),* [2] *Universidad de Cantabria (Spain),* [3] *University College Cork (Ireland)*

Significant effort is being invested in developing alternative materials whose optical properties can be reversibly modified. Here, we demonstrate the reversible non-volatile MoO3 to MoO2 çhemical"transition reporting a change from a metallic to a dielectric behavior in the dielectric function through cycles of annealing in different atmospheres. Applicability of the reversible cycling to reconfigurable color pixel displays is shown.

14:00 - 16:10 — Room 4

Session 2A14

Symposium I: Hybrid Nanomaterials and Metastructures for Photonics, Sensing and Energy

Organized by: Jerome Plain, Alexander Govorov, Davy Gerard and Pedro Hernandez Martinez

Chaired by: Jerome Plain, Alexander Govorov, Davy Gerard and Pedro Hernandez Martinez

14:00 : Invited talk
Engineered Near- and Far-Field Optical Response of Dielectric Nanostructures using Focused Cylin-

drical Vector Beams

Martin Montagnac[1], Gonzague Agez[1], Sebastien Weber[1], Aurelien Cuche[1], Arnaud Arbouet[1], Yoann Brule[2], Gerard Colas des Francs[2], Peter Wiecha[1], Guilhem Larrieu[1], Bruno Masenelli[3], Vincent Larrey[4], Vincent Paillard[1]

[1]*Universite de Toulouse (France),* [2]*Universite de Bourgogne-Franche Comte (France),* [3]*Universite de Lyon (France),* [4]*Universite Grenoble-Alpes (France)*

We investigate by numerical simulations (FDTD) the optical properties of silicon nanoantennas excited by focused cylindrical vector beams. We present preliminary experimental results of photoluminescence mappings of rare-earth-doped thin films coupled to silicon nanorings obtained by raster scanning of focused cylindrical vector beams. We also show specific geometries for controlled Purcell effect obtained by evolutionary algorithms coupled to Green Dyadic Method simulations of the LDOS.

14:20 : Electrically Switchable, Polarization-Sensitive Encryption Based on Aluminum Nanoaperture Arrays Integrated with Polymer-Dispersed Liquid Crystals

Ke Li[1], Jiawei Wang[1], Wenfeng Cai[1], Huilin He[1], Mengjia Cen[1], Jianxun Liu[1], Dan Luo[1], Quanquan Mu[2], Davy Gerard[3], Yan Jun Liu[1]

[1]*Southern University of Science and Technology (China),* [2]*Chinese Academy of Sciences (China),* [3]*Universite de Technologie de Troyes (France)*

Metasurface-based structural coloration is a promising enabling technology for advanced optical encryption with a high-security level. Herein, we propose a paradigm of electrically switchable, polarization-sensitive optical encryption based on designed metasurfaces integrated with polymer-dispersed liquid crystals (PDLCs). The proposed technique can be applied to many fields including high-security optical encryption, security tags, anti-counterfeiting, multichannel imaging, and dynamic displays.

14:35 : Invited talk

Multimodal Plasmonic Hybrids: Efficient and Selective Photocatalysts

Miguel Comesana-Hermo

Universite Paris Cite (France)

Plasmonic nanoparticles can be used as photosensitizers in order to expand the photocatalytic activityof large bandgap semiconductors into a broader electromagnetic spectrum. Nevertheless, the elucidation of themechanisms behind such interaction is complex, given the possible coexistence of multiple photoactivationchannels (generation of hot charge carriers, enhancement of the local electromagnetic field and photothermalgeneration of heat). In this presentation we will discuss the fundamental aspects involved in plasmonicphotosensitization

14:55 : Invited talk

Simulation-based Comparison of the Performance of Various Phase-Change Materials on a SiN-based Photonic Platform

Clement Zrounba[1], Fouad Bentata[1], Raphael Cardoso[1], Alberto Bosio[1], Sebastien Le Beux[1], Patrice Genevet[2], Stephane Monfray[3], Lotfi Berguiga[1], X. Letartre[1], Ian O'Connor[1], Sebastien Cueff[1], Fabio Pavanello[1]

[1]*Universite Claude Bernard Lyon 1 (France),* [2]*Universite Côte d'Azur (France),* [3]*STMicroelectronics (France)*

We present a simulation-based performance assessment of various phase-change materials (PCMs) in the context of photonic integrated circuits. We study a device consisting of a thin rectangular patch of PCM deposited on a silicon nitride waveguide. This device is programmed using guided optical pulses to alter its optical transmission by partially changing the phase of the PCM. Using two application-aware figures of merit, we evaluate the programming efficiency for each PCM considered.

15:15 : Invited talk

Nano-optics of 2D materials and van der Waals heterosturctures using free electron spectroscopies

Luiz Tizei

Universite Paris-Saclay (France)

Electron spectroscopies have emerged as extremely useful tools for nanomaterials characterization. However, until recently, the limited spectral resolution available prevented wide-spread applications in the optical energy range. In this contribution, we will discuss how this techniques can be used to understand the physics of 2D materials and their heterostructures. More importantly, a new technique based on the temporal coincidence of absorption and emission events will be described, that allows one to map the relative quantum efficiency of different excitation pathways.

15:35 : Invited talk

Thermoplasmonic approach for preparing metal-semiconductor nanocomposites

Laurent Noel[1], Ching-Fu Lin[2], Amine Khitous[1], Celine Molinaro[1], Hsiao-Wen Zan[2], Olivier Soppera[1]
[1] *Universite de Haute-Alsace (France),* [2] *National Yang Ming Chiao Tung University (Taiwan)*

The plasmonic effect can be used to trigger chemical reactions. In specific conditions, thermoplasmonic effect can obtained resulting in a local heating of the material, sometimes very high for certain wavelengths of the excitation source corresponding to the resonance conditions of the material. Metal-semiconductor (ZnO, TiO2, IZO) nanocomposite structures were prepared by thermoplasmonic effect to prepare photodetector for visible to near-infrared range.

15:55 : Synthesis of Au-Ag nano-hybrids to investigate heat transfer

Clement Vecco-Garda[1], Clement Panais[2], Noelle Lascoux[2], Natalia Del Fatti[2], Fabien Vialla[2], Aurelien Crut[2], Stephane Mornet[1], Mona Treguer-Delapierre[1]
[1] *Institut de Chimie de la Matiere Condensee de Bordeaux (France),* [2] *Institut Lumiere Matiere (France)*

The modalities of energy transfer at the nanoscale strongly differ from those at the macroscopic scales because of the increased role played by interfaces. With the development of nanotechnology, understanding these mechanisms is crucial for fundamental and technological advances in many fields such as electronics or sensing. We'll show how with self-assembly approaches, we can construct hybrid nano-systems with well-defined geometry and stability to investigate the modalities of heat transfer in the time domain phonon transport at single particle level.

14:00 - 16:00 — Room 5

Session 2A15

Symposium III: Advanced passive and active metasurfaces

Organized by: Howard Lee and Pin-Chieh Wu

Chaired by: Howard Lee and Pin-Chieh Wu

14:00 : Invited talk

Quantum Metasurfaces with Deterministically Integrated Single Photon Emitters

Samuel Peana, Omer Yesilyurt, Mira Marinova, Alexander Senichev, Zachariah Martin, Vahagn Mkhitaryan, Alexandra Boltasseva, Alexander Kildishev, Vladimir Shalaev
Purdue University (USA)

We have recently discovered a novel deterministic high yield ($textgreater 50\,\%$) scalable process for creating single photon emitters (SPEs) in silicon nitride (SiN) nanopillars. Such scalable high yield and deterministic precision placement of SPEs promises to unlock large scale integration of SiN SPEs into carefully engineered nanostructured SiN dielectric quantum metasurfaces. Such SPE integrated quantum metasurfaces promise to enable a variety of previously impossible exciting quantum devices and physics.

14:20 : Invited talk

Radial bound states in the continuum for polarization-invariant nanophotonics

Lucca Kuhner[1], Luca Sortino[1], Rodrigo Berte[1], Juan Wang[1], Haoran Ren[1], Stefan Maier[1], Yuri Kivshar[2], Andreas Tittl[1]
[1] *Ludwig-Maximilians-Universitat Munchen (Germany),* [2] *Australian National University (Australia)*

We demonstrate radial bound states in the continuum as a new concept for realizing resonances with high Q factors, strong near-field enhancements, and polarization invariance in a compact footprint, and utilize them for applications in biomolecular sensing and higher harmonic generation from 2D materials.

14:40 : Invited talk

Multiscale Optimization of Metaoptic Hybrid Lenses

Philip Hon[1], Stephane Larouche[1], Katherine Fountaine[1], Sze Wah Lee[1], Shu-I Wang[2], Edgar Bustamante[3], Ihab El-Kady[4], Ekaterina Poutrina[4], Augustine Urbas[5]
[1]*Northrop Grumman Corporation- Space Systems (USA),* [2]*Northrop Grumman Corporation- Mission Systems (USA),* [3]*Sandia National Laboratories (USA),* [4]*UES, Inc. (USA),* [5]*Air Force Research Lab (USA)*

Combining planar optics such as metalenses or metacorrectors with conventional lenses can improve the optical performance of imaging systems with additional benefits to cost, size and weight. Incorporating metacorrectors with conventional lens elements requires multiscale simulations to account for the different length scale features and interactions. Namely, full wave scattering and geometric optics (GO) analysis is needed. Multiscale inverse optimization using Sandia National Laboratories' MIRaGE along with different wave propagation and commercial-off-the-shelf GO tools are considered to accurately predict performance.

15:00 : Invited talk
Nonlinear wave mixing by monolayer transition metal dichalcogenides
Francesco Tonelli[1], Alessandro Ciattoni[1], Andrea Marini[2]
[1]*CNR-SPIN (Italy),* [2]*University of L'Aquila (Italy)*

We theoretically model the second- and third-order nonlinear response of monolayer transition metal dichalcogenides, demonstrating their potential for phase-matching free harmonic generation and difference frequency generation thanks to their atomic-layer thickness implying a surface-like nonlinear interaction.

15:20 : Invited talk
Metasurfaces meet optical fibers: a novel platform for flexible optical trapping and boosting in-coupling efficiencies
Markus Schmidt[1], Schneidewind Henrik[1], Uwe Huebner[1], Matthias Zeisberger[1], Malte Plidschun[1], Jisoo Kim[1], Oleh Yermakov[2], Yuri Kivshar[3], Andrey Bogdanov[4], Haoran Ren[5], Stefan A. Maier[6]
[1]*Leibniz Institute of Photonic Technology (Germany),* [2]*V. N. Karazin Kharkiv National University (Ukraine),* [3]*Australian National University (Australia),* [4]*ITMO University (Russia),* [5]*Macquarie University (Australia),* [6]*Ludwig-Maximilian University of Munich (Germany)*

In this talk, we show that the combination of optical fibers with nanostructures defines a new class of fiber integrated devices - nanostructured fibers - which opens up new application areas for optical fiber research. Using 3D nanoprinting and modified electron beam lithography, we integrate high-NA meta-lenses and dielectric ring gratings onto the end faces of single-mode fibers. These devices enable efficient light coupling at angles up to 80° and trapping of Escherichia coli with an individual single-mode fiber device.

15:40 : Invited talk
Ultrasensitive Thin Film Circular Dichroism Detection using Metasurface-assisted Cavity Ring-Down Spectroscop
A. K. Singh, Z.-H. Lin, M. Jiang, Jershing Huang
Leibniz IPHT (Germany)

We propose a new chiroptical detection scheme that combines dielectric metasurface and evanescent wave cavity-ring down spectroscopy (EW-CRDS) to enable CD detection of chiral thin films and chiral samples at ultralow concentration.

14:00 - 15:55 — Room 6

Session 2A16

Local enhancement and control of light-matter interaction

Organized by: Antonio Ambrosio

Chaired by: Stefano Chiodini

14:00 : Invited talk
Metal-Hydrogel-Metal Cavity for Dynamic Emission Control
Dipa Ghindani, Ibrahim Issah, Semyon Chervinskii, Markus Lahikainen, Kim Kuntze, Arri Priimagi, Hu-

meyra Caglayan
Tampere University (Finland)

Actively controllable photoluminescence is potent for a variety of applications from biosensing and imaging to optoelectronic components. Traditionally, methods to achieve active emission control are limited due to complex fabrication or irreversible tuning. Here, we demonstrate active emission tuning, achieved by changing the ambient humidity in a fluorescent dye-containing metal-hydrogel-metal integrated system. Altering the overlapping region of the MIM cavity resonance and the absorption and emission spectra of the dye used is underlying principle to achieve tunability of the emission.

14:20 : Invited talk
Epsilon-Near-Zero Optics in Planar and Optical Fiber Platforms
Sudip Gurung, Aleksei Anopchenko, Christopher M. Gonzalez, David Dang, Leon Zhang, Kent Nguyen, Alexander Galkin, Tingwei Liu, Meena Salib, Howard Lee
University of California (USA)

Epsilon-near-zero materials have been shown to be as one of the most promising optical materials in the recent years as the electromagnetic field inside media with near-zero permittivity has been shown to exhibit unique optical properties. I will review our recent studies on the active linear, nonlinear, and emission properties of conducting oxide and metallic nitride epsilon-near-zero materials.

14:40 : Invited talk
On-Chip Circularly Polarized Single-Photon Sources with Quantum Metasurfaces
Fei Ding
University of Southern Denmark (Denmark)

We have demonstrated a conceptually new approach of quantum metasurfaces to the room-temperature generation of circularly polarized single photons entailing quantum emitters non-radiative coupling to surface plasmons that are transformed, by interacting with an optical metasurface, into a collimated stream of single photons with the designed spin and orbital angular momentum.

15:00 : Invited talk
Ultrafast All-optical Reconfiguration of Plasmonic Metasurfaces
Andrea Schirato[1], Margherita Maiuri[1], Remo Proietti Zaccaria[2], Alessandro Alabastri[3], Giulio Cerullo[1], Giuseppe Della Valle[1]
[1]Politecnico di Milano (Italy), [2]Istituto Italiano di Tecnologia (Italy), [3]Rice University (USA)

Light-matter interaction enhanced by resonant plasmonic effects in gold metaatoms is exploited to achieve all-optical control of light with unprecedented speed. Photoinduced broadband dichroism, fully reversible and transiently vanishing in less than 1 picosecond, has been experimentally demonstrated in plasmonic metasurfaces with nanocross metaatoms. Also, we designed a nonlinear plasmonic metagrating where the photoinduced hot-electron symmetry breaking enables ultrafast reconfiguration of diffraction orders via control laser pulses. Our results pave the way for the all-optical reconfiguration of plasmonic metasurfaces.

15:20 : Invited talk
Strongly confined terahertz polaritons in topological insulators revealed by terahertz near-field nanoscopy
Eva Arianna Aurelia Pogna[1], Leonardo Viti[2], Antonio Politano[3], Massimo Brambilla[4], Gaetano Scamarcio[4], Miriam Serena Vitiello[2]
[1]CNR-IFN (Italy), [2]NEST (Italy), [3]University of L'Aquila (Italy), [4]Università degli Studi e Politecnico di Bari (Italy)

The terahertz collective excitations of thin films of Bi2Se3 and Bi2Te2.2Se0.8 topological insulators are investigated by a combination of hyperspectral nano-imaging and detectorless scattering-near-field optical microscopy. We provide first experimental evidence for the activation of propagating sub-diffractional bulk plasmons polaritons and hybridized collective modes formed by the coupling of bulk hyperbolic phonon-polaritons with the Dirac-plasmons associated with the topological surface-states, which can support low-loss, highly tunable and strongly confined terahertz electromagnetic modes.

15:40 : Self-Assembled Meta-Atoms and Metasurfaces
Maeva Lafitte, Rajam Elancheliyan, Cian Cummins, Alberto Alvarez Fernandez, Philippe Barois, Alexandre baron, Olivier Mondain-Monval, Guillaume Fleury, Virginie Ponsinet

Universite de Bordeaux (France)

Metamaterials rely on artificial assembled optical resonators, with strong interactions with light and local field enhancements. This presentation aims at pointing out how colloid- and polymer-based chemical engineering offers exciting routes to tailor the optical response, including polarizabilities and scattering diagram of such resonators, and transmission and absorption of their planar assemblies. We will discuss examples where bottom-up synthesis and assembly of tailored metallic nanoresonators leads to promising optical properties, specifically using self-assembled soft matter systems like emulsions and copolymers.

14:00 - 15:55 — Room 7

Session 2A17

Bottom-up approaches, new fabrication routes and ENSEMBLE3

Organized by: Dorota Pawlak and Virginie Ponsinet

Chaired by: Dorota Pawlak

14:00 : Invited talk
Helical assemblies of plasmonic 1D-nanoobjects with giant circular dichroism
Matthias Pauly, W. Wu, V. Lemaire, S. Sekar, G. Decher
Universite de Strasbourg (France)

Grazing Incidence Spraying combined to Layer-by-Layer assembly is used to assemble anisotropic plasmonic nanoparticles as mono- and multilayer thin films on large areas, in particular into helical (and thus chiral) multilayer thin films. The resulting giant chiroptical properties can be finely tuned over a broad wavelength range using simple design principles, reaching ellipticity values higher than 13° and g-factor values up to 1.6 in the visible and near-IR range.

14:20 : Design of Si-based particles for infrared-active metamaterials
Cynthia Cibaka-Ndaya[1], Megan Parker[1], Lucien Roach[1], Maria Letizia De Marco[1], Brian A. Korgel[2], Raul Barbosa[2], Philippe Barois[1], Virginie Ponsinet[1], Cyril Aymonier[1], Glenna L. Drisko[1]
[1] *Universite de Bordeaux (France),* [2] *The University of Texas (USA)*

We report the synthesis and self-assembly of Si@SiOxNy core-shell particles, scattering infrared light. They were produced by decomposing a Si coordination complex alongside cyclohexasilane, under supercritical conditions. Core and shell dimensions were controlled through precursor stoichiometry and relative concentration. The electric and magnetic multipoles were characterized using a custom-built static light scattering spectrometer. Simulations show that the magnetic and electric responses are respectively located in the core and shell. The particles were self-assembled into metasurfaces and optically characterized using ellipsometry.

14:35 : Invited talk
Active and Extreme Plasmonics
Jeremy Baumberg
University of Cambridge (United Kingdom)

Integration of active polymers into the 1-10nm nanogaps of plasmonic self-assembled patch antennas opens up wide opportunities for building-scale applications. We demonstrate the construction and large-scale fabrication of such active films, and the large range of unusual properties that can result.

14:55 : Invited talk
Design of photonic nanostructures via chirality induction
Jie Gao[1], Wenbing Wu[2], Vincent Lemaire[2], Alain Carvalho[2], Sylvain Nlate[1], Thierry Buffeteau[1], Reiko Oda[1], Yann Battie[3], Matthias Pauly[2], Emilie Pouget[1]
[1] *Bordeaux University (France),* [2] *Universite de Strasbourg (France),* [3] *Universite de Lorraine (France)*

In this project, new nanomaterials based on gold nanoparticles organized on chiral colloidal nano-substrates are designed and organized on surfaces via Grazing Incidence Spraying in order to control the chiroptical properties.

15:15 : Invited talk

Narrowband visible and mid-infrared polarizing filters with self assembled Al doped Zno-ZnWO4 eutectic composites

Maria Cristina Larciprete[1], **Marco Centini**[2], **Grigore Leahu**[2], **Alessandro Belardini**[2], **Roberto Li Voti**[2], **Concita Sibilia**[2], **Dorota Pawlak**[1]

[1] *Ensemble3 (Poland)*, [2] *University of Roma La Sapienza (Italy)*

We report an overview of optical properties of eutectics Al-ZnO/ZnWo4. Filtering properties and polarization dependent properties, as function of Al concentration are presented in the visible and I.R. range

15:35 : Invited talk

On-Demand Assembly of Reconfigurable Optical Metamolecules and Metamaterials

Yuebing Zheng

The University of Texas at Austin (USA)

We develop new optical manipulation techniques to realize on-demand assembly of discrete nanomaterials into reconfigurable optical metamolecules and metamaterials both in liquid solutions and on solid substrates. With their highly tunable optical properties, these metamolecules and metamaterials advance chiroptical spectroscopy for label-free enantiodiscrimination of drug molecules and high-sensitive detection of anomalistic chiral molecules as disease biomarkers and enable room-temperature active modulation of valley dynamics in monolayer semiconductors.

14:00 - 16:00 — Room 8

Session 2A18

Symposium II: New trends in nanophotonics and advanced materials

Organized by: Junsuk Rho, Hakjoo Lee and Namkyoo Park

Chaired by: Junsuk Rho, Hakjoo Lee and Namkyoo Park

14:00 : Invited talk

THz charge, spin, and magnon currents in magnetic heterostructures

Kyusup Lee, Yi Wang, Hyunsoo Yang

National University of Singapore (Singapore)

We show a high-performance THz emitter based on ferromagnetic/nonmagnetic heterostructures. By changing the nonmagnetic layer with a 2D material, topological insulator, and Weyl semimetal, the intriguing features of exotic materials, such as THz spin currents and spin-to-charge conversion time scales, can be revealed from emitted THz signals. By inserting an antiferromagnet between the ferromagnet and nonmagnet, magnon currents can be identified from THz emission, and the magnon currents are strong enough to manipulate the state of magnetic memory.

14:20 : Invited talk

Nano-optomechanics on a fiber-tip

Arthur Hendriks, Luca Picelli, Rene van Veldhoven, Ewold Verhagen, Andrea Fiore

Eindhoven University of Technology (Netherlands)

Nano-optomechanical sensors enable precision sensing of displacement, force and mass. However, the complexity and limited efficiency of light coupling to the sensor hinders their practical application. Here, we present a solution by placing a nano-optomechanical structure on a cleaved fiber facet. The structure is designed to enable efficient coupling to the fiber mode without any optics. Our process is based on wafer-scale fabrication in combination with a simple wafer-to-fiber transfer method. The sensor displays displacement imprecisions around 20 fm/Hz1/2.

14:40 : Invited talk

Terahertz photonic band-gap confinement at micrometer scale in SrTiO3 photonic crystals

Juan Pablo Vasco[1], **Tobia Nova**[2], **Vincenzo Savona**[1], **Atac Imamoglu**[2]

[1] *EPFL (Switzerland),* [2] *ETH Zurich (Switzerland)*

We show the possibility of photonic band-gap confinement in SrTiO3 photonic crystal slabs at cryogenic temperatures in the terahertz band, where the SrTiO3 refractive index reaches values above 150. We then use a Particles Swarm optimization approach to propose a photonic crystal cavity with an effective mode volume of 0.77 μm3 and resonant frequency at 0.88 THz

15:00 : Invited talk

Magnetoplasmonic nanocavities for the amplification of magneto-optical activity via hybridization with dark plasmons

Paolo Vavassori[1], Andrey Chuvilin[1], Alberto López-Ortega[2], Nicoló Maccaferri[3], Mario Zapata-Herrera[4], Matteo Pancaldi[5]

[1] *CIC nanoGUNE (Spain),* [2] *Universidad Pública de Navarra (Spain),* [3] *Umeå University (Sweden),* [4] *Materials Physics Center (Spain),* [5] *Elettra Synchrotron Trieste (Italy)*

Magneto-optical effects are widely used in studying magnetic materials and to realize optical devices exploiting non-reciprocal propagation of light. Enhancing MO effects is crucial for size reduction of key photonic devices based on non-reciprocal propagation of light and to enable active nanophotonics. Here, we disclose a promising approach that exploits multipolar Fano resonances excitable in symmetry broken magnetoplasmonic nanocavities and arising from the hybridization of dark plasmons with dipolar plasmonic resonances to induce a large amplification of magneto-optical activity.

15:20 : Invited talk

Scalable and efficient photonic designs using disordered metamaterial nanounits

Ekmel Ozbay

Bilkent University (Turkey)

Subwavelength metamaterial nanounits can efficiently harvest electromagnetic (EM) waves, resulting in near unity light absorption in the narrow or broad frequency range. For this purpose, we explored the material and architecture requirements for the realization of light perfect absorption using these metamaterial designs from ultraviolet (UV) to far-infrared (FIR) wavelength regimes. We adopted these lithography-free techniques in many applications including photoelectrochemical water splitting, photodetection, light emission, sensing, filtering and thermal camouflage.

15:40 : Invited talk

Exciton-plasmon hybridization effects in a system of gold nanostars and J-aggregates *online*

Yury Rakovich

CSIC-UPV/EHU (Spain)

Report on the investigation of the interaction between localized and hybridized plasmons in gold nanostars and excitons in J-aggregates with a complex mechanism of hybridization of states. Our findings demonstrate the quality performance of the formed plexitonic system with multiple hybridization channels in terms of the parameters of strong-coupling such as Rabi splitting (230 meV), coupling-strength-to-transition energy ratio (0.07) and cooperativity (2.03). The results of time-resolved experiments elucidate the observed enhanced spontaneous emission rate with regard to the Purcell effect.

Coffee Break

Session 2P2

Poster session IV

16:00 - 16:40

Chaired by:

P1: Bound State in the Continuum in Resonant hBN Antenna Arrays

Harsh Gupta, Michele Tamagnone

Istituto Italiano di Tecnologia (Italy)

We demonstrate that arrays of pairs of elliptical hexagonal boron nitride antennas can support bound states in the continuum. We tune the coupling of the BIC modes with incident light using the angle of the major axis of the antennas and we demonstrate a trifold enhancement of the quality factor of the resonance.

P2: Correlative electron and optical spectroscopy of strongly-coupled mid-infrared plasmon and phonon polaritons

Pavel Gallina[1], Andrea Konecna[1], Michal Horak[1], Michal Kvapil[1], Jiri Liska[1], Vlastimil Krapek[1], Radek Kalousek[1], Juan C. Idrobo[2], Tomas Sikola[1]

[1] *Brno University of Technology (Czech Republic),* [2] *Oak Ridge National Laboratory (USA)*

We explored a system supporting low-energy excitations, in particular, mid-infrared localized plasmon modes and phonon polaritons that are tuned to be strongly coupled. We studied the coupled modes by using far-field infrared spectroscopy, state-of-the-art monochromated electron energy-loss spectroscopy, numerical simulations and analytical modeling. We demonstrated that the electron probe facilitates a precise characterization of polaritons constituting the coupled system, and enables an active control over the coupling and the resulting sample response both in frequency and space.

P3: Tunable scattering-absorbing VO2 nanoantennas in the near-infrared

Peter Kepic, Filip Ligmajer, Katarina Rovenska, Tomas Sikola

Brno University of Technology (Czech Republic)

The development of metasurfaces offers many novel optical functions provided by precisely fabricated nanostructures. One can tune the functionality of the metasurface after its fabrication by incorporating phase-transition materials. Vanadium dioxide (VO2), which undergoes the volatile dielectric-metallic phase transition, offers such potential for tunability already around 67°C. Here, we focus on the alignment of the dielectric and plasmonic resonances of VO2 nanostructures at near-infrared wavelengths that can be applied into a perfect tunable scattering-absorbing meta-grating.

P4: Plasmon-excited near-field luminescence of semiconductor light sources

Vlastimil Krapek, Petr Dvorak, Lukas Kejik, Zoltan edes, Michal Kvapil, Michal Horak, Petr Liska, Jan Krpensky, Tomas Sikola

Brno University of Technology (Czech Republic)

On-chip integration of light sources would benefit from near-field handling of the emission with a subwavelength spatial resolution. Here we present a fully near-field photoluminescence study of semiconductor quantum dots, with a surface plasmon interference device (SPID) used for the excitation and an aperture-type scanning near-field optical microscope (SNOM) combined with a spectrometer for the collection.

P5: Plasmonic Surface Lattice Resonance and Optomechanics for Self-Assembled Nanolasers

Mindaugas Juodenas[1], Domantas Peckus[2], Nadzeya Khinevich[2], Joel Henzie[3], Tomas Tamulevicius[2], Asta Tamuleviciene[2], Sigitas Tamulevicius[2]

[1] *Chalmers University of Technology (Sweden),* [2] *Kaunas University of Technology (Lithuania),* [3] *National Institute for Materials Science (Japan)*

Plasmonic surface lattice resonance-based (SLR) nanolasers are attractive because of small mode volumes, ultrafast dynamics and good beam directionality. Underlying nanocavities are usually produced by standard lithography processes. We developed a method to arrange monodisperse colloidal nanoparticles onto large, patterned substrates with a high assembly yield. Furthermore, we showed that the SLR is not static at ultrafast time scale due to the optomechanical modes of constituent nanoparticles. Our findings open new opportunities for large scale nanolasers with ultrafast functions.

P6: Strongly deflecting and simultaneously focusing cylindrical Metalens for ultra-compact surface plasmon resonance sensing and more

Mindaugas Juedenas, Vasilii Mylnikov, Sebastian Gobel, Mikael Kall

Chalmers University Of Technology (Sweden)

We demonstrate a strongly deflecting and simultaneously focusing cylindrical Metalens, with purpose to allow for the miniaturization of spectroscopic surface plasmon resonance based sensors and more. This by replacing the bulk optics with a single Metasurface that generates the required angular spread, something that could find further uses in microscopy and more.

P7: Phase-gradient metalens for optical confinement and transport of microparticles

Mohammad Mahdi Shanei, Einstom Engay, Mikael Kall

Chalmers University of Technology (Sweden)

In this work, we have designed and fabricated a dielectric metasurface able to trap and push particles along its focal line. The required phase profile was experimentally realized by using arrays of silicon nanofins with locally varying rotation angles. We envisage that this kind of flat structure for optical manipulation could be integrated with microfluidic chips to form miniaturized devices for sensing, driving and sorting of various kinds of microscopic objects.

P8: Accurate Inverse Design of Fabry-Perot-Cavity-Based Transmissive Color Filter via Deep Learning

Peng Dai[1], Kai Sun[1], Xingzhao Yan[1], C.H. (Kees) de Groot[1], Otto Muskens[1], Huigao Duan[2], Ruomeng Huang[1]
[1] *University of Southampton (United Kingdom),* [2] *Hunan University (China)*

Deep learning approaches have been applied to achieve the fast and accurate inverse design of F-P-cavity-based structural color. The trained networks cover a large gamut (215 % of sRGB) while allowing multiple designs identification for each color.

P9: Passive Thermal Radiation Control based on thermochromic W-doped VO2 Metasurfaces

Kai Sun[1], Callum Wheeler[1], Ioannis Zeimpekis[1], Mirko Simeoni[2], Alessandro Urbani[2], Matteo Gaspari[2], Sandro Mengali[2], Lars Kildebro[3], Dan Hewak[1], Cornelis de Groot[1], Otto Muskens[1]
[1] *University of Southampton (United Kingdom),* [2] *Consorzio C.R.E.O (Italy),* [3] *NIL Technology (Denmark)*

Radiative cooling becomes a popular research topic targeting an energy efficient solution for thermal management. Vanadium dioxide (VO2), as a thermochromic material, is able to switch optical property between dielectric and metallic states depending on its temperature. We present a passive thermal management solution through a VO2 based metasurface. Through a novel ALD process, the fabricated VO2 metasurface on polyimide substrate has a room-temperature transition and a high infrared emissivity of $\sim$0.4.

P10: Fabrication and characterization of electrically tuned photonic nanodevice

Alexander Korneluk, Julia Szymczak, Tomasz Stefaniuk
University of Warsaw (Poland)

This work presents experimental results on fabrication and characterization of an electro-opticalmodulator in the form of metal-oxide-semiconductor multilayer structure that exhibits refractive index changeunder applied external voltage. This variation in optical properties is enabled by the changes in the carrierdensity present in the vicinity of the indium-tin-oxide layer - fused silica interface. In our investigations,we identify the critical electrical and morphological parameters of the e-beam deposited semiconductor film thatgovern the process of accumulation/depletion layer formation.

P11: On the study of the enhanced nanowire metamaterial structure

Patrik Micek[1], Thanos Ioannidis[2], Tatjana Gric[2]
[1] *University of Zilina (Slovakia),* [2] *VILNIUS TECH (Lithuania)*

This paper presents the theoretical characterization of enhanced nanowire metamaterial structure consisting of anisotropic semiconductor nanowires. By changing the semiconductor's parameters such as doping results in effective tuning of the hyperbolic dispersion of the metamaterial, which is not possible with noble metals. At last, the effects of the nanowire's diameter, spacing and structure symmetry on hyperbolic dispersion were analytically investigated.

P12: Advanced anisotropic hybrid plasmonic nano-emitters

Minyu Chen[1], Dandan Ge[1], Sylvie Marguet[2], Ali Issa[1], Safi Jradi[1], Christophe Couteau[1], Renaud Bachelot[1]
[1] *UTT/L2N (France),* [2] *Universite Paris Saclay (France)*

We report on the optimal overlap of antenna's near-field and active medium whose spatial distribution is controlled via a plasmon-triggered 2-photon polymerization of a photosensitive formulation containing QDs. Both liner and circularly polarized excitation are considered.

P13: Light Matter Interaction in Chiral Metasurfaces

Leeju Singh[1], Shmuel Sternklar[2], Yuri Gorodetski[2]
[1] *Weizmann Institute Of Science (Israel),* [2] *Ariel University (Israel)*

We demonstrate the connection between the reduced rotational symmetry of a chiral structure unit-cell to the existence of the Kramers-Kronig relations between the chiral spectral parameters in the k-space and found that the reduction in rotational symmetry affects the locality condition, which unavoidably leads to the deviation from the KK relation. Further, we experimentally investigated plasmonic metasurfaces comprising topological edge states. We discussed line and point dislocations with trivial and non-trivial topological phases.

P14: Multi Objective Optimization of sensing performances of a Cu-Ni-Graphene Surface Plasmon Resonance based sensor
Pericle Varasteanu
University of Bucharest (Romania)

In this study, a multi objective optimization algorithm, NSGA II was employed to increase the sensing performances of a Cu-Ni SPR sensor. The impact of objectives on the sensor's structure and performance is emphasized by considering three test cases where different pairs of sensing parameters were considered as objectives: sensitivity (S), fullwidth at half maximum (FWHM), and reflectivity at resonance (r0), S and FWHM, and S and r0. Sensitivities up to 222 deg/RIU were obtained

P15: Enhancing photon avalanche in upconversion nanoparticles
Conrad Corbella Bagot, Eric Rappeport, Taleb Ba Tis, Wounjhang Park
University of Colorado Boulder (USA)

Upconversion photon avalanche has recently been shown in highly Tm3+-doped upconverting nanoparticles. However, the threshold power for this mechanism is still high, limiting its range of applications. In this presentation, we will discuss the advantages of using plasmonics in order to enhance photon avalanche. We will also present the experimental results of a design that could reduce the threshold power for such phenomenon by up to two orders of magnitude.

P16: Anomalous Reflection Designed Considering Spaitally Varying Surface Impedance
Kyle Arnold[1], Nathan Clow[2], Simon Horsley[1], Alastair Hibbins[1], Roy Sambles[1]
[1]*University of Exeter (United Kingdom),* [2]*DSTL (United Kingdom)*

We have designed an anomalous reflection surface by considering the surface impedance at the boundary of the metasurface. We have built an approximation of this surface using strips, a simplification of a patch array, of varying sizes to match the desired impedance distribution. Using this anomalous reflection surface we have then studied the angular response of the surface compared to models of the surface impedance distribution. Using this design methodology we aim to design more complex spatially varying surface impedances.

P17: Introducing tunability into structural color filters using vanadium dioxid
Katarina Rovenska, Beata Idesova, Filip Ligmajer, Peter Kepic, Tomas Sikola
Brno University of Technology (Czech Republic)

Once a conventional structural color filter is fabricated, its optical response cannot be changed. By incorporating tunable materials into these filters, we can alter the performance of color-filtering metasurfaces even after fabrication. In this work, we use vanadium dioxide for its thermally inducible and repeatable transition from dielectric to metallic state at ca. 67 °C. We prepare holey structural color filters with various Al/VO2 geometries and analyze the thermally inducible tunability of these color-filtering systems

P18: Microscopic origin of chirality in elemental Tellurium
Rikuto Oiwa, Hiroaki Kusunose
Meiji University (Japan)

We investigate a microscopic origin of chirality based on the realistic tight-binding model for elemental Tellurium. Expressing the model in terms of the symmetry-adapted basis, we found the dominant components in both the local and itinerant terms corresponding to the time-even pseudoscalar property, i.e., chirality. Here we show their microscopic expressions and discuss the essential coupling to them that is the origin of both the electric-field induced rotation and rotation-field induced electric polarization.

P19: Heavily doped semiconductor nanostructures on LWIR T2SL for reduced detector thickness
Clement Gureghian, G. Vincent, J-B. Rodriguez, G. Sombrio, I. Ribet-Mohamed, T. Taliercio
ONERA (France)

Achieving higher operating temperatures is a key-point in the current infrared photodetection research. One promising way to achieve this goal is through the reduction of the thickness of the active region and the use of optical resonators to compensate the consequent loss of absorption. Herein we present simulation results of the absorption in a thin LWIR T2SL photodetectors, capped with heavily doped semiconductors nanostructures.

P20: Electrically Tunable Strongly Coupled Epsilon-Near-Zero and Plasmonic Hybrid Mode

Dipa Ghindani, Alireza R. Rashed, Mohsin Habib, Humeyra Caglayan
Tampere University (Finland)

Achieving active tunability of light and matter interaction opens a new avenue for exploring various high-performance photonic devices. In this prospect, developing a novel way to achieve active tuning of a strongly coupled system is vital. Here, we demonstrated an active tuning of the coupling strength in a strongly coupled system comprised of ENZ material and plasmonic resonators. The incorporation of these two components exhibits strong coupling that manifests as spectral splitting in the transmission spectra in near-infrared spectral range.

P21: Polarization Control over Light via Integrated Grating Outcoupling Structure for Trapped Ion Quantum Computers

Anastasiia Sorokina, Steffen Sauer, Guochun Du, Carl Grimpe, Johannes Dickmann, Tanja Mehlstaubler, Stefanie Kroker
Technische Universitat Braunschweig (Germany)

Ion traps are a promising platform for the realization of high-performance quantum computers. To enable the future scalability of these systems, integrated photonic components for guiding and manipulating laser light on chip-scale are important. Such passive optical components offer μm-beam radii due to their proximity to the ions. To achieve full optical control over the ions, the manipulation of light polarization is essential. We present the first simulation results for different grating outcouplers and their applications on ion trap chips.

P22: Fractal-like aluminum optical antennas

T. Simon[1], X. Li[2], J. Martin[1], D. Khlopin[1], O. Stephan[2], M. Kociak[2], Davy Gerard[1]
[1]*Universite de Technologie de Troyes (France)*, [2]*Universite Paris Saclay (France)*

We propose aluminum self-similar, fractal-like structures (Cayley trees) as broadband optical antennas. Using electron energy loss spectroscopy, we experimentally evidence that a single aluminum Cayley tree sustains multiple and scalable plasmonic resonances.

P23: Spin-wave nonreciprocity in cylindrical synthetic antiferromagnets

Rodolfo Gallardo, Pablo Alvarado, Pedro Landeros
Universidad Tecnica Federico Santa Maria (Chile)

A cylindrical synthetic antiferromagnet is proposed as a potential candidate to generate nonreciprocal spin waves. It is demonstrated that such a system presents a notable spin-wave asymmetry induced by the combined action of the antiferromagnetic state and the curvature. Analytical expressions are proposed for the case of thin cylindrical shells. These results are relevant from a fundamental and practical point of view since the chirality of the spin waves is a crucial ingredient to visualize future magnon-based logic applications.

P24: Design of Metamaterial Absorber for Biomedical Applications

Brinta Chowdhury, Abdullah Eroglu
North Carolina A and T State University (USA)

Design of a metamaterial absorber operating at THz frequency to be used as a sensor for biomedical applications is given. The absorber has multilayers including Glass substrate, InSb semiconductor layer, MgF_2 buffer layer, InSb Resonator ring, buffer layer, and a mask. The performance of the absorber is investigated for various conditions including absorption, transmission and reflection versus frequency, and wavelength. It has been confirmed that the absorber provides expected results for absorption for THz frequency range.

P25: DNA-PAINT based super-resolution microscopy to assess plasmon-mediated single-molecule FRET

Swayandipta Dey, Sjoerd W. Nooteboom, Peter Zijlstra
Eindhoven University of Technology (The Netherlands)

Forster Resonance Energy Transfer (FRET) has been widely used as a "nanoscale spectroscopic ruler"to gauge the proximity between two biomolecules or follow their conformational dynamics. The brightness of the FRET signal is however limited by the fluorophores. Herein, we propose to use plasmon-enhanced FRET (PFRET) to boost the brightness and to develop a multi-color single-molecule sensor. We present numerical simulations of the plasmon-mediated FRET process and use DNA mediated super-resolution microscopy (DNA-PAINT1) to measure single-molecule enhancement factors and spectra.

P26: Metamaterial Cell Proposal for Hybrid Shielding of Vehicle Components at Low Frequencies *online*

Geyse Mirelle Brito da Silva, Diego N. Lemos, Valdeth S. Sousa, Leandro T. Manera, Marcelo G. Villalva
State University of Campinas (Brazil)

This article proposes an optimized metamaterial cell with a honeycomb-based substrate with the aim of electromagnetic and acoustic shielding. The proposed cell presented an absorption of 95 % and a maximum of 103 dB of sound transmission loss. The proposed electromagnetic shielding goal is to fulfill vehicle EMC standards while mitigating unpleasant noise from vehicle components.

P27: Scattering characteristics of a cylindrical conductor coated by Dispersive and Lossy Metamaterials with an intervening air gap *online*

Adnan Jamil, Tenneti Rao
University of Massachusetts (USA)

Plane wave backscattering of a conducting cylinder coated by a layer of metamaterial having dispersive constitutive parameters with an intervening air gap is investigated by using the boundary-value technique. The results indicate that it is possible to achieve an extremely low radar echo width over a broad range of frequencies. Further investigations on the total scattering cross section for the TM incidence for DNG type metamaterial appear to strengthen the belief that a broadband cloaking is possible with this geometry.

P28: Coupling interfaces between SiN photonic and CGSiN plasmonic waveguides *online*

Lamprini Damakoudi, Dimitra Ketzaki, Dimitrios Chatzitheocharis, Georgios Patsamanis, Konstantinos Vyrsokinos
Aristotle University of Thessaloniki (Greece)

This work focuses on the design of high-efficiency coupling interfaces between silicon nitride (SiN) photonic and Conductor-Gap-SiN (CGSiN) plasmonic waveguides, revealing numerically simulated coupling efficiency (CE) values up to 88 % at 1310nm.

P29: Light amplification in silver nanoparticles containing organic luminophore thin films *online*

Jelena Mikelsone, Aivars Vembris
University of Latvia (Latvia)

Metal nanoparticles are active research object. They can be used in various applications. Silver nanoparticles typically are synthesized in aqueous solution and their transfer to organic solvents is required for application purposes with organic luminophores. We studied silver nanoparticles transfer from aqueous to organic media by ultrasonic and shell changing processes. Photoluminescence properties - emission maps, photoluminescence quantum yield and lifetime of nanoparticles containing luminophore DWK-1-TB thin films were studied. Improvements of photoluminescence properties in nanoparticles containing films was observed.

P30: Wearable Lab-in-a-watch Plasmonic Biosensor of Sweat Molecules for Non-invasive Glucose Monitoring *online*

Y. Zhao, T. Hou, J. A. Huang
University of Oulu (Finland)

State-of-the-art optical skin sensors need a separate step of detection by portable detectors, hindering their development toward continuous measurement of sweat glucose. Here, we report a wearable optical biosensor system on skin by integrating an electro-plasmonic chip into an optical watch that together enables controllable sweat stimulation and on-watch detection of the sweat glucose. By fine controlling gold nanogaps in the nanohole array, we have achieved plasmonic detection of molecule monolayer with a sensitivity of 170 RIU.

P31: Plasmonic Properties of Differently Oriented Lattices of Nanoparticles Revealed by Microellipsometry *online*

Eugene Bortchagovsky[1], Yu. V. Demydenko[1], A. B. Bogoslovska[1], T. O. Mishakova[2], J. Tang[3], M. Fleischer[3], I. A. Milekhin[4], Dietrich Zahn[4]
[1] *V. Lashkarev Institute of semiconductor physics (Ukraine)*, [2] *Shevchenko Kyiv National University (Ukraine)*, [3] *Eberhard Karls Universitat Tubingen (Germany)*, [4] *Chemnitz University of Technology (Germany)*

Microellipsometry was used to reveal plasmonic properties of ordered lattices of nanoparticles depending on the mutual orientation of the plane of incidence of the exciting light and own vectors of the lattice. The registered spectral positions of plasmonic resonances are dependent on the mutual orientation and the behavior observed indicates non-standard birefringence.

P32: Nonadiabatic plasmonic tunneling of photoelectrons *online*

Bela Lovasz[1], Peter Sandor[1], Gellert-Zsolt Kiss[1], Balazs Banhegyi[1], Zsuzsanna Papa[1], Judit Budai[2], Christine Prietl[3], Joachim R. Krenn[3], Peter Dombi[1]
[1]Wigner Research Centre for Physics (Hungary), [2]ELI-ALPS Research Institute (Hungary), [3]Universitat of Graz (Austria)

Nonadiabatic nano-optical electron tunneling in the transition region between multiphoton-induced emission and adiabatic tunnel emission is explored in the near-field of plasmonic nanostructures. For Keldysh γ values between $\sim$1.3 and $\sim$2.2, measured photoemission spectra show recollision driven by the near-field. Simultaneously, the photoemission yield shows an intensity scaling with a constant nonlinearity, which is characteristic for multiphoton-induced emission. Our observations in this transition region were reproduced with the numerical solution of Schrodinger's equation, mimicking the nanoscale field geometry.

P33: Directional couplers based on parity-time symmetric Bragg gratings *online*

Tianyi Hao, Pierre Berini
Univeristy of Ottawa (Canada)

Parity-time symmetric Bragg gratings produce unidirectional reflection around the exceptional point. We investigate directional coupling between a pair of parity-time symmetric waveguide Bragg gratings operating near their exceptional point around 880 nm with long-range surface plasmon polaritons (LRSPPs), arranged in various configurations - duplicate, duplicate-shifted and duplicate-flipped. We also investigate coupling to a bus waveguide. Unidirectional multi-wavelength reflection and coupled supermode conversion are predicted.

P34: Meta-Programmable Analog Differentiation *online*

Jerôme Sol[1], David R. Smith[2], Philipp del Hougne[3]
[1]INSA Rennes (France), [2]Duke University (USA), [3]Universite de Rennes (France)

We experimentally achieve wave-based analog differentiation with unprecedented precision and programmability. Instead of designing a few-mode structure with few tunable degrees of freedom (DOFs), we take a random overmoded scattering system as starting point and tune it in situ to the desired response with hundreds of tunable DOFs. Thereby, we simultaneously overcome two vexing weaknesses of wave processors: their vulnerability (fabrication inaccuracies, environmental perturbations) and their lack of in-situ programmability. We experimentally demonstrate programmable parallelized high-fidelity differentiation and higher-order differentiation.

16:40 - 18:40 — Room 1

Session 2A19

Symposium I: Hybrid Nanomaterials and Metastructures for Photonics, Sensing and Energy

Organized by: Jerome Plain, Alexander Govorov, Davy Gerard and Pedro Hernandez Martinez

Chaired by: Jerome Plain, Alexander Govorov, Davy Gerard and Pedro Hernandez Martinez

16:40 : Keynote talk
Advanced plasmonic photocatalysts for solar-to-chemical energy conversion

Alberto Naldoni
University of Turin (Italy)

Plasmonic nanostructures provide enhanced light-matter interaction offering exciting opportunities inthe conversion and storage of solar energy in the form of chemical bonds. In this talk, I will overview our recentprogress on the understanding of plasmonic effects such as near fields, non-thermal carriers, and local heatinggenerated both in nanocrystals and metasurfaces and on their use in chemical reactions relevant for energyapplications.

17:10 : Invited talk
The anisotropy of hot carriers' spatial distribution contrasts the isotropy of photothermal effects in

complex and small plasmonic nanocrystals with complex shapes

Artur Movsesyan[1], Eva Yazmin Santiago[2], Sven Burger[3], Miguel A. Correa-Duarte[4], Lucas V. Besteiro[4], Zhiming Wang[1], Alexander O. Govorov[2]
[1]*University of Electronic Science and Technology of China (China),* [2]*Ohio University (USA),* [3]*Zuse Institute Berlin (Germany),* [4]*Universidade de Vigo (Spain)*

A microscopic description of the hot-electron states represents a challenging problem, limiting the capability to design efficient nanoantennas for photochemistry. Here, we addressed these limitations and studied the spatial distributions of the photophysical dynamic parameters controlling the local surface photochemistry on a plasmonic nanocrystal: hot carriers and phototemperature. We showcased that the generation of high-energy electrons and holes in small plasmonic nanocrystals with complex shapes is strongly position-dependent and anisotropic, whereas the phototemperature across the nanocrystal surface is nearly uniform.

17:30 : Invited talk
Strong Inhibition of Spontaneous Emission near the Si nanocylinder

Alina Muravitskaya[1], Artur Movsesyan[2], Dmitry Guzatov[3], Ann-Laure Baudrion[2], Pierre-Michel Adam[2], Sergey Gaponenko[3], Vincent Remi[2]
[1]*University of Hull (United Kingdom),* [2]*Universite de Technologie de Troyes (France),* [3]*National Academy of Sciences (Belarus)*

Dielectric nanoparticle may induce either a decrease or an increase in decay rates of the excited states of the emitter in its vicinity. By tuning the size of Si nanocylinder and, consequently, spectral positions of the magnetic and electric modes, we obtained strong inhibition for randomly oriented emitters. The inhibition value is robust to the distance between the emitter and the nanoparticle in the range of nearly 50 nm, which is cruciallyimportant for the applications.

17:50 : Invited talk
Hyper resolute two-photon direct laser writing for realization of 2D and 3D nanostructures

G. E. Lio, A. Ferraro, T. Ritacco, D. M. Aceti, A. De Luca, M. Giocondo, R. Caputo
University of Calabria (Italy)

In this contribution, a metal/insulator/metal/insulator (MIMI) metamaterial upgrades a standard two-photon direct laser writing process to hyper resolution thanks to its uncommon feature as extraordinary transmittance, zero reflectance and epsilon-near-zero permittivity. The voxel size reduction of about 89 % height and 50 % width allows fabrication of apochromatic broadband metalenses with extended focal length and depth of focus, and numerical aperture of 0.087. Hyper resolution is also exploited in the fabrication of a nano bas-relief of Da Vinci's "Lady with an Ermine"

18:10 : In Situ optical thermometry of hybrid plasmonic nanosystems

Julian Gargiulo[1], Mariano Barella[2], Matias Herran[1], Ianina L. Violi[2], Ana Sousa Castillo[1], Simone Ezendam[1], Luciana P. Martinez[2], Roland Grzeschik[3], Sebastian Schlucker[3], Stefan A. Maier[1], Fernando D. Stefani[2], Emiliano Cortes[1]
[1]*Ludwig Maximilians Universitat (Germany),* [2]*Centro de Investigaciones en Bionanociencias (CIBION) (Spain),* [3]*CENIDE (Germany)*

We present a new implementation of anti-Stokes thermometry that enables the in situ photothermal characterization of individual plasmonic nanoparticles from a single hyperspectral photoluminescence confocal image. We study the photothermal response at the single-particle level of spherical gold NPs with sizes ranging from 50 to 100 nm supported on glass, sapphire, and graphene substrates. In addition, we study bimetallic Au@Pd NPs in a core@shell configuration. The developed method allows quantitative assessment of the role of temperature in plasmon-assisted applications.

18:25 : Engineering the circular dichroism of plasmonic chiral nanostructures on a stretchable substrate

Florian Lamaze[1], Julien Proust[1], Jeremie Beal[1], Louis Giraudet[2]
[1]*Light, nanomaterials, nanotechnologies EMR (France),* [2]*Laboratoire De Recherche en Nanosciences (LRN) (France)*

Understanding and controlling the circular dichroism (CD) of gold chiral 2D nanostructures is a major challenge for researchers who aspire to use its properties and thus achieve application based on this effect. The most common way to proceed is to tune it is at the fabrication step, however this method makes it impossible to modulate later. In this presentation, we propose a solution to this issue based on the deformation of a stretchable substrate.

16:40 - 18:25 — Room 2

Session 2A20

Symposium IV: Chirality, magnetism, and magnetoelectricity: Separate phenomena and joint effects in metamaterial structures

Organized by: Eugene Kamenetskii

Chaired by: Eugene Kamenetskii

16:40 : Invited talk
Interplay of Phonons and Spins in Chiral Materials
Jun-Ichiro Kishine
The Open University of Japan (Japan)

Recent progress on theoretical studies on the interplay of phonons and quantum spins in chiral materials will be presented. I will put emphasis on how to understand "truly chiral phonons.ªnd its essential roles in the so called çhirality-induced spin selectivity (CISS)"phenomena.

17:00 : Gate Voltage induced Magnetization dynamics based on magnetoelectric effect
Matheus S. de Sousa[1], **Manfred Sigrist**[2], **Wei Chen**[1]
[1] *PUC-Rio (Brazil),* [2] *ETH Zurich (Switzerland)*

Two mechanisms are proposed to generate magnetization dynamics based on magnetoelectric effect. Firstly, in multiferroic materials of a single magnetic domain, applying an oscillating electric field can cause a coherent rotation of the magnetic order. Secondly, in geometrically confined magnetic heterostructures with an interface spin-orbit coupling, if the ferromagnet only partially covers the sample, then a spin torque can be induced solely by a gate voltage without any bias current.

17:15 : Invited talk
Ab initio calculation of plasma frequency in spin-polarized metals
Maria Pogodaeva[1], **Sergey Levchenko**[1], **Ildar Gabitov**[2], **Vladimir Drachev**[1]
[1] *Skolkovo Institute of Science and Technology (Russia),* [2] *University of Arizona (USA)*

We present an accurate first-principles study of the spin-dependent plasma frequency of iron and cobalt using density-functional theory in an all-electron full-potential framework. The results are compared to the results obtained with standard pseudopotential approaches and experimental data obtained from photo-emission, absorption, and electron energy loss spectra. Using our new implementation, we calculate plasma frequency for two spin channels separately. Our results explain the significant difference between observed contributions from majority and minority electrons to plasmon resonance in cobalt nanoparticles.

17:35 : Keynote talk
Cavity Magnonics
Silvia Viola Kusminskiy
RWTH Aachen University (Germany)

Cavity Magnonics strives to control the elementary excitations of magnetic materials (magnons) and to interface them coherently to other elementary excitations such as photons or phonons. This can allow us to explore magnetism in new ways and regimes, has the potential of unraveling quantum phenomena at unprecedented scales, and could lead to breakthroughs for quantum technologies. I will introduce the field and present theoretical results from our group aimed to push the boundaries of the current state of the art.

18:05 : Invited talk
Nanoscale interplay of chirality and magnetism
Shoufeng Lan
Texas A and M University (USA)

The interplay between chirality and magnetism is of great interest in physics, chemistry, and mathematics since they share a common ground of circulating possession. Here, we present a series of engineered materials that exhibit a wide range of chiral phenomena in spectroscopy, imaging, optoelectronics, and nonlinear optics. We also investigate chiral interactions with nearby objects, such as quantum dots and two-dimensional materials. Finally, we share the recent observation of an excitonic magneto-chiral effect in twisted van der Waals bilayer crystals.

16:40 - 18:40 — Room 3

Session 2A21

Symposium II: New trends in nanophotonics and advanced materials

Organized by: Junsuk Rho, Hakjoo Lee and Namkyoo Park

Chaired by: Junsuk Rho, Hakjoo Lee and Namkyoo Park

16:40 : Invited talk
Analytical Routes to Multistability in Nonlinear Metasurfaces
Constantinos Valagiannopoulos
Nazarbayev University (Kazakhstan)

Nonlinear designs are notorious for their difficulty in getting rigorously treated. In this talk, the full electromagnetic interactions with nonlinear metasurfaces will be analytically described in several setups incorporating planar or cylindrical geometries, coupled or not, being excited normally or obliquely. The reported results are expected to assist the modeling of nonlinear metasurfaces and open unexplored opportunities towards the efficient design of photonic memory elements.

17:00 : Invited talk
Tailoring the emission and the photodynamics of quantum emitters with high index dielectric nanostructures
Melodie Humbert[1], Peter R Wiecha[1], Clement Majorel[1], Romain Hernandez[1], Nicolas Mallet[1], Bruno Masenelli[2], Gerard Colas des Francs[3], Frank Fournel[4], Vincent Larrey[4], Aurelie Lecestre[1], Guilhem Larrieu[1], Arnaud Arbouet[1], Christian Girard[1], Laurence Ressier[1], Vincent Paillard[1], Aurelien Cuche[1]
[1]Universite de Toulouse (France), [2]Universite de Lyon (France), [3]Universite Bourgogne-Franche Comte (France), [4]Universite Grenoble Alpes (France)

We show both experimentally and theoretically that the photodynamics of several electric and/or magnetic quantum emitters (rare earth Eu3+ ions or NV colored centers in nanodiamonds)can be controlled by high index dielectric nanostructures made of Silicon.

17:20 : Invited talk
Annihilation of exceptional points from different Dirac valleys in a 2D photonic system
M. Krol[1], I. Septembre[2], P. Oliwa[1], M. Kedziora[1], K. Lempicka-Mirek[1], M. Muszynski[1], R. Mazur[3], P. Morawiak[3], W. Piecek[3], P. Kula[3], W. Bardyszewski[1], P. G. Lagoudakis[4], G. Malpuech[2], B. Pietka[1], J. Szczytk[1], Dmitry Solnyshkov[2]
[1]University of Warsaw (Poland), [2]Universite Clermont Auvergne (France), [3]Military University of Technology (Poland), [4]Skolkovo Institute of Science and Technology (Russia)

Topological physics relies on singularities carrying topological charges, such as Dirac points and exceptional points (EPs). Here, we demonstrate experimentally that an increase of non-Hermiticity can lead to the annihilation of EPs from different Dirac points (valleys). We study a liquid crystal microcavity with birefringence and TE-TM spin-orbit-coupling. Non-Hermiticity is provided by polarization-dependent losses. Increasing the non-Hermiticity degree, we move the EPs from different valleys towards each other. After their annihilation, the system is free of any singularity.

17:40 : Invited talk
Extended hybridization and energy transfer in multimaterial polaritonic metasurfaces

Joel Bellessa, Antoine Bard, Sylvain Minot, Clementine Symonds, Jean-Michel Benoit, Alban Gassenq, Francois Bessueille
Universite de Lyon (France)

In this talk we propose a new way to hybridize two organic materials and transfer energy through a surface plasmon over micrometric distances. For this purpose, two patterned interlocked dyes arrays, one donor and one acceptor, are deposited on a silver surface by successive micro contact printing, leading to a pattern of 5 microns period. The mixing in these polaritonic metasurfaces enables an energy transfer mechanism in strong coupling, which is observed with luminescence experiments.

18:00 : Invited talk
Noise-free supercontinuum from picosecond pulses in silicon waveguides *online*
David Castello-Lurbe
Vrije Universiteit Brussel (Belgium)

Exploiting the Kerr nonlinear-index dispersion in silicon waveguides, noise amplification inherent tothe spectral broadening of picosecond pulses in the anomalous group-velocity dispersion regime is removed. Onthis basis, supercontinuum generation from picosecond pulses is numerically demonstrated in a foundry-compatible silicon waveguide.

18:20 : Invited talk
Ultrafast Probing of Plasmonic Hot Electron Occupancies *online*
Peter Dombi
Wigner Research Centre for Physics (Hungary)

We discuss in-depth distribution and time evolution of hot electrons generated upon the excitation of surface plasmon polaritons. Dielectric function of plasmonic systems was measured with ellipsometric methods to reveal the electron distribution.

16:40 - 18:40 — Room 4

Session 2A22

Symposium III: Advanced passive and active metasurfaces

Organized by: Howard Lee and Pin-Chieh Wu

Chaired by: Howard Lee and Pin-Chieh Wu

16:40 : Invited talk
Nonlinear Metalens for 197-nm Vacuum UV Light Generation and Control
Ming Lun Tseng[1], Michael Semmlinger[2], Ming Zhang[2], Catherine Arndt[2], Tzu-Ting Huang[3], Jian Yang[2], Hsin Yu Kuo[4], Vin-Cent Su[5], Mu Ku Chen[6], Cheng Hung Chu[3], Benjamin Cerjan[2], Din Ping Tsai[3], Peter Nordlander[2], Naomi J. Halas[2]
[1]*National Yang Ming Chiao Tung University (Taiwan),* [2]*Rice University (USA),* [3]*Academia Sinica (Taiwan),* [4]*National Taiwan University (Taiwan),* [5]*National United University (Taiwan),* [6]*City University of Hong Kong (Hong Kong)*

Vacuum ultraviolet (VUV) light plays a key role in many technologies. However, it is challenging to advance current VUV photonic devices due to the significant absorption of object. Here, we demonstrate a metalens which can effectively generate and focus VUV light via second harmonic generation. It generates a tight focusing spot with a power density enhancement over 20X. This work paves a novel route toward the realization of novel VUV devices.

17:00 : Invited talk
Controlling Dielectric Permittivity in Space and Time for Dynamic Nanophotonics, Time Crystals, and Beyond
Alexandra Boltasseva[1], Soham Saha[1], Mustafa Goksu Ozlu[1], Moti Segev[2], Vladimir Shalaev[1]
[1]*Purdue University (USA),* [2]*Technion (Israel)*

We demonstrate various methods to actively tune and passively tailor the optical properties of conducting oxides and nitrides, for dynamic nanophotonic applications.

17:20 : Invited talk
Conformal volumetric grayscale metamaterials with broad angle and broadband electromagnetic functionality
Qinglan Huang, Lucia Gan, Jonathan Fan
Stanford University (USA)
We introduce conformal grayscale metamaterials as a new class of volumetric electromagnetic media capable of supporting highly multiplexed responses and arbitrary, curvilinear form factors.

17:40 : Invited talk
Passive and active metasurface for multifunctional imaging and processing
Junxiao Zhou, Zhaowei Liu
University of California (USA)
Metasurfaces consisting of engineered nanostructures enable us to manipulate wavefront as desired, which leads to various applications. Here, we review our recent studies about multifunctional imaging and processing including edge imaging, quantitative phase imaging and tunable weighted summation of edge image and full image based on the designed metasurfaces. Such passive and active metasurface becomes promising candidate in real time image processing and parallel analog computing.

18:00 : Invited talk
Plasmonic nanoantennas and their applications *online*
Pierre Berini
University of Ottawa (Canada)
We review recent work on plasmonic nanoantennas and their applications in nonlinear optics and in optoelectronics.

18:20 : Invited talk
Mie lattice resonance with coupled multipoles *online*
Viktoriia Babicheva
University of New Mexico (USA)
In this work, we aim at designing efficient directional scatterers and their arrays for metasurfaces and transdimensional metastructures. Nanoparticles of high-refractive-index materials like semiconductors enable strong confinement of light at the subwavelength scale because of the strong reflection from material boundaries and excitation of Mie resonances within the nanoscale-size particle. The combination of different materials in the nanoparticle allows to tune electric and magnetic resonances of the nanoparticles and achieve broadband overlap.

16:40 - 18:40 — Room 5

Session 2A23

Symposium II: New trends in nanophotonics and advanced materials

Organized by: Junsuk Rho, Hakjoo Lee and Namkyoo Park

Chaired by: Junsuk Rho, Hakjoo Lee and Namkyoo Park

16:40 : Invited talk
Time-Domain Properties of Strongly Coupled Epsilon-Near-Zero Modes
Mehdi H. Ebrahim[1], Andrea Marini[2], Vincenzo Bruno[1], Nathaniel Kinsey[3], Jacob B. Khurgin[4], Daniele Faccio[1], Matteo Clerici[1]
[1]*University of Glasgow (United Kingdom),* [2]*University of L'Aquila (Italy),* [3]*Virginia Commonwealth University (USA),* [4]*Johns Hopkins University (USA)*

We numerically demonstrate a significant light-trapping mechanism in a deeply subwavelength epsilon-near-zero (ENZ) system strongly coupled with the plasmonic modes of gold nanoantennae. The longitudinal and transverse field components of the impinging pulse are shown to dominate the temporal response at the higher and lower resonant frequencies, respectively. Moreover, the slow-light effect is particularly accentuated within the strongly coupled regime and thus such ENZ plasmonic systems can provide an alternative platform for control and manipulation of light.

17:00 : Invited talk

Latent Symmetries for the Design of Flat Bands

Malte Rontgen, Christian Morfonios, Maxim Pyzh, Peter Schmelcher

University of Hamburg (Germany)

Flat energy bands of lattice Hamiltonians provide a key ingredient in designing dispersionless wave excitations. We show that flat bands can be generated from a hidden symmetry of the lattice unit cell. This allows us to construct them by using a latently symmetric unit cell and multiplet interconnections. We demonstrate that the resulting flat bands are tunable and preserve the latent symmetry. The developed framework may offer fruitful perspectives to analyze and design flat band structures.

17:20 : Invited talk

Indirect imaging of plasmonic resonances modes in terahertz inkjet printed metasurfaces using an infrared camera.

Cyprien Brulon, Baptiste Fix, Patrick Bouchon

Universite Paris-Saclay (France)

We investigate the use of an ultrafast infrared camera to map the electromagnetic losses induced by terahertz plasmonic resonators. We demonstrate its application to a periodic array of "dolmen"type resonators showing two near-field modes whose coupling gives rise to an electromagnetically induced transparency. The response of these resonators fabricated by inkjet printing is compared with electromagnetic simulations. This non-invasive mode-mapping method appears to be effective for studying the near-fields of sub-wavelength plasmonic terahertz resonators on macrometric scales.

17:40 : Invited talk

Optimized laser-induced colors and image multiplexing on plasmonic quasi-random metasurfaces using deep learning

Hongfeng Ma, Nicolas Dalloz, Amaury Habrard, Marc Sebban, Mathieu Hebert, Nathalie Destouches

Universite de Lyon (France)

We demonstrate that deep learning can be used to predict the colors and spectra that can emerge in different observation conditions from the laser processing of metasurfaces including random metallic nanostructures. Our approach offers an accuracy on the color prediction that is better than the minimum color difference that a human eye can perceive. We then use the predicted color charts to greatly improve the performance of the printed image multiplexing method in terms of image contrast.

18:00 : Invited talk

Low-loss Tamm modes applied to room temperature lasing

Clementine Symonds[1], Vincent Toanen[1], Jean-Michel Benoit[1], Alban Gassenq[2], Aristide Lemaitre[3], Joel Bellessa[2]

[1]*Universite de Lyon (France),* [2]*Universite Lyon 1 (France),* [3]*Universite Paris-Saclay (France)*

Tamm structures are very promising for the development of confined lasers, polarized lasers or plasmon sources. The quality factor is a key issue to realize such devices. We propose here an optimized design of these structures, enabling an increased quality factor. In particular, we will show that these optimized structures enable room temperature lasing operation. This first demonstration is an important step toward future applicative developments of Tamm lasers.

18:20 : Invited talk

Light management strategies for luminescent solar concentrators and cooling of photovoltaic modules

Vivian Ferry

University of Minnesota (USA)

This presentation will discuss different strategies for light management in photovoltaic systems. Luminescent solar concentrators are building-integrated sunlight-harvesting systems that utilize down-shifting to concentrate sunlight. Performance of these structures is improved with photonic designs that optimally redirect light. In the second, structures are integrated into photovoltaic modules to enhance the energy yield by simultaneously acting as anti-reflection coatings and reflectors of near-infrared light, lowering the operating temperature. We will discuss the design of these structures and the limits to performance.

16:40 - 18:35 — Room 6

Session 2A24

Symposium V: Phononics and acoustic metamaterials

Organized by: Jensen Li and Guoliang Huang

Chaired by: Jensen Li and Guoliang Huang

16:40 : Invited talk

Wave scattering and latent symmetries: some acoustic examples

Malte Rontgen[1], **Vassos Achilleos**[2], **Christian Morfonios**[1], **Olivier Richoux**[2], **Georgios Theocharis**[2], **Peter Schmelcher**[1]
[1]*Universitat Hamburg (Germany)*, [2]*LAUM (France)*

In this work, we make a connection between latent symmetries and wave scattering. By choosing simple waveguide configurations with an underlying latent symmetry we construct scatterers that are not mirror symmetric but their scattering matrix inherits the properties of a mirror symmetric problem. Also by introducing the concept of generalized cospectrality we show that it provides a direct means to devices featuring coherent perfect absorption for at least one frequency. Numerical examples in airborne acoustics confirm the theoretical findings.

17:00 : Invited talk

Stealthy hyperuniform phononic resonant materials: One dimension

Vicente Romero-García[1], **E. Cheron**[1], **S. Kuznetsova**[1], **J.-P. Groby**[1], **S. Felix**[1], **V. Pagneux**[1], **L. M. Garcia-Raffi**[2]
[1]*Le Mans Universite (France)*, [2]*Universitat Politecnica de Valencia (Spain)*

In this presentation, we discuss the fundamental effect of resonant and non-resonant scatterers on the opening of band gaps in 1D stealthy hyperuniform materials.

17:20 : Invited talk

Holey Silicon Thin-Films for Thermoelectric Applications

Mona Zebarjadi, T. Zhu
University of Virginia (USA)

Silicon thin films are compatible with the semiconductor industry and are appropriate for thermoelectricpower generation and cooling. It is shown that by patterning the silicon thin-films with nanosized holes spaced closerthan the phonon mean free path, their thermal conductivity can be greatly suppressed while their electronic propertiesare maintained. Further, by using surface doping, the thermoelectric power factor can enhance resulting in animproved thermoelectric figure of merit, ZT. Here, we study the limits of these two approaches.

17:40 : Invited talk

Refraction-type transmodal metasurface for broad-angle elastic mode conversion

Sungwon Lee[1], **H. M. Seung**[2], **W. J. Choi**[2], **M. Kim**[3], **J. H. Oh**[1]
[1]*UNIST (Korea)*, [2]*Korea Research Institute of Standards and Science (Korea)*, [3]*UST (Korea)*

We suggest refraction-type transmodal metasurface which can totally convert longitudinal to shear wave for broad incident angle. According to the classical elastics, such total mode conversion is only possible at a certain incident angle. However, we achieved the broad angle total mode conversion through sufficiently large phase gradient which is realized under full transmission. By numerical and experimental validations, we showed that the proposed metasurface can provide the desired functionality for broad incident angles from

-20.4 degree to 22.3 degree.

17:55 : Invited talk
Modeling thermal conductance of a finite superlattice
Keivan Esfarjani
University of Virginia (USA)

In this work, we report on a model which describes the thermal conductance of a finite superlattice deposited on a semi-infinite substrate. This problem has been challenging because in the thin limit, transport of phonons is essentially ballistic, while in the thick limit it is diffusive. This model incorporates coherence in the small superlattice thickness limit and recovers the incoherent case where resistances add, in the thick limit.

18:15 : Invited talk
Controlling Sound Wave via Spinning Media *online*
Mohamed Farhat, Ying Wu
King Abdullah University of Science and Technology (Saudi Arabia)

In this talk, we will discuss our recent advances on controlling sound wave via spinning media. First, we study the torque and force a spinning cylindrical column of fluid experiences in evanescent acoustic fields, and show that the resulting discontinuity can scatter sound in unusual ways, e.g., a negative radiation force. In another example, we develop a generalized scattering cancellation theory (SCT) to cloak spinning objects from static observers. Our work extends the applicable realms of SCT to moving objects.

16:40 - 18:40 — Room 7

Session 2A25

Bottom-up approaches, new fabrication routes and ENSEMBLE3

Organized by: Dorota Pawlak and Virginie Ponsinet

Chaired by: Virginie Ponsinet

16:40 : Invited talk
3D optical metamaterials made from self-assembled block copolymer templates
Ilja Gunkel
Adolphe Merkle Institute (Switzerland)

Block copolymer (BCP) self-assembly allows the efficient fabrication of otherwise inaccessible 3D nanoscale structures. Replicating the often-complex periodic nanostructure of a polymer template into gold or silver leads to emerging properties such as linear or circular dichroism.

17:00 : Invited talk
Functional nanostructures for photocatalysis and optical applications
S. H. Mir, B. D. Jennings, G. E. Akinoglu, A. Selkirk, R. Gatensby, Parvaneh Mokarian-Tabari
Trinity College Dublin (Ireland)

Nanostructures are well-known for their increased reactivity/interactivity compared to their bulk counterparts. They have stimulated the development of many fabrication techniques, including block copolymer (BCP) patterning. We will present a nanostructured photocatalytic device fabricated using BCP patterning. The device is comprised of a nanoporous silicon substrate infiltrated with gold nanoparticles (AuNPs) and achieved near complete photo-degradation of dye within 90 minutes1, significantly faster than for AuNPs on unstructured Si. Other BCP-fabricated nanostructures2 which present near-zero reflectance will also be presented.

17:20 : Invited talk
Photonic nanomaterials by self-assembly of block copolymers
Tapio Niemi
Tampere University (Finland)

Scientific community and industry are actively investigating innovative means to overcome the fundamental limitations of conventional nanolithography. One emerging technique is based on directed self-assembly of block copolymers. Besides the possibility to realize extremely small feature sizes, they enable fabrication of exotic nanostructures, which are challenging or impossible to fabricate by other methods. I shall demonstrate few applications for etch masks, refractive index tuning and preparation of multi-material nanostructures.

17:40 : Invited talk

Self-Assembled Huygens' Metasurfaces and Their Integration into Photovoltaic Devices

Peter M. Piechulla[1], **Evgeniia Slivina**[2], **Derk Batzner**[3], **Ivan Fernandez-Corbaton**[2], **Prerak Dhawan**[2], **Ralf B. Wehrspohn**[1], **Alexander N. Sprafke**[1], **Carsten Rockstuhl**[2]

[1] *Martin Luther University Halle-Wittenberg (Germany)*, [2] *Karlsruhe Institute of Technology (Germany)*, [3] *Meyer Burger Research AG (Switzerland)*

Huygens' Metasurfaces made from high permittivity dielectric discs are fabricated by a self-assembly process on large areas. This permits their integration into industrial grade solar cells to optimize the light management. Two aspects are important. The helicity preserving character of the Huygens' metasurfaces suppresses reflection, and the hyperuniform disorder improves the response in an extended spectral region. By theoretical, computational, and experimental means, we explore the optical and electrical characteristics of the solar cell in this contribution.

18:00 : Invited talk

Biosensing with Plasmon Enhanced Upconversion Luminescence

Wounjhang Park

University of Colorado Boulder (USA)

This paper will present upconversion nanoparticle-based Forster resonant energy transfer (FRET) sensor which can clearly separate the effect of FRET and photon reabsorption. It will then describe how plasmonic nanostructures can be used to enhance the sensitivity and robustness of the sensor.

18:20 : Invited talk

Asembling and tunning metamaterials with laser-based techniques

Rosalia Serna[1], **Johann Toudert**[2], **Jose Gonzalo**[1], **Carlota Ruiz de Galarreta**[1], **Jan Siegel**[1]

[1] *CSIC (Spain)*, [2] *ENSEMBLE3 (Poland)*

The enormous success of nanophotonics to manipulate the light response in the nanoscale is due to the unprecedent development of techniques achieved to fabricate the material nano- and metasurfaces. Herein we will discuss the successful preparation and modification of nano-and meta-structures by laser-based processes designed to achieve functional nanophotonic and plasmonic responses in large areas. Examples will include metamaterials both based in conventional noble metals, and in topological materials for both pasive and active applications.

16:40 - 18:35 — Room 8

Session 2A26

Local enhancement and control of light-matter interaction

Organized by: Antonio Ambrosio

Chaired by: Stefano Chiodini

16:40 : Invited talk

Light-induced modulation of visco-elastic properties in azobenzene polymers

Stefano Chiodini[1], **Fabio Borbone**[2], **Stefano Oscurato**[2], **Antonio Ambrosio**[1]

[1] *IIT Milano (Italy)*, [2] *University of Naples "Federico II"(Italy)*

Photo-isomerization of azobenzene molecules can induce mass-migrations in azopolymers. Despite many applications, the mechanisms behind the mass-transfer is still under debate.[1] In this regard, azopolymer mechanical properties have been intensively studied, but the lack of a nanoscale technique capable of quantitative visco-elastic measurements have possibly hindered the field evolution. Here, we propose bi-modal AFM[2] for full nanomechanical characterizations of azopolymers. Our findings address a position-dependent photo-softening/hardening of the azopolymer, which we ascribe to a correspondent local photo-expansion/compression of the material.

17:00 : Invited talk
Out-of-plane symmetry-protected bound states in the continuum
Andreas Aigner[1], **Juan Wang**[1], **Andreas Tittl**[1], **Stefan A. Maier**[1], **Haoran Ren**[2]
[1] *Ludwig-Maximilians-University Munich (Germany),* [2] *Macquarie University (Australia)*

Symmetry-protected bound states in the continuum (BICs) combines high-quality factors (q-factors) with a large spectral tunability, offering an ideal platform for optical sensing. We present a plasmonic nanofin metasurface harnessing the out-of-plane symmetry breaking in parameter space by tuning the opening angle of 3D laser nanoprinted polymer triangles coated with gold. The plasmonic nature of the out-of-plane symmetry-protected BICs enables high surface field enhancement together with high q-factors, which have been utilised for refractive index and pixelated molecular sensing.

17:20 : Invited talk
Vortex laser arrays with topological charge control and self-healing of defects *online*
Marco Piccardo[1], **Michael de Oliveira**[1], **Andrea Toma**[1], **Vincenzo Aglieri**[1], **Andrew Forbes**[2], **Antonio Ambrosio**[1]
[1] *Fondazione Istituto Italiano di Tecnologia (Italy),* [2] *University of the Witwatersrand (South Africa)*

We present a non-Hermitian metasurface laser generating 100 strongly coupled vortices. The internal coupling mechanism allows to tune their charges as well as to heal defects in the system, opening new perspectives in topological optics.

17:40 : Invited talk
Symmetric high-Q metasurface enabled by bound states in the continuum
Guoce Yang[1], **Sukrith U. Dev**[2], **Monica S. Allen**[2], **Jeffery W. Allen**[2], **Hayk Harutyunyan**[1]
[1] *Emory University (USA),* [2] *Air Force Research Laboratory (USA)*

Metasurfaces based on bound states in the continuum have recently shown tremendous potential for demonstrating narrow spectral resonances enhancing light-matter interaction. However, these modes typically require complex asymmetric geometry and feature strong polarization dependence which complicates the fabrication process and limits practical applications. Here, we introduce a novel concept of magnetic resonances on a mirror which exhibit high quality bound states in the continuum with simple geometric parameters requiring no broken symmetry enabling easy control and large-area fabrication of metasurfaces.

18:00 : Invited talk
Long-Wavelength Resonant Antennas for Enhanced Radiation-Matter Interaction
Luca Razzari
INRS-EMT (Canada)

In this talk, I will provide a brief summary of our work on the use of resonant structures for boosting long-wavelength radiation - matter interactions.

18:20 : High performance, customizable infrared hyperbolic nanomaterials
Shangjie Yu, John Andris Roberts, Jonathan Fan
Stanford University (USA)

We introduce new classes of high performance infrared hyperbolic nanomaterials based on self-assembled carbon nanotube metamaterials and crystalline flame-grown MoO3 nanostructures.

Thursday 21st July, 2022

08:30 - 09:40 — Room 1

Session 3A1

Plenary Session III

08:30 : Plenary talk
Plenary Talk of Duheon Song
Duheon Song
Samsung Advanced Institute of Technology (Korea)
Plenary Talk of Duheon Song

09:05 : Plenary talk
Plenary Talk of Harry Atwater
Harry Atwater
California Institute of Technology (USA)
Plenary Talk of Harry Atwater

Coffee Break

Session 3P1

Poster session V

9:40 - 10:20

Chaired by:

P1: Hot electron photodetection with spectral selectivity using bismuth: strong light-matter interaction with nanosecond excited-state lifetime
Amir Ghobadi, Turkan Gamze Ulusoy Ghobadi, Ekmel Ozbay
Bilkent University (Turkey)
In this work, high-performance broadband and spectrally selective Bismuth (Bi) based hot electron photodetection are demonstrated. By coupling Bi with a Febry-Perot cavity, spectrally selective photodetectors. In the meantime, Bi nanorods can provide ultra-broadband light absorption, covering most of the solar spectrum. The characterization results show responsivity values larger than 100 mA/W, in both cases. This responsivity value is significantly larger than that of gold-based photodetectors. This is mainly originated from the nanosecond excited-state lifetime of the Bi hot electrons.

P2: Sub-wavelength Densely-packed Disordered Semiconductor Metasurface Units for Photoelectrochemical Hydrogen Generation
Turkan Gamze Ulusoy Ghobadi, Amir Ghobadi, Ekmel Ozbay
Bilkent University (Turkey)
In this work, we demonstrate the photoelectrochemical hydrogen generation capability of chromium oxide (CrOX) disordered nanorods. Later, to substantiate the photocurrent response, a core-crown (CrOX-NiOX) heterostructure is developed to catalyze the hydrogen evolution reaction. The optimal design provides photocurrent values as large as 50 μA cm-2, with a broadband spectral response covering the UV and short visible ranges (300-500 nm). Moreover, the photocathode shows unprecedented long-term stability under light irradiation for a duration of 9 hours.

P3: Non-Abelian Charged Nodal Lines in a Spring-Mass Phonon Wave System

Haedong Park[1], **Stephan Wong**[1], **Adrien Bouhon**[2], **Robert-Jan Slager**[2], **Sang Soon Oh**[1]
[1]*Cardiff University (United Kingdom),* [2]*University of Cambridge (United Kingdom)*

We demonstrate phase transitions of non-Abelian charged nodal lines in a classical spring-mass system. The nodal lines with non-Abelian charges are braided by tunning the spring constants allowing for topological phase transitions from nodal lines to a link. Here, we analyze the stability and instability of nodal lines using Euler class that provides a clear insight on possible phase transitions in a system with multi-gap topologies.

P4: Effective properties of two-dimensional dispersed composites

Natalia Rylko, Vladimir Mityushev
Cracow University of Technolog (Poland)

The generalized alternating method of Schwarz can be presented as an infinite sequence of all the mutual interactions between inclusions in the boundary value problem stated for a composite. New approximate analytical formulas for the effective properties of dispersed composites are derived by Schwarz's method for two-dimensional composites.

P5: Compendium of Natural Epsilon-Near Zero Materials

Hamid Reza Darabian, Dorota Anna Pawlak
Ensemble3 (Poland)

In this work, a complete set of natural materials, including metals, semiconductors, oxides, halides and so on, which have dielectric permittivity around zero, together with different quality factors will be presented. The calculations are based on optical properties like refractive index and absorption coefficient. We will discuss different quality factors for various applications and eventually introduce best candidates for those applications.

P6: Effective models for space-coiled metasurfaces

Joar Zhou Hagstrom[1], **Agnes Maurel**[2], **Kim Pham**[1]
[1]*ENSTA ParisTech (France),* [2]*ESPCI ParisTech (France)*

We study two types of transmission problems for so-called spaced-coiled or labyrinthine structured metasurfaces. The two different types of metasurfaces differ by their winding arrangements and we show that this leads to very different resonant mechanisms and effective asymptotic models are provided for both.

P7: ZrN-ZrO2 multilayered metamaterials as thermophotovoltaic selective emitters

Jose Luis Ocana Pujol, Katja Sha Bjornstad, Ralph Spolenak, Henning Galinski
ETH Zurich (Switzerland)

We propose ZrN-ZrO2 multilayered hyperbolic metamaterials as a selective emitter for thermophotovoltaic energy conversion. Our calculations show a twofold improvement in the spectral selectivity compared with a black body at 1200K. The system was fabricated using scalable reactive magnetron sputtering using solely a single zirconium target. The combination of FIB cross sections imaging with optical characterization shows that samples annealed in vacuum to up to 1200K show no sign of chemical degradation and therefore no decrease in the spectral efficiency.

P8: Modeling of High Harmonic Generation in CdSe Quantum dot: a simple Model

Farshid Yahyaei, Ulf Peschel
Friedrich Schiller University Jena (Germany)

We simulate higher harmonic generation in a CdSe Quantum dot using a simple box model. The effect of near-field enhancement and of a space-dependent effective mass of electrons are investigated.

P9: Low Cost Additive Manufacturing of Bandgap Photonic Crystals for mmWave Applications

Simon Hehenberger[1], **Stefano Caizzone**[1], **Alexander Yarovoy**[2]
[1]*German Aerospace Center (DLR) (Germany),* [2]*TU Delft (The Netherlands)*

3D electromagnetic bandgap photonic crystal structures for applications in the millimeter-wave domain, fabricated via low-cost fused deposition modeling (FDM) additive manufacturing methods are studied. A simulation study of the woodpile and diamond bandgap lattices in terms of their bandgap frequencies and fractional bandwidth as a function of the index contrast is presented. Furthermore, suitable materials compatible with commonly available FDM 3D printers and with high permittivity are identified.

P10: Enhanced second-harmonic generation in MoS2 integrated into an asymmetric one-dimensional

photonic crystals

Sara Khazaee, Ulf Peschel
IFTO (Germany)

Two-dimensional transition metal dichalcogenides (TMDCs) have shown large second-order nonlinear responses due to their broken crystal inversion symmetry. However, their nonlinear interaction with light is restricted to an atomically thin layer. Combining TMDCs with resonant structures can compensate for this shortcoming. Here, we numerically demonstrate 9-fold second-harmonic (SH) enhancement from MoS2 integration onto engineered asymmetric silicon nitride photonic crystals (PCs) relative to the previous PCs design for SH enhancement.

P11: Mapping localized stress relaxation in epitaxial strained Ge films with tip-enhanced Raman spectroscopy

Zoheb Khan, Thomas Nuytten, Han Han, Claudia Fleischmann, Ingrid De Wolf, Wilfried Vandervorst
IMEC (Belgium)

Epitaxially grown strained semiconductor films are the building block of state-of-the-art strained fin field-effect transistor devices. The reliable characterization of the local stress state in these films is important to ensure quality of the manufacturing processes. Tip-enhanced Raman spectroscopy can map the material stress with nanoscale spatial resolution. We apply TERS to study local stress relaxations in strained films and combine the technique with atomic force microscopy and electron channeling contrast imaging, to understand the underlying relaxation mechanisms.

P12: Autler-Townes splitting in a hybridized Helmholtz resonator

Sarah Tachet[1], Agnes Maurel[2], Kim Pham[1]
[1] *Institut Polytechnique de Paris (France),* [2] *Universite PSL (France)*

We study acoustic wave propagation in a narrow 2D waveguide containing a subwavelength scatterer. We derive effective one-dimensional models which encode the effect of the scatterer in effective jump conditions [1], we envision the successive cases where the scatterer is a plain rigid obstacle, a resonator of the Helmholtz type and eventually a split resonator.

P13: Exciton-polariton optical nonlinearity in perovskite planar photonic crystal slab affected by polaronic effects

Mikhail Masharin, Vanik Shahnazaryan, Fedor Benimetsky, Ivan Shelykh, Ivan Iorsh, Sergey Makarov, Anton Samusev
ITMO University (Russia)

The strong light-matter coupling regime of excitonic materials embedded in optical cavities is a highly studied phenomenon today due to several attractive properties of exciton-polaritons. Recent works have shown that halide perovskites a new group of perspective polaritonic materials thanks to their high exciton binding energy and large oscillator strength. In this work, we demonstrate the nonlinear response of exciton-polariton states in perovskite planar crystal slab at cryogenic temperatures, showing record-high polariton blueshifts of 19,7 meV.

P14: Electrically Controlled Multiferroic Photonic Grating

Ramaz Khomeriki
Javakhishvili Tbilisi State University (Georgia)

Single phase multiferroic with easy plane magnetic anisotropy and Dzyaloshinskii-Moriya typeelectro-magnetic coupling is considered. Static electric field causes the establishment of helically ordered groundstate and it is shown that this structure acts as a periodic potential for light propagation through the multiferroic.The corresponding magnon-photonic band-gap spectrum is calculated and the possibility of light trapping whiledriving inside the photonic gap is numerically revieled.

P15: Inversely designed ultrahigh refractive index metamaterial for compact sensing

Maxim Elizarov, Andrea Fratalocchi
KAUST (Saudi Arabia)

We propose optical RI sensor with sensitivity of 350 nm/RIU for the micrometer footprint. The advantage of this sensor is the ability to sustain air-confined high-Q modes which probe the analyte material with entire energy distribution of the mode. The device is based on artificial material which can emulate non-dispersive ultra-high refractive index (n$\sim$100) capable of strong localization of incoming radiation. This is achieved by suitable deformation of a reflective substrate by applying inverse design to transformation optics approach.

P16: Snapshot hyperspectral imaging via learned metasurface encoders

Maksim Makarenko, Fedor Getman, Arturo Burguete-Lopez, Qizhou Wang, Silvio Giancola, Bernard Ghanem, Andrea Fratalocchi
KAUST (Saudi Arabia)

In this work, we present Hyplex system, a real-time high-resolution hyperspectral camera based on a combination of hardware metasurface encoders and software decoders.

P17: Fabrication and Characterization of Multifunctional Copper Thin film by Direct Current Sputtering

Abdullah Aljishi, Mohammad Hossain
King Fahd University of Petroleum and Minerals (Saudi Arabia)

Copper (Cu) is an earth abundant element and widely used in different areas of research. Nanostructured Cu thin film possesses multifunctional characteristics such as luminescent down shifting, UV protection and hydrophobicity, a few to mention amongst others. Here in this work, we have fabricated ultrathin layer of Cu on glass substrate by direct current sputtering technique. Optical, structural and topographical investigations have been carried out thoroughly. A series of characterization techniques were carried out to confirm the multifunctional characteristics.

P18: Electromagnetic Near-Field Distributions at the Interstitials of Plasmonic Nanoparticles through Finite-Difference Time-Domain Analysis

Abdullah Aljishi, Mohammad Hossain
King Fahd University of Petroleum and Minerals (Saudi Arabia)

Electromagnetic (EM) near-field distribution is a key ingredient that defines the intensity and stature of surface plasmon resonances (SPRs), coherent and collective oscillations of surface electrons. However, EM distributions rely on the nanometric geometry of the interstitials of plasmonic nanoassembly. In this work, we have carried out extensive finite-difference time-domain analysis on EM near-field distributions for a wide range of plasmonic nanoassemblies ranging from monomer, dimer, trimer, tetramer, heptamer to long-range two-dimensional nanoassembly of gold nanoparticles.

P19: Near-Field Surface-Enhanced Raman Scattering of a Well-Defined Gold Nanoaggregate

Mohammad Kamal Hossain
King Fahd University of Petroleum and Minerals (Saudi Arabia)

We provide near-field spectroscopy of gold nanoaggregates with a substantial enhancement in surface-enhanced Raman scattering. Using an aperture near-field scanning optical microscope and a well-defined aggregate, a good correlation between topography and optical confinement was revealed. The genesis of the localized electromagnetic (EM) field at the "hotsite.ªnd the EM enhancement factor in the SERS process require such a direct observation with high spatial resolution. The results were validated using a finite deffirence time domain analysis.

P20: Fabrication of Copper-Doped Zinc Oxide Thin film in Nitrogen Environment for Solar Cell Applications

Mohammad Kamal Hossain, M. Al-Rasheidi
King Fahd University of Petroleum and Minerals (Saudi Arabia)

Due to high expectations to increase inherent characteristics, there is a major challenge to dope Zinc Oxide (ZnO) with metal as well as replace Oxygen sites with Nitrogen (N2). Therefore, acceptor and donor doping simultaneously are one of the recent interests in ZnO thin film research. A simple and one-step process to fabricate N2-rich Copper-doped ZnO ultrathin layer through a co-sputtering technique has been reported in this study. Optical, structural, and topographical investigations have been carried out thoroughly.

P21: Complete Tunable Phase Modulation Using Avoided Crossing of Resonances

Ju Young Kim[1], Juho Park[1], G. R. Holdman[2], J. T. Heiden[1], S. Kim[1], V. W. Brar[2], M. Jang[1]
[1]*Korea Advanced Institute of Science and Technology (Korea)*, [2]*University of Wisconsin-Madison (USA)*

Active metasurfaces are an attractive means of achieving high-resolution spatiotemporal control of optical wavefronts, having applications such as LIDAR and dynamic holography. However, achieving full, dynamic phase control has been elusive in metasurfaces. Here, we unveil a metasurface design strategy that operates near the avoided crossing of two resonances. A proof-of-concept metasurface using quasi-bound states in the continuum and graphene plasmon resonances is verified numerically, with results showing a 3π phase modulation capacity with a uniform reflection amplitude of $\sim$0.65.

P22: A Terahertz Room-temperature Detector Based on Double-layer Cantilevers and Photothermal Metasurface

Hailiang Zhu[1], Kai Wang[1], Ganyu Liu[1], Yuwei Qiu[1], Jinchao Mou[2], Gao Wei[1]
[1]*Northwestern Polytechnical University (China),* [2]*Beijing Research Institute of Telemetry (China)*

This paper proposes a photomechanical terahertz detector, which is ideal for forming the focal plane array. The detector works at room temperature, a metasurface absorber is used to couple the incident terahertz radiation with near perfect absorption performance. The double-layer cantilevers will produce a deformation corresponding to incident power. The responsivity and response time are calculated and shown satisfied performance. Thermal isolation between pixels is also realized by introducing heat-insulating cantilevers.

P23: Broadband Terahertz Metasurface Absorber Based on Multi-layer Resonances

Kai Wang[1], Hailiang Zhu[1], Ganyu Liu[1], Yuwei Qiu[1], Jinchao Mou[2], Gao Wei[1]
[1]*Northwestern Polytechnical University (China),* [2]*Beijing Research Institute of Telemetry (China)*

In this paper, a near-perfect terahertz absorber is proposed. Based on the multi-layer resonances, the metasurface has obtained satisfactory absorbing rate with a broadband. Since the strict center symmetry of the structure, the same absorbing rate and bandwidth can be maintained for any polarization angle. In addition, while the incident angle increasing, the metasurface can hold original bandwidth, and the absorbing rate is approximately maintained above eighty percent.

P24: Position-Robust Microwave Lip Language Recognition Based on Programmable Metasurface

Siyuan Jiang, Hanting Zhao, Hongrui Zhang, Zhuo Wang, Menglin Wei, Lianlin Li
Peking University (China)

In this work, we realize a Microwave Lip Language Recognition system that can accurately translate microwave data of the speaker's lip language into English text even when there exists interference caused by pose variation and head movement. Combined with Programmable metasurface's ability of scattering EM wave, the system can recognize lip language when the speaker stands in different positions or faces different directions and be qualified for the robust lip language recognition task.

P25: Nanoscale SERS Thermometry on Photothermally Heated Nanoparticles

Zee Hwan Kim
Seoul National University (Korea)

The local temperatures of a metal nanostructure and its adsorbate carry essential information about the energy dissipation dynamics, calling for nanoscale thermometry techniques. Here we present a surface-enhanced Raman scattering (SERS) thermometry method providing an accurate local temperature of the adsorbates on metallic nanostructures.

P26: Color modulation based on dynamic plasmon resonance tuning in inter-cubes of Ag nanocube monolayer

Ayana Mizuno, Atsushi Ono
Shizuoka University (Japan)

We demonstrated color modulation by dynamically tuning a plasmon resonance excited in an assembled Ag nanocube monolayer. The plasmon resonance of the monolayer depends on inter-cube distances. This study fabricated a crystalline Ag nanocube monolayer in a stretchable and transparent substrate and continuously controlled the inter-cube distance by stretching the substrate. The transmitted light color modulated from magenta, orange, to yellow by stretching the substrate from 0 % to 20 %.

P27: 3D Printed Multilayer Achromatic Metalens with Large Numerical Aperture

Chengfeng Pan, Hao Wang, Joel Yang
Singapore University of Technology and Design (Singapore)

The design of achromatic metalens with large numerical aperture (NA) and wide band is a big challenge in metalens research. Here, two-photon polymerization lithography is used to fabricate multilayers high-resolution, high NA, and broadband visible achromatic metalens. The optimization of multilayer parameters is achieved by combining topology optimization with adjoint method. The effects of interlayer spacing, number of layers and polarization are discussed, and finally a metalens with NA=0.5, 300-700 nm wide and average efficiency of 30 % is achieved.

P28: Topologically-protected four-port optical coupler with broadband equal proportion splitting

Guo-Jing Tang, Xin-Tao He, Jian-Wen Dong
Sun Yat-Sen University (China)

In this talk, we propose a topological four-port coupler based on valley photonic crystals. Equal proportion splitting in continuous wavelength range is realized to be robust against structural perturbation. We reveal that the equal proportion splitting is guaranteed by valley topology and structural symmetry. With the topological four-port coupler, an on-chip interferometer is constructed to measure reflective phase. Our study clarifies the mechanism of equal proportion splitting in valley photonic crystals and promote the practical application of topological photonic systems.

P29: A spin-wave driven skyrmion diode under transverse magnetic fields

Lingling Song, Huanhuan Yang, Yunshan Cao, Peng Yan
University of Electronic Science and Technology (China)

We study the motion of the skyrmion driven by the spin wave (SW) in the presence of a transverse magnetic field. We show that the external magnetic field induces an asymmetric skyrmion propagation when SWs are injected from opposite sides. Based on this findings, we propose the concept of a SW-driven skyrmion diode. The asymmetry skyrmion velocity is explained by computing the spin-wave transport coefficients. Our results offer a new insight to design skyrmion devices embracing chiral SWs.

P30: N00N-states of surface plasmon-polariton pairs from a nonlinear nanoparticle

Nikita Olekhno[1], Mikhail Petrov[1], Ivan Iorsh[1], Andrey Sukhorukov[2], Alexander Solntsev[3]
[1]*ITMO University (Russia),* [2]*The Australian National University (Australia),* [3]*University of Technology Sydney (Australia)*

We study the generation of surface plasmon-polariton pairs with a gallium arsenide nanoparticle located at the silver-air interface. We demonstrate theoretically that N00N-states of surface plasmon-polariton pairs with N=2 can be obtained for certain excitation geometries. The effect can be physically interpreted as the result of a quantum interference between pairs of induced sources, each emitting either signal or idler plasmons.

P31: Coherent Conversion Between One and Two Photons in Waveguides with Engineered Dispersion

Alexander Solntsev[1], Sergey Batalov[2], Nathan Langford[1], Andrey Sukhorukov[3]
[1]*University of Technology Sydney (Australia),* [2]*ITMO University (Russia),* [3]*Australian National University (Australia)*

High-efficiency photon-pair production is a long-sought-after goal for many optical quantum technologies, and coherent photon conversion processes are promising candidates for achieving this. We show theoretically how to control coherent conversion between a narrow-band pump photon and broadband photon pairs in nonlinear optical waveguides by tailoring frequency dispersion for broadband quantum frequency mixing.

P32: Simple Metasurfaces for Efficient Optical Dating of Minerals *online*

Athanasios Papadimopoulos[1], B. Bianchi Pardo[2], A. Baccini[2], A. Di Iorio[2]
[1]*Cyprus Space Exploration Organization (Greece),* [2]*Alma Sistemi Srl (Italy)*

Optical dating is a well-established methodology, frequently employed in geology and archaeology in order to determine the duration that certain minerals have been exposed to sunlight. Metamaterials and metasurfaces, artificially engineered materials with extraordinary electromagnetic properties, have the potential to substantially improve the performance of optical components. In this paper we propose simple metasurface designs to improve the efficiency of optical dating devices.

P33: Design of a near infrared polarization filter using the epsilon near zero properties of donor-doped ZnO *online*

Ranjeet Dwivedi, Johann Toudert
ENSEMBLE3 (Poland)

We propose the design of a near infrared polarization filter based on periodic donor-doped ZnO nano-layers embedded in a transparent dielectric matrix. We show that, for TM polarized incident light, around the epsilon near zero wavelength, the electric field is extremely confined in the donor-doped ZnO nano-layers, which gives an ultra-high propagation loss compared to the TE polarization. By harnessing this feature, we found a polarization extinction ratio $textgreater$1000 and a TE transmittance $textgreater$80 %, in the wavelength range 1230-1460 nm.

P34: Flexible broken-symmetry metasurfaces with sharp resonant response *online*

Odysseas Tsilipakos[1], **Luca Maiolo**[2], **Francesco Maita**[2], **Romeo Beccherelli**[2], **Maria Kafesaki**[1], **Emmanouil Kriezis**[3], **Traianos Yioultsis**[3], **Dimitrios Zografopoulos**[2]
[1] *Foundation for Research and Technology Hellas (Greece),* [2] *CNR-IMM (Italy),* [3] *Aristotle University of Thessaloniki (Greece)*

We demonstrate flexible, sharply-resonant metasurfaces for the technologically-important low millimeter wave (25GHz) frequencies. Initially non-radiative meta-atoms are made to couple with free space via a small degree of geometric asymmetry, leading to controllably-sharp spectral response. The proposed metasurface is fabricated on an ultrathin polyimide substrate, resulting in a low-loss and flexible structure that can conformally coat objects or textiles. Theoretical results are verified by measurements and quality factors of several hundreds are experimentally obtained.

P35: Nonlinear Optical Response of Thin Film Amorphous Gold Nanoparticle Layers *online*

Navid Daryakar, Christin David
Friedrich Schiller University of Jena (Germany)

The effective medium theory has been used to investigate third order nonlinear response of gold nanoparticles embedded in alumina host. In the nonlinear regime, the optical response is modified and the dependence on fill fraction at different frequency were studied. The results show that the enhancement factor shows different behavior depending on the volume fraction, this indicates that it is possible to optimize enhancement by appropriate selection of the volume fraction of the nanoparticles.

P36: Design and Development of Tunable Metamaterial based planar Band stop filter for wireless application *online*

Khyati Chavda
Shantilal Shah Engineering College (India)

This paper design and developing a very compact microstrip based reconfigurable filter using for as per IEEE 802.11 WLAN application. To tunable frequency range from 2.1 to 3.5 GHz. The measured return losses of more than- 23 dB and insertion losses of less than -0.8 dB, the bandwidth is very narrow kept between 22 and 47 MHz . The size of filter is 11x 20x1.57mm3 is very compact to previous work. The great agreement between simulation and measured results.

P37: Ionic plasmon-polariton model of the saltatory conduction in myelinated axons *online*

Monika Laska, Zofia Krzeminska, Janusz Jacak, Witold Jacak
Wroclaw University of Science and Technology (Poland)

The microscopic theory of ionic plasmon-polariton kinetics in periodically myelinated axons is developed in order to explain the high speed signal transduction in such axons not available to diffusive ion currents in nerve cells. The model takes advantage from the plasmon-polariton dynamics observed in metallic nano-chains.

10:20 - 12:35 — Room 1

Session 3A2

Symposium III: Advanced passive and active metasurfaces

Organized by: Howard Lee and Pin-Chieh Wu

Chaired by: Howard Lee and Pin-Chieh Wu

10:20 : Keynote talk
Flat Optics for Dynamic Wavefront Manipulation

Mark Brongersma
Geballe Laboratory for Advanced Materials (USA)

In this presentation, I will highlight recent efforts in our group to realize electrically-tunable metasurfaces employing nanomechanics, tunable transparent oxides, microfluidics, phase change materials, and atomically-thin semiconductors. Such elements are capable of dynamic wavefront manipulation for optical beam steering and holography. The proposed optical elements can be fabricated by scalable fabrication technologies, opening the door to a wide range of commercial applications.

10:50 : Keynote talk
Topological Metasurfaces
Patrice Genevet
Universite Côte d'Azur (France)

New degrees of freedom in the design of optical components are attained by considering the response of topological nanostructures. Relying on symmetry-breaking arguments and topological properties of non-Hermitian metasurfaces, we provide new guidelines for achieving 2π phase coverage in transmission and reflection. Crossing of the branch cut is shown to provide a very intuitive design approach for achieving full resonant phase scattering. Our results highlight the role of topological defects for achieving realistic and insightful metasurface designs.

11:20 : Invited talk
Dispersion-engineered metasurfaces for ultrafast pulse compression and large-scale RGB-achromatic focusing
Yao-Wei Huang[1], Zhaoyi Li[2], Marcus Ossiander[2], Peng Lin[3], Raphaël Pestourie[4], Joon-Suh Park[2], Wei Ting Chen[2], Zhenhao Wang[5], Xinghui Yin[2], Zhujun Shi[2], Yousef Ibrahim[2], Cheng-Wei Qiu[6], Martin Schultze[5], Ji-Xin Cheng[3], Steven Johnson[4], Federico Capasso[2]
[1]*National Yang Ming Chiao Tung University (Taiwan),* [2]*Harvard University (USA),* [3]*Boston University (USA),* [4]*Massachusetts Institute of Technology (USA),* [5]*Graz University of Technology (Austria),* [6]*National University of Singapore (USA)*

It has become possible to manipulate light spectrally and spatially on demand at wavelength scale in recent years. Manipulations of ultrashort laser pulses in the time domain and large-scale penetration of achromatic metasurface-based lens are current challenges. In this talk, I will report our recent developments and applications of dispersion-engineered metasurfaces in compression of ultrashort laser pulses, millimeter-scale diameter RGB-achromatic metalens, and its potential for future virtual-reality platforms.

11:40 : Invited talk
Dynamic metaphotonics for structural colors and holographic displays
Junsuk Rho
POSTECH (Korea)

Flat optics, which is realized by the artificially created two-dimensional material platform called optical metasurfaces, is currently undergoing a science-to-technology transition. A representative example includes a flat and ultra-compact metalens, which has huge potential for replacing conventional bulky and heavy optical lens. However, real-time.ªctive operations of those flat optical devices have remained unresolved yet. To resolve such a grand challenge, we propose two approaches to realize dynamic metaphotonic devices using multiple light properties and tunable materials.

12:00 : Invited talk
Metasurface for multidimensional light field sensing
Yuanmu Yang
Tsinghua University (China)

I will present my group"s recent effort to replace conventional camera lenses with metalenses. By leveraging the unique capability of metasurface to tailor the vectorial field of light, in combination with advanced image retrieval algorithm, we aim to build a compact camera system that can capture multi-dimensional light field information of a target scene in a single shot under ambient illumination conditions.

12:20 : Metasurface coincidence images with Hong-Ou-Mandel effect *online*
Tsz Kit Yung, Wing Yim Tam, Jensen Li
The Hong Kong University of Science and Technology (China)

By using orthogonal linear-polarized photons, images with tailor-made second-order coherence signatures are generated as çoincidence images"from metasurfaces. The metasurfaces provide arbitrary control on the coincidence signal (correlated, anticorrelated, or uncorrelated photons) at different locations either on the metasurface or the focal plane of the metasurface. The ability to generate polarization coincidence images from metasurfaces is potentially useful for setting up quantum imaging schemes.

10:20 - 12:40 — Room 2

Session 3A3

Symposium II: New trends in nanophotonics and advanced materials

Organized by: Junsuk Rho, Hakjoo Lee and Namkyoo Park

Chaired by: Junsuk Rho, Hakjoo Lee and Namkyoo Park

10:20 : Invited talk

Non-Hermitian Topological Whispering Gallery: Experiments

Zhiwang Zhang[1], Ying Cheng[1], Xiaojun Liu[1], Johan Christensen[2]
[1]*Nanjing University (China),* [2]*Universidad Carlos III de Madrid (Spain)*

Lately, intense research efforts have focused on exploring non-Hermitian systems with cleverly matched gain and loss. Likewise, the surge in physics using topological insulators have laid the groundwork in reshaping highly unconventional avenues for robust and reflection-free guiding. Here, we construct a topological gallery-insulator using sonic crystals made of thermoplastic rods that are decorated by carbon nanotube (CNT) films. By engineering specific non-Hermiticity textures, we are able to achieve topological .ªudio lasing"modes with the handedness as one desires.

10:40 : Invited talk

Non-phase-matching brings new nonlinear functionalities

Mengxin Ren, Zhanghang Zhu, Di Zhang, Bofeng Gao, Wei Wu, Jingjun Xu
Nankai University (China)

The phase-matching condition is considered as a golden rule for achieving efficient nonlinear processes. However, in this presentation, we will introduce several new functionalities brought by non-phase-matching.

11:00 : Invited talk

Molecular assembled metasurfaces for midinfrared light sources

Yoshiaki Nishijima
Yokohama National University (Japan)

We demonstrate spectrally narrowband mid-infrared radiation absorbance and thermal emittance with the strong surface enhancement of molecular infrared absorption (SEIRA) using mid-midinfrared metasurfaces. This was achieved by harnessing mode coupling between a plasmonic metal-insulator-metal (MIM) meta-surface and molecular vibrational mode resonances. We found that the weak/strong coupling has a high potential for the future application of thermal emitters for mid-infrared light sources and thermal radiation analytical method. We will present recent advances in the coupling of molecular vibration and metasurfaces.

11:20 : Invited talk

Advanced Signal processing utilising integrate stimulated Brillouin scattering

Moritz Merklein
The University of Sydney (Australia)

Integrated photonic circuits offer great potential for high-performance optical and microwave signal processing in a compact footprint. Inducing stimulated Brillouin scattering on chip provides a highly frequency selective, agile, and reconfigurable way to control and manipulate the phase and amplitude of optical signals. I will give an overview of on-chip platforms that support Brillouin scattering and highlight different signal processing functionalities.

11:40 : Invited talk

Visualization of photonic topological edge states in 1D and 2D plasmonic structures in the optical region

Yuto Moritake
Tokyo Institute of Technology (Japan)

Recently, topological photonics, which exploits the topological properties of systems and band structures, has become active. In this presentation, I introduce experimental observations of photonic topological edge states in plasmonic systems. The edge states in 1D plasmonic zigzag chains and 2D valley plasmonic crystals were visualized by far-field imaging and cathode luminescence, respectively. The topological plasmonic systems are expected to be developed into a new platform to increase the light-matter interaction with two-dimensional materials, which also have topological properties.

12:00 : Invited talk
Highly Efficient Metaphotonic Color-Routing Structure in the Sub-micron CMOS Image Sensor
Sookyoung Roh, Seokho Yun, Sangyun Lee, Hongkyu Park, Minwoo Lim, Sungmo Ahn, Hyuck Choo
Samsung Advanced Institute of Technology (Korea)

We report a novel metaphotonic color-routing (MPCR) structure that can significantly increase the quantum efficiency of sub-micron CMOS image sensors. Fabricated on the Samsung's commercial 0.8μm-pixel sensor, MPCR structures separate the incident light energy into appropriate color pixels at high efficiency, resulting in higher quantum efficiency up to +20 % than the conventional sensor. Our experimental demonstration confirms a luminance SNR improvement of +1.22dB under low light condition below 20 lux, accompanied with a comparably low color reproduction error.

12:20 : Invited talk
Enhanced fluorescence of fluorene-based pi-conjugated copolymer utilizing hyperbolic metamaterials *online*
Tatsunosuke Matsui[1], Fumiya Hashikawa[1], Hirotake Kajii[2]
[1] *Mie University (Japan),* [2] *Osaka University (Japan)*

We demonstrate the enhanced fluorescence of fluorene-based pi-conjugated copolymer utilizing hyperbolic metamaterials (HMMs). The HMMs were fabricated by alternately sputtering subwavelength thin layers of Au and Al2O3. As an active material, poly(9,9-dioctylfluorene-alt-benzothiadiazole) (F8BT), was spin-coated on the substrate with a thin layer of SiO2 inserted in between as a spacer. We have achieved a 3-fold enhancement of photoluminescence in the optimum device. Our findings may open the way for the development of a novel type of efficient organic light-emitting device.

10:20 - 12:45 — Room 3

Session 3A4

Symposium IV: Chirality, magnetism, and magnetoelectricity: Separate phenomena and joint effects in metamaterial structures

Organized by: Eugene Kamenetskii

Chaired by: Eugene Kamenetskii

10:20 : Invited talk
Dynamical Magnetic Phase Transitions in Spin-Charge Coupled Systems
Masahito Mochizuki, Rintaro Eto, Takashi Inoue
Waseda University (Japan)

Magnetization dynamics in magnets driven by light/microwave electromagnetic fields are attracting a great deal of research interest nowadays from the viewpoints of both fundamental science and technical application. We discuss our recent theoretical studies on dynamical manipulation of magnetism in spin-charge coupled metallic magnets via application of electromagnetic waves, i.e., the microwave-induced switching of magnetic topology and the photoinduced magnetic phase transition to a nonequilibrium 120-degree spin ordered phase in the triangular Kondo-lattice model.

10:40 : Invited talk

Magnon frequency comb

Zhenyu Wang[1], **H. Y. Yuan**[2], **Yunshan Cao**[1], **Z.-X. Li**[1], **Rembert A. Duine**[2], **Peng Yan**[1]
[1]*University of Electronic Science and Technology of China (China),* [2]*Utrecht University (The Netherlands)*

We theoretically study the magnon-skyrmion interaction and find that a magnonic frequency comb (MFC) can be generated above a threshold driving amplitude, where the nonlinear scattering process involving three magnons prevails. The mode spacing of the MFC is equal to the breathing-mode frequency of the skyrmion and is thus tunable by either electric or magnetic means. The theoretical prediction is verified by micromagnetic simulations, and the essential physics can be generalized to a large class of magnetic solitons.

11:00 : Invited talk

Metamaterial enhanced IR spectroscopy for solid, liquid, gas, and chiral materials

Takuo Tanaka
RIKEN (Japan)

Metamaterial enhanced infrared spectroscopy techniques are discussed. 2D metal-insulator-metal (MIM) metamaterial absorber was applied for sensing of solid monolayer of organic molecule. Metamaterials and nanofluidic hybrid device was proposed to introduce analytes solved in liquid solvent into the hot spots of MIM and 10-4molecules/Å2 sensitivity was demonstrated. For gas samples, 3D MIM metamaterial absorber was proposed and 20 ppm concentration of carbon dioxide and butane were detected. Chiral metamaterial absorber for enhancing the vibrational circular dichroism spectrum was also demonstrated.

11:20 : Invited talk

Hydrodynamic theory of electron and spin transport in disordered metal

Gen Tatara
RIKEN (Japan)

Electron and spin transports in metals are theoretically studied from a hydrodynamic viewpoint by calculating momentum flux density as a linear response to an applied electric field. Dissipative (ohmic) fluid regime is considered. An angular momentum generation in chiral (Weyl) system and spin motive force (voltage generation) by magnetization-vorticity coupling in anomalous Hall system are discussed. The spin Hall effect is argued from the viewpoint of a spin-vorticity coupling.

11:40 : Keynote talk

One-way photonic crystal waveguide modes with and without magnetic material *online*

Che Ting Chan
Hong Kong University of Science and Technology (Hong Kong)

Robust transport of edge modes is an important signature of topological materials. The bulk-edge correspondence states that the number of topological edge modes is determined by the bulk topological invariants and such edge modes decay exponentially into the bulk. Here, we discuss some examples in which one-way going modes can be realized with and without magnetic materials, but they are not .edge"modes in the sense that the wave is not exponentially localized on the edge.

12:10 : Invited talk

Spin-motion interconversion in ferromagnetic-nanomechanical hybrid systems *online*

Mamoru Matsuo
University of Chinese Academy of Sciences (China)

Recent developments in nanotechnology allow us to access microscopic spin relaxation processes to lattice in nanomechanical systems. This talk will discuss the interconversion phenomena between spin and motion in ferromagnetic systems, aiming to reveal microscopic angular momentum conversion mechanisms.

12:30 : Probing local chirality utilizing the Chiral Induced Spin Selective (CISS) effect

Shira Yochelis
The Hebrew Universit (Israel)

A new, effective spintronics was developed using the Chiral-Induced Spin Selectivity (CISS) effect [1]. Utilizing this effect we demonstrated a magnetless memory [2,3,4]. Also, local spin-based magnetization generated optically at ambient temperatures [5].

10:20 - 11:55 — Room 4

Session 3A5

Symposium I: Hybrid Nanomaterials and Metastructures for Photonics, Sensing and Energy

Organized by: Jerome Plain, Alexander Govorov, Davy Gerard and Pedro Hernandez Martinez

Chaired by: Jerome Plain, Alexander Govorov, Davy Gerard and Pedro Hernandez Martinez

10:20 : Invited talk

Chiral Growth of Achiral Plasmonic Nanocrystals under Circularly Polarized Light

Lucas Vazquez Besteiro[1], Miguel A. Correa-Duarte[1], Zhiming M. Wang[2], Alexander O. Govorov[3]

[1]Universidade de Vigo (Spain), [2]University of Electronic Science and Technology (China), [3]Ohio University (USA)

Plasmonic nanoparticles are powerful nanoantennas, and the energy deposited in their resonant modes can drive phenomena such as photocatalysis. The injection of plasmonic hot carriers can trigger redox reactions non- homogeneously, with spatially-differentiated reaction rates depending on the symmetries of nanocrystal and incoming light, allowing the chiral growth of achiral nanocrystals under circularly polarized light. This talk presents a computational model studying the geometrical evolution of plasmonic nanocrystals under different conditions, directly from the optical response of the system.

10:40 : Invited talk

Numerical methods for the investigation of resonances in nanophotonics

Felix Binkowski[1], Fridtjof Betz[1], Martin Hammerschmidt[2], Philipp-Immanuel Schneider[2], Lin Zschiedrich[2], Sven Burger[1]

[1]Zuse Institute Berlin (Germany), [2]JCMwave GmbH (Germany)

We review numerical methods for the computation of resonances and for resonance expansion in nanophotonics. We report on Riesz-projection-based approaches and numerical investigations of light sources coupled to nanoresonators.

11:00 : Invited talk

Near Field Probing of Optical (Super)Chirality For Enhanced Bio-detection

Victor Tabouillot, Rahul Kumar, Paula Laborda Lalgauna, Maryam Hajji, Rebecca Clarke, Drew Thomson, Andrew Sutherland, Nikolaj Gadegaard, Malcolm Kadodwala

University of Glasgow (United Kingdom)

We exploit an intriguing phenomenon, plasmonic circularly polarised luminescence (PCPL), which is an incisive local probe of near field chirality. This allow chiral detection of monolayer quantities of a de novo designed peptide, which is not achieved with a far field response. Our work demonstrates that by leveraging the capabilities of nanophotonic platforms with the near field sensitivity of PCPL, optimal biomolecular detection performance can be achieved, opening new avenues for nanometrology.

11:20 : Invited talk

Fingerprint - mimicked Chiral Elastomeric Grating Meta-Skin

Ki-Jae Jeong[1], Juyong Gwak[1], Caifeng Wang[1], Young-Mi Kim[1], Van Tan Tran[2], Jaebeom Lee[1]

[1]Chungnam National University (Korea), [2]Phenikaa University (Vietnam)

Fingerprint-inspired elastomeric grating meta-skin (EGMS) is fabricated to investigate the chirality of fingerprints. The chirality of the surface is caused by symmetry breaking, induced by the pattern (P) and curvature (T). Furthermore, the chiroptical properties of EGMS are reconfigurable through the control of the skew angle (θ). The chiroptical properties of a fingerprint are also shown and interpreted in this perspective. It will be a useful method to produce chirality in advance biometric recognition.

11:40 : Surface Lattice Resonance assisted UV light generation in Zinc Oxide - Aluminum hybrid nanostructures

Thomas Simon, S. Kostcheev, A. Rumyantseva, J. Beal, Davy Gerard, Jerôme Martin

L2n - UTT (France)

Combining aluminum nanostructures sustaining blue-UV resonances with lattice geometries supporting grating Rayleigh anomalies allows to obtain hybrid modes called Surface Lattice resonances, shaper and more intense than standard Localized Surface Plasmon Resonances. Placed on top of a wide band-gap semiconductor thin film such as Zinc Oxide, these aluminum nanoparticle arrays act both as nanoantennas and light amplifiers, allowing to enhance the band-edge emission of the semiconductor, experimentally measured up to about 3.5 compared to bare ZnO.

12:00 - 12:40 — Room 4

Session 3A6

Parity-Time and quasi-normal modes in Photonics, Plasmonics, Acoustics

Organized by: Anatole Lupu and Henri Benisty

Chaired by: Anatole Lupu and Henri Benisty

12:00 : Invited talk

Non-Hermitian Control of Chiral Singular Points in Periodic Nanophotonic Systems

Masaya Notomi[1], Shutaro Otsuka[2], Yuto Moritake[2], Taiki Yoda[1]
[1]*NTT Basic Research Laboratories (Japan),* [2]*Tokyo Institute of Technology (Japan)*

We have investigated various interplays of polarization singular points and exceptional points in the momentum space of non-Hermitian periodic nanophotonic systems, both theoretically and experimentally. We manipulate chiral singular points in the momentum space by varying the symmetry of non-Hermitian periodic systems, resulting interesting polarization properties that cannot be achieved in Hermitian systems.

12:20 : Invited talk

Generation of quantum photon pairs tailored by quasi-normal mode dispersion in nonlinear metasurfaces *online*

Andrey Sukhorukov
Australian National University (Australia)

Metasurfaces consisting of nano-scale structures are underpinning new physical principles for the creation and shaping of quantum states of light. We predict and demonstrate experimentally the generation of spatially entangled photon pairs through spontaneous parametric down-conversion from a metasurface incorporating a nonlinear thin film of lithium niobate. This is achieved through nonlocal resonances with tailored angular dispersion of quasi-normal modes.

10:20 - 12:45 — Room 5

Session 3A7

Symposium V: Phononics and acoustic metamaterials

Organized by: Jensen Li and Guoliang Huang

Chaired by: Jensen Li and Guoliang Huang

10:20 : Invited talk

Omnidirectional isolation and efficient elastic-wave routing in ultrathin metagrating-based waveguides

Yabin Hu[1], Yongquan Liu[2], Bing Li[1]
[1]*Northwestern Polytechnical University (China),* [2]*Xi'an Jiaotong University (China)*

Guiding classical waves has been always playing an essential role in a wide range of fields. However, a compact and robust way to route energy flux travelling along an arbitrary path in a uniform medium is difficult to achieve. Here, an ultrathin, broadband elastic metagrating is proposed for suppression of parasitic diffraction and guiding waves along an arbitrary path.

10:40 : Invited talk

Delocalization of topological modes by non-Hermitian skin effect

Wei Wang[1], **Guancong Ma**[2]

[1] *Hong Kong Baptist University (Hong Kong),* [2] *Hong Kong Baptist University (China)*

We demonstrate that topological modes can be fully extended by the non-Hermitian skin effect. These extended modes occupy the entire bulk lattice while maintaining their topological characteristics. The effect is observed in both 1D and 2D topological mechanical lattices with active components.

11:00 : A CMOS-compatible hollow pillared surface acoustic wave GHz phononic crystal

Subrahmanyam Gantasala, Prabhu Rajagopal, Tiju Thomas

Indian Institute of Technology Madras (India)

In this study a SAW PnC based on Aluminum Nitride (AlN) cylindrical pillars on AlN-Si substrate is designed and analyzed using finite element simulations. The band structure and transmission analysis reveals a 200MHz band gap around 1GHz frequency due to local resonance in pillars. Bandgap widening and whispering gallery modes are observed by replacing pillars in the PnC structure with hollow pillars. Introduction of hollow pillars as a line defect within the perfect PnC localizes a waveguide mode at 1.115GHz.

11:15 : Invited talk

Thermal phonon mean free path analysis of semiconductor membranes *online*

Masahiro Nomura[1], **Jose Ordonez-Miranda**[2], **Roman Anufriev**[1]

[1] *The University of Tokyo (Japan),* [2] *Universite de Poitiers (France)*

The dimension of the playground of coherent thermal conduction is limited to the thermal phonon mean free path. In this talk, we demonstrate that the dependence of the cumulative thermal conductivity on the thermal phonon mean free path for semiconductor membranes can be reconstructed by combining systematic thermal conductivity measurements with theoretical analyses for a series of semiconductor membranes with slit structures. We introduce this method with examples measured for Si and SiC membranes.

11:35 : Invited talk

Self-collimated waves in a waveguide comprised of phononic crystals *online*

Jia-Hong Sun[1], **Cheng-Fu Chou**[2], **Yung-Yu Chen**[2]

[1] *Chang Gung University (Taiwan),* [2] *Tatung University (Taiwan)*

Elastic waves in a phononic crystal (PnC) can show various velocities in different directions. In this paper, a waveguide that allows self-collimation of longitudinal waves was designed based on the anisotropic propagation property. Then beam steering appears in the inlet and outlet of the PnC-based waveguide, which allows controlling the direction of a wave beam through the waveguide. The work included design, fabrication of specimens, and experiments. This study is valuable for nondestructive tests in industry and medical applications.

11:55 : Invited talk

How coherence is driving phonon heat conduction *online*

Sebastian Volz

The University of Tokyo (Japan)

We derive an original thermal conductivity formula where coherence times and life-times appear. We validate the theory with a complex crystal and an amorphous solid. The simulation reveals an intrinsic and a -previously investigated- mutual coherence appearing in two different temperature ranges.

12:15 : Spin-orbit interactions of transverse sound *online*

Shubo Wang[1], **Guanqing Zhang**[2], **Xulong Wang**[2], **Qing Tong**[1], **Jensen Li**[3], **Guancong Ma**[2]

[1] *City University of Hong Kong (Hong Kong),* [2] *Hong Kong Baptist University (Hong Kong),* [3] *The Hong Kong University of Science and Technology (Hong Kong)*

In this talk, I will report the discovery of airborne transverse sound that can carry both spin and orbital angular momentum. I will show that the spin-orbit interactions of the transverse sound can give rise to novel phenomena inaccessible to conventional acoustic systems, including acoustic-activity-induced negative refraction and spin-dependent vortex generation in sound scattering.

12:30 : Inverse Design of Direction Dependent Mechanical Metamaterial *online*

Pravinkumar Ghodake
Indian Institute of Technology Bombay (India)

A direction-dependent mechanical metamaterial is designed which can control longitudinal waves in one direction and transverse waves in exactly opposite direction simultaneously as well as independently both in time and frequency domains. Time-dependent inverse problems to reduce second harmonics (2f = 4 MHz) and also maximize fundamental harmonics (f = 2 MHz) by maintaining maximum power of a short Gaussian pulse as the second objective are proposed and solved using gradient-free algorithms. Designed metamaterials show promising applications in nonlinear ultrasonics.

10:20 - 12:40 — Room 6

Session 3A8

Topological photonics and plasmonics

Organized by: Yuri Gorodetski and Denis Garoli

Chaired by: Yuri Gorodetski and Denis Garoli

10:20 : Invited talk
Directional plasmonic excitation by helical nanotips

Leeju Singh[1], Denis Garoli[2], Yuri Gorodetski[1]
[1]*Ariel University (Israel),* [2]*Istituto Italiano di Tecnologia (Italy)*

The phenomenon of coupling between light and surface plasmon polaritons requires specific momentum-matching conditions. In the case of a single scattering object on a metallic surface, like a nanoparticle or a nanohole,the coupling between a broadband effect, i.e. scattering, and a discrete one such as surface plasmon excitation, leads toFano-like resonance line shapes. We study directional plasmonic excitation - via Fano-like resonance by using achiral nanotip to excite surface plasmon with a strong spin-dependent azimuthal variation.

10:40 : Invited talk
Optical singularities in higher dimensions: theory and topological protection

Michele Tamagnone[1], Christina M. Spaegele[2], Soon Wei Daniel Lim[2], Federico Capasso[2]
[1]*Fondazione Istituto Italiano di Tecnologia (Italy),* [2]*Harvard University (USA)*

We generalize the idea of optical singularity to four dimensions using the three spatial dimensions and the wavelength obtaining a complete polarization singularity, i.e. a topologically protected point in the 4D space where the polarization and phase of the field are not defined.

11:00 : Invited talk
Nonlinear Metasurface Route to Two-Way Asymmetric Flat Optics

Nir Shitrit
Ben-Gurion University of the Negev (Israel)

We report asymmetric transport of free-space light at nonlinear metasurfaces upon transmission and reflection. Moreover, we theoretically derive the nonlinear generalized Snell's laws that were experimentally confirmed by the anomalous nonlinear refraction and reflection. The asymmetric transport at optically thin nonlinear interfaces is revealed by the concept of a reversed propagation path. Such an asymmetric transport at metasurfaces opens a new paradigm for free-space ultrathin lightweight optical devices with one-way operation including unrivaled optical valves and diodes.

11:20 : Invited talk
Optoinduced magnetization in a metal from the spin and orbital angular momenta of light

Vage Karakhanyan, Clement Eustache, Yannick Lefier, Thierry Grosjean

FEMTO-ST Institute (France)

We provide a spin and orbital angular momentum representation of the inverse Faraday effect in a metal. We show the role of the spin and orbital angular momenta of light (SAM and OAM), as well as the spin-orbit interaction (SOI), in the generation of an optoinduced magnetization. We also show that resonances in plasmonic nanoantennas enhance and confine the IFE, thereby leading to static magnetic fields directly applicable in a vast application domain including all-optical magnetization switching and spin-wave excitation.

11:40 : Invited talk

Topological surface bound states in the continuum in double network metamaterials

Wenhui Wang, Antonio Guenzler, Bodo Wilts, Matthias Saba

Fribourg University (Switzerland)

Photonic bound states in the continuum are spatially localized modes that exist within a radiation continuum. Here, we propose a new generic mechanism to realize bound states in the continuum free of other resonances and are robust upon parameter tuning. We predict two new types of bound states in the continuum: i) generic modes confined to the metamaterial bulk, mimicking electronic acoustic waves in a hydrodynamic double plasma, and ii) topological surface bound states in the continuum.

12:00 : Invited talk

Optical properties of laterally confined metal/insulator/metal cavities

R. D. Pothuraju, L. Lin, R. Proietti Zacceria, Roman Krahne

Istituto Italiano di Tecnologia (Italy)

Photonic metal/insulator/metal (MIM) cavities sustain resonances with near-zero dielectric permittivity (ENZ) whose frequency can be tuned by the thickness of the dielectric layer. Lateral patterning of such systems introduces additional opportunities to modify their properties and interaction with other systems such as light emitting dyes. We will discuss the optical properties of MIM pillar arrays that reveal confined and lattice modes, and explore how these can be exploited for light emission and photosensing enhancement.

12:20 : Invited talk

Spin-Orbit Interaction of Light Enabled by Negative Coupling in High-Quality-Factor Optical Metasurfaces

Wenlong Gao, Basudeb Sain, Thomas Zentgraf

Paderborn University (Germany)

We study negative couplings amid local resonances of photonic metasurfaces and their radiation polarizations. In our analysis, we discover circularly polarized, wave-vector variant, radiational eigenstates that are attributed to inter-orbit negative couplings. Our theoretical model is exemplified via a guided resonance dielectric metasurface that possesses Type-II Non-Hermitian Dirac points, from where the circular polarization lines emanate. The high quality factor nature and field enhancement of the designed metasurface could lead to applications for spin-selective sensing, beam control and nonlinear optics.

10:20 - 12:40 — Room 7

Session 3A9

Thermal plasmonics and metamaterials for low-carbon society

Organized by: Junichi Takahara and Kotaro Kajikawa

Chaired by: Junichi Takahara and Kotaro Kajikawa

10:20 : Invited talk

Affordable and Environmentally Sustainable Biomass-based Photothermal Material for Efficient Desalination Solutions

Tien Thanh Pham, Hoang Giang Nguyen

Vietnam National University (Vietnam)

In this study, a common agricultural waste was utilized to fabricate the photothermal material that can be applied in the solar steam generation (SSG) system. The resulting composite material demonstrated significant advantages such as high light absorption, low thermal conductivity, ultra-fast water transportation, low moisture enthalpy, and self-cleaning properties. The biomass based SSG system possessed high seawater evaporation rate and evaporation efficiency, which are comparable to those in the previous studies on biomass composite material based SSG systems.

10:40 : Invited talk

Non-equilibrium Light Emission from Quantum Materials for Thermophotonic Applications

Atsushi Sakurai
Niigata University (Japan)

Thermophotonics (TPX) power generation systems, which generate electricity using thermal emission and electroluminescence from light emitting diodes. Compared to thermophotovoltaics, it can operate at lower temperatures and is expected to be efficient. On the other hand, studies of light-emitting devices in the near- to mid-infrared region are still in their developing stage, and fundamental studies of new materials and light-emitting mechanisms are important. Thus, we focus on quantum materials as infrared light emitting sources for application to TPX power generation.

11:00 : Invited talk

Directive multiband thermal emitters *online*

Makoto Shimizu, R. Benlyas, S. Tsuda, Z. Liu, H. Yugami
Tohoku University (Japan)

While many isotropic multiband emitters and directive narrow-band emitters have been reported, there are few reports of emitters capable of directional and multiband thermal emission. We present an emitter with a polymer thin film on a metal substrate which enables molecular vibration-induced thermal emission limited to grazing-angles. We also show metal-dielectric-metal metamaterials can realize tunable multiband emission limited in grazing angles based on similar physics. These emitters could enable directional heat transfer which could be a novel thermal management technology.

11:20 : Invited talk

Development of one-chip near-field thermophotovoltaic device overcoming far-field blackbody limit *online*

Takuya Inoue, Takashi Asano, Susumu Noda
Kyoto University (Japan)

Near-field thermal radiation transfer has attracted significant attention owing to its potential for increasing the output power and conversion efficiency of thermophotovoltaic (TPV) systems. Here, we demonstrate a one-chip near-field TPV device integrating a Si emitter and an InGaAs PV cell with a sub-wavelength gap ($textless$140 nm). The device shows a photocurrent density of 1.49 A/cm2 at the emitter temperature of 1192 K, which is 1.5 times larger than the far-field blackbody limit at the same temperature.

11:40 : Invited talk

Thermoelectric generation in day and night by daytime radiative cooling *online*

Satoshi Ishii, Ken-Ichi Uchida, Tadaaki Nagao
National Institute for Materials Science (Japan)

Daytime radiative cooling surface can be cooled both in day and night, thus generating temperature difference against the surrounding temperature throughout the day. We demonstrate experimentally that this temperature difference can be used for 24-h thermoelectric generation. Our first design combines a daytime radiative cooler on a Peltier module which only takes advantage of radiative cooling. Our second design allows to harvest radiative cooling and solar heat simultaneously, thus has a potential to generate larger temperature difference for thermoelectric generation.

12:00 : Invited talk

Complex metamaterials for carbon-negative and carbon-free applications in energy, desalination and printing *online*

Andrea Fratalocchi
KAUST (Saudi Arabia)

In this talk I will summarize our recent results in the field on complex metamaterials for solar desalination, structural paper and solar hydrogen production, presenting the design, implementation and characterization of various record performing systems and devices.

12:20 : Invited talk
Plasmonic Energy Harvesting *online*
Wakana Kubo
Tokyo University of Agriculture and Technology (Japan)
We demonstrate a thermoelectric device that can generate electricity even in a uniform-temperature environment.

10:20 - 12:40 — Room 8

Session 3A10

Molecular Optomechanics

Organized by: Alejandro Martinez

Chaired by: Alejandro Martinez

10:20 : Invited talk
Molecular optomechanics in plasmonic nanocavities
Ruben Esteban[1], Yuan Zhang[2], Tomas Neuman[3], William M. Deacon[4], Lukas A. Jakob[1], Jeremy J. Baumberg[4], Javier Aizpurua[1]
[1]*CSIC - UPV/EHU (Spain),* [2]*Zhengzhou University (China),* [3]*Universite Paris-Sud (France),* [4]*University of Cambridge (United Kingdom)*
We show that the optomechanical interaction that governs the coupling of molecular vibrations with plasmonic structures can be strongly affected by higher-order plasmonic modes of metallic nanocavities, leading to strong modifications of the vibrational states and Raman spectra of organic molecules located in the proximity of the nanostructures, illuminated by a very intense laser. We discuss changes on the energy and effective losses of the molecular vibrations, as well as on the scaling of the emitted signal with laser intensity.

10:40 : Invited talk
Few-mode field quantization in plasmonic and hybrid cavities
Johannes Feist
Universidad Autónoma de Madrid (Spain)
We present a framework that provides a few-mode master equation description of the interaction between quantum emitters and an arbitrary electromagnetic environment. It requires only the fitting of the spectral density, obtained through classical electromagnetic simulations, to a model system involving a "minimal"number of discrete lossy and interacting modes. It allows the description of complex environments characterized by several overlapping and interacting resonances, as typically encountered in plasmonic (metallic) and hybrid metallodielectric nanocavity setups.

11:00 : Invited talk
Engineering long-lived vibrational states for an organic molecule
Burak Gurlek[1], Vahid Sandoghdar[1], Diego Martin Cano[2]
[1]*Max Planck Institute for the Science of Light (Germany),* [2]*Friedrich-Alexander University (Germany)*
In this work we improve the optomechanical quality of a molecule by several orders of magnitude through phononic engineering of its nanoscopic surrounding. By dressing a molecule with long-lived high-frequency phonon modes of its host matrix, we achieve storage and retrieval of photons at millisecond timescales and allow for the emergence of single-photon strong coupling in optomechanics. Our strategy can be extended to the realization of molecular quantum optomechanical networks.

11:20 : Invited talk
Resonant coupling to molecular bonds and detection by vibrational frequency upconversion
Rohit Chikkaraddy, Rakesh Arul, Lukas A. Jakob, Jeremy J. Baumberg

University of Cambridge (United Kingdom)

Metal nanostructures with sub-nm gaps tightly confine light by million-fold below the diffraction volumes, enhancing light-matter coupling. Here I will present a unique way to assemble nanogaps into multi-layer metasurfaces with nanometre-sized gaps to support tunable resonant optical modes from visible to the mid-infrared regime. These structures are utilized to enhance coupling to molecular bond vibrations and mid-infrared detection via vibrational frequency upconversion.

11:40 : Invited talk

Selective Enhancement of Raman Scattering with a Nanocube-on-Mirror in a Cavity

Ilan Shlesinger, Jente Vandersmissen, Ewold Verhagen, Femius Koenderink
AMOLF (The Netherlands)

We report on the fabrication of a new generation of hybrid resonators using a bottom-up process and featuring in-situ tunability. It consists of the gap mode of a Nanocube-on-mirror coupled to the mode of a tunable Fabry-Perot cavity. The system allows the demonstration of selective enhancement of single vibrational lines of molecules and paves the way towards parametric instabilities with a reduced number of molcules.

12:00 : Invited talk

Continuous-Wave mid-Infrared to Visible Frequency Upconversion with a Molecular Optomechanical Nanocavity *online*

Wen Chen[1], Philippe Roelli[1], Huatian Hu[2], Sachin Verlekar[1], Sakthi Amirtharaj[1], Angela Barreda[3], Tobias Kippenberg[1], Mikov Kovylina[4], Ewold Verhagen[5], Alejandro Martinez[4], Christophe Galland[1]
[1]*EPFL (Switzerland),* [2]*Wuhan Institute of Technology (China),* [3]*Friedrich Schiller University Jena (Germany),* [4]*Universitat Politecnica de Valencia (Spain),* [5]*AMOLF (Germany)*

We develop a plasmonic nanoparticle-in-groove nanocavity coupled with a few hundred molecules, demonstrating optomechanical transduction of sub-microwatt continuous wave signals from the mid-infrared (32 THz) onto the visible domain at ambient conditions. The dual resonant nanocavity offers an estimated 13 orders of magnitude enhancement in upconversion efficiency per molecule. Our results establish molecular cavity optomechanics as a new paradigm for coherent frequency conversion free of phase-matching constraints.

12:20 : Invited talk

Plasmonic Nanogap-enhanced Single-molecule Raman Spectroscopy: Towards Single-protein Raman Sequencing *online*

Y. Zhao[1], M. Iarossi[2], A. F. De Fazio[2], J. A. Huang[1], F. De Angelis[2]
[1]*University of Oulu (Finland),* [2]*Instituto Italiano di Tecnologia (Italy)*

Current protein analysis and sequencing rely on insensitive mass spectroscopy that generally requires 1 billion copies of proteins. The fact that proteins cannot be amplified results in a serious lag of proteomics behind genomics and transcriptomics, hampering not only mechanistic studies but also clinical applications. Here, we report our recent work on a plasmonic nanogap biosensor that has demonstrated single-molecule Raman detection of all 20 proteinogenic amino acids and detecting single amino acid residues within single peptide molecule.

Lunch

12:30 - 14:00

14:00 - 15:00 — Room 1

Session 3A11

Conference Tutorials II

14:00 : Tutorial

Tutorial of Vladimir Shalaev

Vladimir Shalaev
Purdue University (USA)

Tutorial of Vladimir Shalaev

15:00 - 16:00 — Room 1

Session 3A12

Machine learning for metamaterials and metasurfaces

Organized by: Willie Padilla

Chaired by: Willie Padilla

15:00 : Invited talk

Design and Optimization of subwavelength waveguide arrays and metasurfaces for spatial phase manipulation

Dominic Palm, Jan Kappa, Lukas Mueller, Lars Franke, Marco Rahm
TU Kaiserslautern (Germany)

We used different methods for the design optimization of waveguide arrays with subwavelength width and periodicity as well as metasurfaces for the manipulation of the spatial phase of transmitted and/or reflected microwaves. The applied methods include particle swarm algorithms, simulated annealing, but also first steps toward machine-learning affine approaches for optimizing metasurface structures.

15:20 : Invited talk

Machine Learning Approach to the Topological Optimization of Metasurfaces

Timo Gahlmann, Philippe Tassin
Chalmers University (Sweden)

We present our work on using machine learning for the topological optimization of metasurfaces. First, we show that deep neural networks can be used to predict the scattering properties of metasurfaces. Subsequently, we demonstrate the inverse design of free-form metasurfaces using a modified CGAN machine learning method that balances the accuracy of desired optical properties with experimental feasibility. Our method allows constraints imposed by the nanofabrication to be integrated in the optimization.

15:40 : Invited talk

Intelligent Meta-Imagers: From Compressed to Learned Sensing *online*

Chloe Saigre-Tardif[1], Rashid Faqiri[1], Hanting Zhao[2], Lianlin Li[2], Philipp del Hougne[1]
[1] *Universite de Rennes (France)*, [2] *Peking University (China)*

Intelligent meta-imagers use learned scene illuminations to pre-select task-relevant information. To that end, they integrate programmable meta-atoms as trainable physical weights into an end-to-end hybrid analog-digital sensing pipeline. Thereby, in contrast to compressive meta-imagers, they seek purposefully non-isometric embeddings, and data acquisition simultaneously constitutes a first .ºver-the-air"processing step. We report proof-of-principle implementations and quantify their remarkable benefits in terms of latency.

14:00 - 15:50 — Room 2

Session 3A13

Parity-Time and quasi-normal modes in Photonics, Plasmonics, Acoustics

Organized by: Anatole Lupu and Henri Benisty

Chaired by: Anatole Lupu and Henri Benisty

14:00 : Invited talk

Quantifying the response of open systems at exceptional points

Jan Wiersig
Otto von Guericke University Magdeburg (Germany)

One reason for the considerable attention of exceptional points in photonics, plasmonics, and acoustics is the strong response of open systems to external perturbations and excitations at such degeneracies. We introduce two characteristics of exceptional points that quantity the response in terms of energy splittings and energy eigenstates, intensity, and dynamics. The concept is illustrated for physically relevant examples.

14:20 : Light control by Non-Hermitian modulation in multimode fiber

Mohammad N. Akhter, Salim Benadouda Ivars, Ramon Herrero Simon, Muriel Botey, Kestutis Staliunas
Universitat Politecnica de Catalunya (Spain)

We show that a non-Hermitian modulation of the potential along the nonlinear multimode fibers controls dynamics of propagating radiation. Specifically we consider simultaneous modulation of the refraction index and gain/loss profile. We observe that the non-Hermitian modulation introduces a unidirectional and controllable coupling towards the lower/higher order transverse modes, depending on the potential parameters. Such effect may enhance the beam self-cleaning phenomena. On the contrary, coupling towards higher order modes may enhance pulsing, turbulence and, eventually help in super-continuum generation.

14:35 : Non-Hermitian potentials for the stabilization of semiconductor laser arrays

Ramon Herrero Simon, Judith Medina Pardell, Muriel Botey, Kestutis Staliunas
Universitat Politecnica de Catalunya (UPC) (Spain)

We propose a stabilization mechanism of a semiconductor laser array based on asymmetric coupling. The stabilization scheme takes advantage of the symmetry breaking of non-Hermitian potentials. We numerically explore the main parameters, like the distance between lasers and spatial shift between the individual laser stripe and corresponding electrode. In turn, an axisymmetric architecture is intended to lead to a light redistribution within the array which is expected to facilitate direct coupling efficiency to optical fibers.

14:50 : Invited talk
Robustness, sensitivity and pseudospectra around higher order exceptional points

Konstantinos Makris
University of Crete (Greece)

One of the hallmarks of non-Hermitian photonics is the existence of unique degeneracies, the so called higher order exceptional points (HEPs). In the first part, we are going to present recent results regarding a systematic way of constructing infinite optical lattices that exhibit HEP's. In the second part of the talk, we are going to examine the interplay between robustness and sensitivity in non-Hermitian topological lattices. The extreme response and sensitivity is examined in the context of pseudospectra theory.

15:10 : Invited talk
Fundamental causality constraints on the non-Hermitian skin effect in passive nonreciprocal systems

Henning Schomerus
Lancaster University (United Kingdom)

I describe physical constraints on the observability of the non-Hermitian skin effect in passive systems.

15:30 : Invited talk
Near-Field Radiative Heat Transfer Eigenmodes *online*

Alejandro Manjavacas
IO-CSIC (Spain)

At the nanoscale, the radiative heat transfer (RHT) between objects can surpass the limits established by far-field blackbody radiation. Here, we introduce a theoretical framework to efficiently describe the thermalization dynamics of ensembles of nanostructures mediated by the RHT. Using this formalism, which is based on an eigenmode expansion of the equations that govern the process, we discuss the fundamental principles that determine the thermalization of collections of nanostructures with thousands of elements and reveal general but often unintuitive dynamics.

14:00 - 15:35 — Room 3

Session 3A14

Symposium III: Advanced passive and active metasurfaces

Organized by: Howard Lee and Pin-Chieh Wu

Chaired by: Howard Lee and Pin-Chieh Wu

14:00 : Invited talk
Metasurfaces for IR-to-THz Detection with Phase-Changing Beams
Ozdal Boyraz, Mohammad Wahiduzzaman
University of California Irvine (USA)

We present plasmonic metasurfaces that are integrated with phase-changing VO 2 beams for bolometric radiation detection from THz to the infrared regime. A comprehensive study is conducted on metal-insulator-metal type metasurface absorbers for efficient electromagnetic absorption and their integration with transition-edge VO 2 beams for high-sensitivity detection. Here, metasurface absorbers offer selectivity and tunability to electromagnetic design. VO 2 beams offer a considerable length to cross-sectional ratio and hence, a large sensitivity in temperature-induced readout signal.

14:20 : Invited talk
Software Defined Meta-Optics
Arka Majumdar
University of Washington (USA)

By co-optimizing passive meta-optics with computational backend, we can correct for aberrations, demonstrate varifocal functionality and also perform object detection.

14:40 : Invited talk
Ultrafast optical force nanoscopy
Hanwei Wang, Sean Michael Meyer, Catherine J. Murphy, Yun-Sheng Chen, Yang Zhao
University of Illinois Urbana-Champaign (USA)

Scanning probe technology is advantageous in visualizing nanoscale light-matter interactions, however, it is limited by the slow scanning speed. Here, I will discuss the visualization of the ultrafast interactions in the nanosecond time scales. Our tool is based on optical force interactions between a nanoscale specimen and a nearfield probe enabled by temporal modulated polarized light. We identify the unique phase properties of each force component and delineate the forces with different origins using decoupled optical nanoscopy.

15:00 : Engineering Extrinsic Nonlinearities in Epsilon-Near-Zero Materials via Surface Lattice Resonances
Dhruv Fomra[1], Adam Ball[1], Jingwei Wu[1], Ray Secondo[1], Sampriti Saha[1], Mohammad Sojib[1], J. B. Khurgin[2], Henri Lezec[3], Nathaniel Kinsey[1]
[1] *Virginia Commonwealth University (USA),* [2] *Johns Hopkins University (USA),* [3] *National Institutes of Standards and Technology (USA)*

Epsilon-near-zero (ENZ) materials have recently demonstrated enhanced several nonlinear optical interactions. However, the irradiance required is still on the order of 100 GW/cm2. Starting from the origins of the nonlinear effects in ENZ, we highlight avenues for intrinsic and extrinsic enhancement to the nonlinearity. We illustrate the combination of surface-lattice-resonances and ENZ as a method to achieve low threshold ($textless$10 GW/cm2) intensity switching at THz speeds.

15:15 : Invited talk
Tunable photonic metasurfaces: fundamentals and applications
Maxim Shcherbakov
University of California (USA)

We summarize our recent results on the design and implementation of tunable metasurfaces for all-optical switches, polarizing optics, and dynamic imaging.

14:00 - 16:00 — Room 4

Session 3A15

Symposium IV: Chirality, magnetism, and magnetoelectricity: Separate phenomena and joint effects in metamaterial structures

Organized by: Eugene Kamenetskii

Chaired by: Eugene Kamenetskii

14:00 : Invited talk

Light and Magnetic Vortices: The Experimental Evidence of Magnetic Helicoidal Dichroism

Mauro Fanciulli[1], Matteo Pancaldi[2], Emanuele Pedersoli[2], Mekha Vimal[1], David Bresteau[1], Martin Luttmann[1], Dario De Angelis[2], Primoz Rebernik Ribic[2], Benedikt Roesner[3], Christian David[3], Carlo Spezzani[2], Michele Manfredda[2], Ricardo Sousa[4], Ioan-Lucian Prejbeanu[4], Laurent Vila[4], Bernard Dieny[4], Giovanni De Ninno[2], Flavio Capotondi[2], Maurizio Sacchi[5], Thierry Ruchon[1]

[1]*Universite Paris-Saclay (France),* [2]*Elettra-Sincrotrone (Italy),* [3]*Paul Scherrer Institut (Switzerland),* [4]*Universite Grenoble Alpes (France),* [5]*Sorbonne Universite (France)*

The magnetic helicoidal dichroism, obtained through the interaction of an extreme ultraviolet vortex beam carrying orbital angular momentum with a magnetic vortex, has been experimentally observed. Numerical simulations based on classical electromagnetic theory show that this dichroism is based on the interference of light modes with different orbital angular momenta, which are populated after the interaction between light and magnetic topology. This observation sets the framework for the development of new tools to investigate ultrafast magnetization dynamics.

14:20 : Invited talk

Non-Hermitian chiral phononics through laser-induced synthetic magnetic fields in nano-optomechanical networks

J. del Pino[1], J. J. Slim[1], Ewold Verhagen[2]

[1]*AMOLF (The Netherlands),* [2]*ETH Zurich (Switzerland)*

We explore the interplay between non-Hermitian dynamics and the breaking of time-reversal symmetry in networks of nanomechanical resonators coupled by light. Optomechanical radiation pressure interactions induce both particle-conserving as well as squeezing interactions in the reconfigurable networks. We observe chiral transport of coherent and thermal excitations, and discover a non-Hermitian Aharonov-Bohm effect in which the non-Hermitian dynamics of the network, including spontaneous breaking of PT symmetry, are controlled by a new geometric phase.

14:40 : Invited talk

Ultrafast, all-optical and highly enantio-sensitive imaging of molecular chirality

David Ayuso[1], Josh Vogwell[1], Laura Rego[1], Olga Smirnova[2]

[1]*Imperial College London (United Kingdom),* [2]*Max-Born-Institut (Germany)*

I will present several strategies for imaging the handedness of chiral molecules with high enantio-sensitivity and on ultrafast time scales. By tailoring the polarization of the driving field in time and in space, we can efficiently control the nonlinear optical response of chiral molecules and imprint their handedness into different macroscopic observables. These strategies rely on the strong longitudinal fields that arise naturally in tightly focused laser beams, in non-collinear configurations, and, interestingly, in optical nanofibers and other nanophotonic structures.

15:00 : Invited talk

Topological magnon band structure of emergent Landau levels in a skyrmion lattice

T. Weber[1], D. M. Fobes[2], J. Waizner[3], P. Steffens[1], G. S. Tucker[4], M. Bohm[1], L. Beddrich[5], C. Franz[5], H. Gabolds[5], R. Bewley[6], D. Voneshen[6], M. Skoulatos[5], R. Georgii[5], G. Ehlers[7], A. Bauer[5], C. Pfleiderer[5], P. Boni[5], M. Janoschek[2], M. Garst[1]

[1]*Institut Laue-Langevin (France),* [2]*Los Alamos National Laboratory (USA),* [3]*Universitat zu Koln (Germany),* [4]*Paul Scherrer Institute (Germany),* [5]*TU Munchen (Germany),* [6]*ISIS Facility (Germany),* [7]*Oak Ridge National Laboratory (USA)*

Here, we report on a collaboration between experiment and theory that explored this topologically non-trivial magnon band structure by means of inelastic neutron scattering experiments on the cubic chiral magnet MnSi. For this material, the spacing of the emergent Landau levels can be estimated to be 10 μeV on average.

15:20 : Invited talk

Enhancement of circular dichroism of a chiral material by dielectric nanospheres

D. Vestler, Gil Markovich
Tel Aviv University (Israel)

Circular dichroism (CD) spectroscopy is very useful for studies of biomolecular conformation but suffers from very weak signals. Several theoretical and experimental papers reported schemes for CD enhancement using enhanced local fields produced by plasmonic nanostructures. We report enhancement of visible wavelength CD of chiral nanocrystals by Mie resonances of amorphous selenium nanospheres. The spatially averaged CD enhancement factor was estimated to be 4.7 ± 1.5 fold, while the peak enhancement at particular locations on the nanospheres is probably $textgreater10$.

15:40 : Invited talk

Vibration-Assisted Spin-Spin Interactions in Chiral Structures

Jonas Fransson
Uppsala University (Sweden)

Interactions between local spin moments are known to be mediated by the electronic structure in metals, semi-conductors, and other compounds where itinerant electrons are available. Less known is the fact that the same is true also for vibrational structures, e.g., phonons as well as incoherent nuclear vibrations, such that vibration-assisted spin-spin interactions should be present and important in insulating compounds. This leads to that an effective model for the spin interactions in terms of Ising-like and Dzyaloshinskii-Moriya-like contributions.

14:00 - 15:45 — Room 5

Session 3A16

Symposium V: Phononics and acoustic metamaterials

Organized by: Jensen Li and Guoliang Huang

Chaired by: Jensen Li and Guoliang Huang

14:00 : Invited talk

Porous soft polymer as raw material for acoustic metasurfaces

Olivier Mondain-Monval, Olivier Lombard, Raj Kumar, Yabin Jin, Thomas Brunet, Olivier Poncelet
Universite de Bordeaux (France)

In this talk I will present the fabrication aspects involved in the synthesis and the molding of acoustic metasurfaces of two different types. Both structural and acoustic characterizations of the devices will be presented.

14:20 : Low-frequency nonreciprocal flexural wave propagation via compact cascaded time-modulated resonators

Sheng Wan, Liyun Cao, Yi Zeng, Tong Guo, Mourad Oudich, Badreddine Assouar
Universite de Lorraine (France)

Compact nonreciprocal mechanical devices are of great interest for unidirectional elastic wave manipulation. We introduce a subwavelength design of a compact low-frequency nonreciprocal metamaterial for flexural waves. This structure is made of two coil-cantilever-magnet resonators where the electromagnetic forces can be time-varied, which can be modeled by two mass-spring resonators with temporal modulation on their effective stiffness. Our structure could inspire the design of compact nonreciprocal devices for flexural waves.

14:35 : Active metamaterials with strongly coupled sensor-driver unit cells

Bogdan Popa

University of Michigan (USA)

This work shows how to design active acoustic metamaterials composed of periodic and aperiodic arrangements of sensor-driver pairs in the general case in which the sensor-drivers pairs strongly interact with each other. The method will be illustrated in examples showing how to use active metamaterials to realize transformation acoustic devices including full omidirectional acoustic cloaks. Extensions of the sensor-driver architecture to scenarios in which the driver produces a different physical field than the sensed field will also be discussed.

14:50 : Invited talk
Nonlinearity and Topological Phononics
Georgios Theocharis[1], R. Chaunsali[2]
[1] *LAUM-CNRS (France),* [2] *Indian Institute of Science (India)*

In this presentation, we will talk about our recent efforts to understand the interplay of nonlinearity and topology in mechanical systems. In particular, we study one-dimensional nonlinear lattices of both Fermi-Pasta-Ulam-Tsingou and Klein-Gordon types and discuss the amplitude-dependent topological transition, soliton formation, and nonlinear Dirac physics. The findings highlight the effect of nonlinearity on the characteristics of topologically-robust edge states and the role of topology in interpreting purely nonlinear states.

15:10 : Invited talk
Elastic wave propagation along a 1D chain of pillars
Rock Akiki[1], Laurent Carpentier[1], Adnane Noual[2], Bernard Bonello[3], Bahram Djafari-Rouhani[1], Yan Pennec[1]
[1] *Universite de Lille (France),* [2] *Universite Mohamed Premier (Morocco),* [3] *UPMC Univ Paris 06 (France)*

We theoretically investigate with the help of the finite element method the interaction between aluminum pillars erected on top of a silicon substrate in the low frequency range. We investigated the resonant modes of a finite linear chain of N pillars and demonstrate the propagation along the chain of pillars deposited on the half-infinite substrate. Different configurations of the chain will be investigated from periodic, linear and bent, to random distributions.

15:30 : Acoustic waves focusing with elliptic pillars type metasurface
Laurent Carpentier, Yan Pennec, Bahram Djafari-Rouhani
Universite de Lille (France)

We numerically investigate the focusing properties of an acoustic metasurface consisting of a line of pillars of elliptic shape on a thin plate. We report on the influence of the ellipticity parameter on both monopolar compressional and dipolar bending modes of the pillars. We show that a line of pillars with a gradient in their ellipticity allows to focus the transmitted elastic wave at different targeted points.

14:00 - 15:50 — Room 6

Session 3A17

Topological photonics and plasmonics

Organized by: Yuri Gorodetski and Denis Garoli

Chaired by: Yuri Gorodetski and Denis Garoli

14:00 : Invited talk
Non-reciprocal light-matter interactions in artificial hyperbolic nanostructures
Nicolò Maccaferri
Umea University (Sweden)

We study non-reciprocal light-matter interactions in hyperbolic nanostructures. Experiments, numerical simulations and analytical modelling reveal the possibility to excite, in nonmagnetic architectures possessing strong optical anisotropy, a magneto-optical activity, which we ascribe to the excitation of electric and magnetic dipole modes coupled to an external magnetic field.

14:20 : Invited talk

Non-Hermitian Topological Whispering Gallery: Numerics

Rene Pernas Salomón[1], Zhiwang Zhang[2], Penglin Gao[3], Ying Cheng[2], Johan Christensen[1]
[1]*Universidad Carlos III de Madrid (Spain),* [2]*Nanjing University (China),* [3]*Shanghai Jiao Tong University (China)*

In 1878, Lord Rayleigh observed the highly celebrated phenomenon of sound waves that creep around the curved gallery of St Paul's Cathedral in London. These whispering-gallery waves have found applications in ultrasonic fatigue and crack testing, and in the optical sensing of nanoparticles. Here we construct a topological gallery insulator using sonic crystals made of thermoplastic rods that are decorated with carbon nanotube films, which act as a sonic gain medium by virtue of electro-thermoacoustic coupling.

14:40 : Invited talk

Spin-orbit Photonic Diode and Bragg-Berry Mirrors From 3D Chiral Liquid Crystal Architectures

Gonzague Agez[1], Etienne Brasselet[2]
[1]*Universite de Toulouse (France),* [2]*Universite de Bordeaux (France)*

Spin-orbit photonic devices usually rely on 2D (transverse) material structuring and are designed for optimal coupling between the polarization state and the spatial degrees of freedom at a given wavelength1. Exploiting the third dimension (longitudinal) provides ways to bypass monochromatic limitations. We show here that chiral liquid crystals endowed with 3D helix axis orientational distribution exhibit broadband spin-orbit optical vortex generation as well as an optical diode effect.

15:00 : Bulk measurement of topological order based on exciton absorption rate

Wei Chen, Gero von Gersdorff
PUC-Ri (Brazil)

Topological order in materials is generally calculated from the integration of certain curvature function in momentum space, such as the Berry curvature. We elaborate a relation between quantum geometry of the Bloch states and the curvature function called metric-curvature correspondence. It follows that bulk measurement of quantum geometry via exciton absorption or pump-probe experiment can directly reveal the topological order.

15:15 : Invited talk

Tailoring Light-Matter Interaction through Resonant and Evanescent Epsilon-Near-Zero Nanostructures

Vincenzo Caligiuri[1], A. Patra[1], A. Pianelli[2], M. Miscuglio[3], N. Maccaferri[4], R. Caputo[1], M. P. De Santo[1], A. Forestiero[5], G. Papuzzo[5], R. Barberi[1], R. Krahne[6], A. De Luca[1]
[1]*University of Calabria (Italy),* [2]*Military University of Technology (Poland),* [3]*George Washington University (USA),* [4]*University of Luxembourg (Luxembourg),* [5]*CNR-ICAR (Italy),* [6]*Istituto Italiano di Tecnologia (Italy)*

Metal/Dielectric multilayers are often present in light-matter interaction scenarios since they can be easily designed to tailor the electromagnetic environment surrounding quantum emitters, through the engineering of Local Density of States. In this presentation, we showcase two examples of metal/dielectric multilayers leveraging on either evanescent or resonant optical responses. The described applications unlocked by these multilayers are multiple, from λ/1660 resolution, to polariton generation through "pseudo cavity"modes to end with a particular example of plasmonic/photonic physical unclonable functions.

15:35 : Phase transitions of nodal lines by structural deformation of photonic crystals

Haedong Park, Sang Soon Oh
Cardiff University (United Kingdom)

We demonstrate a nodal lines' phase transitions that arise from a structural deformation of dielectric photonic crystals. We employ an anisotropic double diamond structure exhibiting a multi-gap nodal link in the three-dimensional momentum space. The possible phase transitions are predicted by calculating non-Abelian charges and Euler class.

14:00 - 15:10 — Room 7

Session 3A18

Thermal plasmonics and metamaterials for low-carbon society

Organized by: Junichi Takahara and Kotaro Kajikawa

Chaired by: Junichi Takahara and Kotaro Kajikawa

14:00 : Invited talk

Photonic enhancements to tailor the comfort of radiative textiles

Muluneh G. Abebe[1], **Alice De Corte**[1], **Gilles Rosolen**[1], **Jozefien Geltmeyer**[2], **Ella Schoolaert**[2], **Karen De Clerck**[2], **Bjorn Maes**[1]

[1]*University of Mons (Belgium)*, [2]*Ghent University (Belgium)*

Personal radiative heat regulation by photonic engineered textiles can contribute to a decreased energy consumption in buildings by expanding the range of comfortable ambient conditions. Here, we propose dual-mode photonic designs (a static and a dynamic one), which modulate the emissivity to provide thermal regulation in both cold and hot environments. The first design is a Janus-yarn fabric that tunes statically via fabric flipping, while the second design is dynamic by utilizing a shape-memory polymer.

14:20 : Invited talk

All-day energy-harvesting device based on radiative cooling

Yuki Ito, Mana Toma, Kotaro Kajikawa

Tokyo Institute of Technology (Japan)

An energy harvesting device based on passive radiative cooling is reported. It consists of a multilayered structure: a solar cell covered with a daytime-radiative-cooling film, a thermoelectric element, and a water heatsink to reduce temperature drop.

14:40 : Switchable thermal radiation based on Si metasurface mediated by VO2

Junichi Takahara, H. Takase

Osaka University (Japan)

We propose a switchable perfect absorber based on silicon metasurface mediated by metal-insulator transition materials of VO2. We demonstrate that the absorptivity in the atmospheric window can be reversibly switched between 0.08 and 0.9 on reaching a transition temperature of VO2 (341K). The switching of thermal radiation spectra was also observed experimentally. This device can be applied to adaptive radiative cooling with transparency at visible wavelength.

14:55 : Near-Perfect Broadband Thermal Reflector and Transmitter using Dielectric High-Contrast Gratings

Richard Zhang, Ken Araki

University of North Texas (USA)

A monolithic dielectric coating composed of at-wavelength periodic metasurface gratings on dielectric multilayers can achieve broadband total reflectance exceeding that of pure and untarnished metal surface. The minimization of thermal emittance can be tailored to any blackbody, for which the dielectric materials are carefully selected for broad near-zero absorption coefficient. Using computational optimization and theoretical understanding of high-contrast grating phase-shift mode conditions, we identified characteristic high-refractive index Germanium grating parameters on near-quarter-wave Ge/KBr refractive index Fabry-Perot cavity pairs.

15:15 - 16:00 — Room 7

Session 3A19

Quantum and topological photonics

15:15 : Synthetic Topological Nodal Phase in Bilayer Resonant Gratings

Ki Young Lee, Jae Woong Yoon, Seok Ho Song

Hanyang University (Korea)

The notion of synthetic dimensions in artificial photonic systems has received considerable attention as it provides novel methods for exploring hypothetical topological phenomena as well as potential device applications. Here, we demonstrate nanophotonic manifestation of a two-dimensional topological nodal phase in bilayer resonant grating structures. Using the mathematical analogy between a topological semimetal and vertically asymmetric resonant grating structures, we show that the interlayer shift simulates an extra momentum dimension for creating a two-dimensional topological nodal phase.

15:30 : Triangular resonators in topological valley photonic crystals

Gaëtan Levêque[1], Alejandro Martinez[2], Yan Pennec[1]
[1] *IEMN - University of Lille (France),* [2] *Universidad Politecnica de Valencia (Spain)*

In that work, we investigate numerically photonic topological insulators based on the valley Hall effect. Linear waveguides are coupled to triangular cavities, and a semi-analytical model is used to evidence the relation between a weak back-scattering along light propagation and the shape of the transmission spectrum through the resonator.

15:45 : Strong coupling of metamaterials in a photonic crystal cavity: Dark-mode coupling and the non-adiabatic switching dynamics of the vacuum ground-state

Fanqi Meng, Hantian Gu, Jahnabi Hazarika, Mark D. Thomson, Hartmut Roskos
Goethe-Universitat (Germany)

We investigate the strong interaction of metamaterials placed in a dielectric cavity at THz frequencies. First, we study a metamaterial with a unit cell of interacting pairs of split-ring resonators, and explain why the metamaterial in bright/dark configuration produces four polaritons in the cavity, while the bright/bright configuration only allows for three. Second, we investigate the sub-cycle destruction of a coupled system's vacuum ground-state by a laser pulse. The response strongly depends on the arrival time of the laser pulse.

14:00 - 15:55 — Room 8

Session 3A20

Symposium II: New trends in nanophotonics and advanced materials

Organized by: Junsuk Rho, Hakjoo Lee and Namkyoo Park

Chaired by: Junsuk Rho, Hakjoo Lee and Namkyoo Park

14:00 : Invited talk

Phonon-Plasmon coupling in pillared phononic crystals mediated by surface acoustic waves

Adnane Noual[1], Rock Akiki[2], Gaëtan Levêque[2], Yan Pennec[2], El Houssaine El Boudouti[1], Bahram Djafari Rouhani[2]
[1] *Universite Mohamed 1er (Morocco),* [2] *University of Lille (France)*

We study theoretically the phonon-plasmon interaction in a multilayered structure supporting metallic nanopillars or ridges. The acoustic vibrations of the pillars, excited by means of an incident surface acoustic wave (Sezawa wave), interact with localized plasmons of metal-insulator-metal type. The strongest couplings are obtained for the compressional resonance of the pillars as well as for a symmetric flexural mode resulting from the interaction between two adjacent ridges. Some Sezawa modes well-confined near the surface can also exhibit high optomechanic couplings.

14:20 : Invited talk

Multiphysics analysis of phase change materials and hydrogels based composite photonic components

Dmitry Chigrin
WTH Aachen University (Germany)

The growing demand on reconfigurability in neuromorphic computing, integrated photonics and microwave photonics is attracting increasing attention towards design of active photonic components. By changing a phase of the phase change material or a state of the hydrogel near a functional photonics building block, it is possible to realize (re)programmable components and materials. Here, we report on our recent developments of a multiphysics description of complex composite active photonic components incorporating phase change materials and hydrogels as their building blocks.

14:40 : Invited talk
Nanoscale nonlinear optics: from classical to quantum plasmonics
Cristian Ciraci, Federico De Luca, Ahsan Noor, Muhammad Khalid
Istituto Italiano di Tecnologia (Italy)

Modern photonic devices rely on nonlinear optical effects to carry out their functionalities. Yet, the realization of efficient nanoscale nonlinear optical components remains a chimera. In this talk, we explore three strategies based on the exploitation of plasmonic systems that might allow to overcome the main challenges and pave the way for all-optical integrated circuits.

15:00 : Invited talk
Magneto-optical binding in the near field *online*
Shulamit Edelstein[1], Antonio Garcia-Martin[2], Pedro Serena[1], Manuel Marques[3]
[1] *ICMM-CSIC (Spain),* [2] *IMN-CNM (Spain),* [3] *Universidad Autonoma de Madrid (Spain)*

We study the formation of a near-field optical binding between two identical particles. The equilibrium binding distance is controlled by the angle between the polarization plane of the incoming field and the dimer axis. The stiffness of this stable attaching interaction is four orders of magnitude larger than the usual far-field optical binding and is formed orthogonally to the propagation direction of the incident beam (transverse binding). The binding distance can be further manipulated considering the magneto-optical effect.

15:20 : Invited talk
Analog computing with short-pulsed metamaterials *online*
Carlo Rizza[1], Giuseppe Castaldi[2], Vincenzo Galdi[2]
[1] *University of l'Aquila (Italy),* [2] *University of Sannio (Italy)*

We investigate short-pulsed metamaterials (SPMs), a class of temporal metamaterials characterized by a time-varying dielectric permittivity waveform of duration much smaller than the characteristic wave-dynamical timescale. We investigate the electromagnetic scattering of a wavepacket interacting with an SPM, and we identify intriguing configurations for which an SPM can perform the first and second derivatives of the incident wavepacket. As the temporal counterpart of spatial metasurfaces, SPMs could open up new perspectives within the framework of space-time metastructures.

15:40 : Casimir torque and force on gratings *online*
Mauro Antezza
University of Montpellier (France)

We will discuss recent results: (i) on the theory of the Casimir torque between two gratings rotated by an angle θ with respect to each other [1], and (ii) on the theory and experiment on the Casimir force between interpenetrating gratings [2]. These findings pave the way to the design of contactless quantum vacuum torsional spring and sensors with possible relevance to micro and nanomechanical devices.

Coffee Break

Session 3P2

Poster session VI

16:00 - 16:40

Chaired by:

P1: Strong Surface Enhanced Raman Scattering by Dye molecules Near the Single and Dimer Ag Nanospheroids
Petros Petrosyan[1], Manuel Goncalves[2], Armen Melikyan[3], Hayk Minassian[4]

[1] *Yerevan State University (Armenia),* [2] *Ulm University (Germany),* [3] *Russian-Armenian University (Armenia),* [4] *Alikhanyan National Laboratory (Armenia)*

The SERS from R6G molecule near the single and dimer Ag nanospheroids in water is studied theoretically. It is shown that small Ag nanospheroids provide strong enhancement of order of owing to small curvature radius of the particle. The contributions of surface plasmons, image effect, lightning rod and hot-spot effects in SERS enhancement factor are explicitly demonstrated.

P2: Distinguishing Thermal from Nonthermal ("Hot") Carriers in Illuminated Molecular Junctions

Yonatan Sivan, Yonatan Dubi
Ben-Gurion University of the Negev (Israel)

The search for the signature of nonthermal ("hot") electrons in illuminated plasmonic nanostructures requires detailed understanding of the nonequilibrium electron distribution under illumination, as well as a careful design of the experimental system employed to distinguish nonthermal electrons from thermal ones. We provide a theory for using plasmonic molecular junctions to achieve this goal. We show how nonthermal electrons can be measured directly and separately from the unavoidable thermal response and discuss the relevance of our theory to recent experiments.

P3: Directed transport in non-Hermitian photonic quantum walks with extended internal symmetries

Henning Schomerus
Lancaster University (United Kingdom)

I describe how to equip photonic quantum walks with topologically meaningful non-Hermitian symmetries, such as a non-Hermitian charge-conjugation symmetry, and identify the resulting protected transport characteristics.

P4: Graphene/Silicon Schottky Solar Cells with Silicon Surface Textured by Photochemical Etching Method

Nardin Avishan, Alp Akbiyik, Khurram Shehzad, Emre Yuce, Alpan Bek
Middle East Technical University (Turkey)

Graphene/Silicon Schottky junction attracted great interest due to the extraordinary optical and mechanical properties of graphene. On the other hand, silicon surface texturing is a must for reflection reduction for Graphene/Silicon Schottky photovoltaics. In this study, photochemical etching is introduced for surface texturing. By utilizing a Digital Micromirror Device, it is possible to texture the surface in specific patterns. This study aims to combine the Si surface texturing by photochemical etching method and Gr/Si Schottky junction features for high-performance photovoltaics.

P5: Surface-enhanced Infrared Absorption phenomenon of the organic film on the gold V-shape nanoantennas metasurface

Anastasia Pisarenko, Roman Zvagelsky, Danila Kolymagin, Elena Zhukova, Dmytro Chubich
MIPT (Russia)

We present a study of surface-enhanced absorption phenomenon for Alq3 thin film. As a dichroic metasurface we fabricated gold V-shape nanoantennas of a 100 nm height. For the series of samples of different layer thicknesses (from 5 to 130 nm) the strong effect of surface-enhanced infrared absorption is demonstrated as well as the dependence properties of light-matter interaction on orientation of light polarization.

P6: Tailoring near-infrared localized plasmon resonances in composite island films

Jordi Sancho Parramon, Vesna Janicki, Matej Bubas, Ivana Fabijanic, Vesna Blazek Bregovic
Rudjer Boskovic Institute (Croatia)

Two different approaches for obtaining localized surface plasmon resonances in the near infrared range in metal islands films are presented. The first method consists of thermal annealing of Ag/Cu films that results in formation of nanoparticles with high aspect ratio. The second method is based on HAuCl4 titration of Ag islands and leads to the formation of AgAu alloy and Au hollow islands. Both approaches are technologically simple and therefore suitable for large-scale application of island films in nanophotonics.

P7: Bifocal Dielectric Metalens with Lateral Focusing of the Orthogonal Polarizations

Elaheh Bazouband[1], Fatemeh Bazouband[2], Mahdieh Hashemi[2], Andra Naresh Kumar Reddy[3]
[1] *Shiraz University (Iran),* [2] *Fasa University (Iran),* [3] *Samara National Research University (Russia)*

Silicon cross-shaped metaatoms with the ability of controlling both x- and y-polarizations are used to make a bifocal metalens with focusing the x- and y-polarizations in laterally-spaced focal spots. In case of coincidence of the two focal spots an intensity has increased by 30-50 %.

P8: Mass-produced optical metasurfaces for time-of-flight devices
James Downing[1], Enrico Carnemolla[1], Matteo Fissore[1], Habib Mohamad[1], Lucie Dilhan[1], John Graff[2], Pawel Latawiec[2]
[1]*STMicroelectronics (United Kingdom),* [2]*Metalenz (USA)*

We demonstrate the performance of our NIR compatible optical metasurface design and fabrication on a dedicated 300mm process in mass production. This technology has been developed to support our time-of-flight product line, providing performant optical components for beam-shaping and imaging functions. The technology is functionally flexible and can realise any arbitrary spatial phase modulation requirement within 1 wave. In high-volume manufacture our optics achieve zeroth order average $textless$0.2 % and transmission $textgreater$80 % measured at wafer level.

P9: Electrically Controlled and Thermally Tuned CMOS Compatible Graphene/Si Guided Mode Resonance Active Filter
Prateeksha Sharma[1], Dor Oz[1], Spyros Doukas[2], Elefterios Lidorikis[2], Ilya Goykhman[1]
[1]*Technion (Israel),* [2]*University of Ioannina (Greece)*

We propose and investigate tunable CMOS compatible Graphene/Si guided-mode resonance active1D and 2D filters based on electro and thermo-optic effects at teilecom wavelengths. The elecro-optic effect isachieved by variation in the graphene doping by electrostatic gating, and the thermo-optic effect utilizesgraphene as a thermal heater. The proposed filters offer narrow resonances of 1.4 nm, a high extinction ratio of20 dB and 30 dB for 1D and 2D gratings respectively and thermal efficiency of 0.056 nm/K.

P10: Comparing Single DNA Transient Hybridization Kinetics Using DNA-PAINT and Optoplasmonic Sensing approaches
Narima Eerqing, Subramanian Sivaraman, Jesus Rubio, Tobias Lutz, Hsin-Yu Wu, Janet Anders, Christian Soeller, Frank Vollmer
The University of Exeter (United Kingdom)

We report a comparison of two single-molecule techniques: fluorescence nanoscopy and optoplasmonic sensing. DNA hybridization kinetics on the surface of gold nanorods are measured in both platforms, and a similar dissociation rate is demonstrated.

P11: Highly Tunable Circular Dichroism through Coupled Modes in Triskelia Nanostructures
Javier Rodriguez Alvarez[1], Antonio Garcia-Martin[2], Arantxa Fraile Rodriguez[1], Xavier Batlle[1], Amilcar Labarta[1]
[1]*Universitat de Barcelona (Spain),* [2]*CSIC (Spain)*

A twisted stack of plasmonic nanostructures with three-fold symmetry showing large dichroic response is studied. Simulations indicate that the interactions between the two elements play a key role on determining the circular dichroism in the total optical loss. In particular, coupled absorption modes are responsible for circular dichroism values up to 0.6 in the visible and near-infrared range.

P12: Biosensor based on Phononic Crystals Supporting Bound States in the Continuum and Fano resonances
Ilyasse Quotane[1], Madiha Amrani[1], Cecile Ghouila-Houri[2], El Houssaine El Boudouti[1], Leonid Krutyanski[3], Bogdan Piwakowski[2], Philippe Pernod[2], Abdelkrim Talbi[2], Bahram Djafari Rouhani[2]
[1]*Universite Mohammed I (Morocco),* [2]*Universite de Lille (France),* [3]*Russian Academy of Sciences (Russia)*

We study a one-dimensional phononic crystal (1D-PC) that provides a new biosensor platform based on bound states in the continuum (BICs) and Fano resonances. The structure consists of a triple solid-liquid-solid layer immersed in water, where epoxy is used as the solid layers and a mixture of water and albumin as the liquid layer. We show that the structure exhibits high sensitivity and high-quality factor (Q) with better detection limit in the vicinity of the BIC.

P13: Controlling diffraction and dichroism of plasmonic metamaterials with nanosecond laser pulses
Van Doan Le, Balint Eles, Nicolas Dalloz, Manuel Alejandro Flores Figueroa, Francis Vocanson, Nathalie Destouches
Universite de Lyon (France)

We demonstrate the huge potential of nanosecond lasers to control diffraction and dichroism of self-organized plasmonic metamaterials by suitably tuning the laser processing parameters. Different diffractive and dichroic behaviors orginate from a large variety of metallic nanoparticle sizes and arrangements and depths of surface gratings. Electromagnetic simulations that reproduce the polarized transmission spectra of disordered plasmonic nanocomposites demonstrate the existence of coupling between localized plasmonic modes and delocalized photonic modes when dichroism is present.

P14: Coupled Confined Acoustic Line Modes within a Glide-Symmetric Waveguide

Daniel Moore[1], Gareth Ward[1], John Smith[2], Alastair Hibbins[1], Roy Sambles[1], Timothy Starkey[1]
[1]University of Exeter (United Kingdom), [2]DSTL (United Kingdom)

Two parallel but opposing lines of equally spaced finite depth holes are shown to support coupled acoustic line modes. Imposing glide symmetry, the confined coupled acoustic line modes have hybrid character, combining symmetric and anti-symmetric properties. These hybrid coupled acoustic line modes have a near constant group velocity over a broad frequency range, forming no band gap at the first Brillouin zone boundary. The hybrid character of these confined modes is explored by changing the spacing between the two surfaces.

P15: Manipulation of sonic waves by a quadruple set of Helmholtz resonators

Robine Sabat[1], Y. Pennec[2], G. Levêque[1], E. Cochin[1], D. Torrent[3], B. Djafari-Rouhani[4]
[1]University of Lille (France), [2]University of Exeter (France), [3]Universitat Jaume I (Spain), [4]IEMN - University of Lille (France)

This paper examines the coupling effect between Helmholtz resonators (HRs) on mitigating low-frequency sound, using the finite element model. Previously, we highlighted the physical mechanism behind double coupled HRs, generating two resonance modes, symmetric and antisymmetric. Such coupling features can be increased by including four HRs, each containing four openings. This paper aims to simulate quadruple HRs which result in a significant degeneracy-lifting of the resonances providing new opportunities for sound monitoring, and controlled by the alteration of units' separation.

P16: Slow light by dual periodic self-similar dielectric multilayered films

Peter Ropac, Urban Mur, Miha Ravnik
University of Ljubljana (Slovenia)

Slow light is emerging as an exciting route to improve long-distance communication, optical sensors and signal processing. We show the effects of self-similar features at different length scales in the dielectric profile of the unit cells of one-dimensional photonic crystals on the photonic bandgaps and group refractive indices. We achieve group refractive indices as large as one thousand. This work is a contribution towards realization of designable slow light photonic crystals.

P17: Understanding the Kinetics of Plasmon Induced Dehalogenation Reaction on the Surface of Silver and Gold Nanoparticles

Anushree Dutta[1], Robin Schurmann[1], Sergio Kogikoski[1], Niclas Muller[2], Stephanie Reich[2], Ilko Bald[1]
[1]University of Potsdam (Germany), [2]Freie Universitat Berlin (Germany)

Understanding the nature and mechanism of plasmon interaction with molecules at metal-molecule interface and factors controlling their reaction rate in a heterogeneous system is of utmost importance as this form the basis of plasmon chemistry. Therefore, the dehalogenation kinetics (C-Br bond cleavage) of brominated purines to define the kinetic rate law and the underlying reaction mechanism prevalent in heterogeneous medium via surface enhanced Raman scattering (SERS) technique have been studied within this report.

P18: Manipulating angular momentums of on-chip single photons

Cuo Wu, Shailesh Kumar, Sergey I. Bozhevolnyi, Fei Ding
University of Southern Denmark (Denmark)

Current metasurfaces have limited access to avoiding external incident lights for achieving orbital angular momentum (OAM) source. Herein, we demonstrate an OAM source that can be fully integrated on chip and emit well-collimated single photons. By efficiently designing Archimedean spiral gratings and deterministically locating quantum emitter, excited surface plasmon polaritons are converted to the OAM-encoded single photons. The output single photons generate two spatially-separated radiation channels with different polarization properties and perform entangled spin and orbital angular momentum states.

P19: MIM and MIIM-based Optical Rectennas for Infrared Energy Harvesting at 10.6 μm

Ali Yahyaoui[1], **Ahmed Elsharabasy**[2], **A. Al-Hashmi**[3], **J. Yousaf**[4], **Hatem Rmili**[3]
[1]*University of Tunis El Manar (UTM) (Tunisia),* [2]*McMaster University (Canada),* [3]*King Abdulaziz University (Saudi Arabia),* [4]*Abu Dhabi University (United Arab Emirates)*

This work presents a comparative study between metal-insulator-metal (MIM) and metal-insulator-insulator-metal (MIIM) based optical log spiral rectennas for infrared IR energy harvesting at 10.6 μm. We have considered the spiral antenna terminals as the electrodes of the rectifying diode and we have integrated the insulators between the two arms (electrodes) to enhance the harvested energy with the proposed nano-antennas. The study presents a comparison between the performance (E-field, I/V, responsivity, and resistivity) of the two proposed rectennas.

P20: Chiral Detection at the Molecular-Plasmonic Interface via Spin-Momentum Locking and Dynamic Symmetry Breaking

Jeremy Lutz[1], **Peter Morokshin**[1], **Jessie Rapoza**[1], **Richard Osgood**[2], **Jimmy Xu**[1]
[1]*Brown University (USA),* [2]*US Army Combat Capabilities Development Command (USA)*

Chiral structures are ubiquitous in nature. In life, pairs of anti-symmetric chiral molecules - enantiomers are intriguing microscopic examples. They are identical in atomic composition and therefore indistinguishable in scalar physical properties. Yet, one enantiomer may be therapeutic while the other toxic [1]. In this work, we demonstrate the feasibility of electrical detection of chiral molecules by optical rectification at the molecular-plasmonic interface via spin-momentum locking and dynamic symmetry-breaking.

P21: Inverse design of a near unity multiband infrared plasmonic grating absorber

Diego Souza Bezerra, Vitaly Felix Rodriguez Esquerre
Federal Universtity of Bahia (Brazil)

In this paper we present the inverse design of a multiband absorber based on a periodical plasmonic structures. The geometrical and optical parameters of the plasmonic grating composed of gold and germanium are obtained by using an efficient inverse design algorithm while the electromagnetic response is evaluated numerically by using the finite element method. We obtained multiband absorbers with almost near unity absorption in the mid- and long-wave infrared region from 4mm to 10mm

P22: Lithography free plasmonic near infrared transmission filter

Joaquim Junior Isidio de Lima[1], **Maria Paula Souza Barros**[1], **Iago Carlos Moreira da Silva**[1], **Marcos Antônio Miranda Araujo da Silva**[1], **Vitaly Felix Rodriguez Esquerre**[2]
[1]*Federal University of San Francisco Valley (Brazil),* [2]*Federal Universtity of Bahia (Brazil)*

A plasmonic transmitter composed of Pentoxide of Tantalum (Ta2O5) and Gold (Au) has been proposed and numerically analyzed. The transmitter has been designed to operate over the wavelength interval from 600 to 850 nm, known as Near Infrared (NI). We studied the dependence of the optical response on the geometrical parameters and they can affect optical response of the plasmonic transmitter, which can be used as optical filters. The Finite Element Method has been used to carry the simulations.

P23: Focusing surface acoustic waves produced by plasmonic mechanical nanoresonators

Hilario Boggiano[1], **L. Nan**[2], **B. Tilmann**[2], **G. Grinblat**[1], **E. Cortes**[2], **A. V. Bragas**[1]
[1]*Universidad de Buenos Aires (Argentina),* [2]*Ludwig-Maximilians-Universitat Munchen (Germany)*

Plasmonic nanoantennas have proven to be efficient optomechanical transducers for generating and detecting hypersound at the nanoscale. Excited with ultrafast laser pulses, these nanostructures sustain high-frequency coherent acoustic vibrations that emit a field of surface acoustic waves onto the underlying substrate. Here we introduce a novel design, consisting of a circular arc array of gold nanodisks, that allows to control the directionality of these waves and even focus them in a very small region of space.

P24: Different plasmonic strategies in metalized perovskite solar cells *online*

Monika Laska, Zofia Krzeminska, Janusz Jacak, Witold Jacak
Wroclaw University of Science and Technology (Poland)

In perovskite solar cells the dominating channel of plasmonic photovoltaic effect is of internal electric type not observed in metallized p-n junction cells, where only absorption of photons is strengthened by metallic nanoparticles. We present the analysis how to activate this latter plasmonic channel also in perovskite cells and to take a benefit from the electric and optical (absorption) plasmonic effects simultaneously in these cells.

P25: Observation of Goos-Hanchen shift in subwavelength gratings enhanced by surface plasmon

resonance *online*

Nikolai Petrov[1], Yuri Sokolov[1], Vladimir Stoiakin[1], Viktor Danilov[1], Vladimir Popov[2], Boris Usievich[1]
[1] *Russian Academy of Sciences (Russia),* [2] *Lomonosov Moscow State University (Russia)*

The lateral Goos-Hanchen displacement for a visible wavelength range beam when surface plasmon resonance is excited in a subwavelength metal grating is carried out theoretically and experimentally. A shift of the order of the beam width for the reflected beam near the surface plasmon resonance is demonstrated. The reflected beam is divided into two beams, the relative powers of which depends on the width of the incident Gaussian beam and the depth of the grating.

P26: Bound states in the continuum with subwavelength localization due to multi-mode interference in waveguides *online*

Nikolay Shubin, Vladimir Kapaev, Alexander Gorbatsevich
P.N. Lebedev Physical Institute of RAS (Russia)

We theoretically study multi-mode interference resulting in the formation of bound states in the continuum (BIC). The conventional description of BIC formation is based, typically, on the Friedrich-Wintgen mechanism, and thus is restricted to a two-resonance (two eigenmodes of the resonator cavity) approximation. We show that in 2D quantum mechanical and optical waveguides with resonators strongly coupled to them, BIC formation can be crucially influenced by multi-mode interference, which provides, in particular, the possibility for subwavelength localization in such BICs.

P27: Concept of optical spin-wave XNOR gate *online*

Anton Kolosvetov, Mikhail Kozhaev, Vladimir Belotelov, Alexander Chernov
Russian Quantum Center (Russia)

We demonstrate the concept of optical spin wave XNOR gate based on the interference of spin waves excited via inverse Faraday effect (IFE) in multiple points in a bismuth-substituted yttrium iron garnet (BIG). The logical output of the gate is determined by constructive and destructive interference controlled by the laser source helicity. Numerical simulations provide an excellent agreement with the experimental results and are further used to design magnon logic gates based on optically excited spin waves interaction.

16:40 - 18:25 — Room 1

Session 3A21

Symposium IV: Chirality, magnetism, and magnetoelectricity: Separate phenomena and joint effects in metamaterial structures

Organized by: Eugene Kamenetskii

Chaired by: Eugene Kamenetskii

16:40 : Keynote talk
Reactive quantities in nanooptics

Manuel Nieto-Vesperinas
CSIC (Spain)

In this talk we discuss the reactive helicity of chiral electromagnetic fields and its alternating flow, as well as its conservation law: the reactive helicity optical theorem, which governs the build-up of this quantity through its zero time-average flow.

17:10 : Invited talk
Spintronic THz emitters for the generation of structured electromagnetic pulses

Dominik Schulz, Schwager Benjamin, Jamal Berakdar
Martin-Luther University (Germany)

Spin current buildup and decay in magnetically active structures (spintronic emitters) can lead to coherent THz radiation. In this work we demonstrate via numerical micromagnetic/electromagnetic simulations, that metastructures of spintronic THz emitters are capable of molding the vectorial distribution and the phase of the emitted THz fields. The simulations evidence the generation of THz fields with tunable magnetic, magnetoelectric or chiral properties by appropriate material engineering.

17:30 : Invited talk
Polarization Properties of Twisted Photonic Crystal Fibers
Peter Banzer
University of Graz (Austria)

Polarization-maintaining fibers play a pivotal role in many applications, from endoscopy and fiber-based imaging to long-distance communication. Here, we discuss the polarization properties and capabilities of a special type of chiral fibers, i.e., twisted photonic crystal fibers, which were introduced only recently and show a strong circular birefringence. Experiments confirm that they are well suited for protecting polarization sub-spaces, a very useful property both from a practical and an applied perspective.

17:50 : Invited talk
3D FDTD-LLG modelling of magnetisation dynamics in thin film ferromagnetic structures
Feodor Ogrin
University of Exeter (United Kingdom)

Here I present a model which uses 3D finite-difference-time-domain (FDTD) approach together with Landau-Lifshits-Gilbert (LLG) equation to find the exact solutions for magnetisation dynamics in ferromagnetic thin films integrated with metal-dielectric structures. Several case studies are demonstrated, in which the model is validated against analytical and experimental methods

18:10 : Rotation and electric-field responses in chiral crystal of elemental Tellurium
Hiroaki Kusunose, Rikuto Oiwa
Meiji University (Japan)

Microscopic origin of chirality and possible electric-field induced rotation and its inverse responses are investigated on the basis of the tight-binding model for elemental Te. We found that the nearest-neighbor spin-dependent hopping is the characteristic element of chirality in Te, and is responsible for the electric-field induced lattice rotation and its inverse process. By these findings, we discuss a possible experimental approach to achieve absolute enantioselection for chiral crystals.

16:40 - 18:30 — Room 2

Session 3A22

Symposium II: New trends in nanophotonics and advanced materials

Organized by: Junsuk Rho, Hakjoo Lee and Namkyoo Park

Chaired by: Junsuk Rho, Hakjoo Lee and Namkyoo Park

16:40 : Invited talk
Hyperuniform disordered gap plasmon metasurface perfect light absorber
Junpeng Guo[1], Wonkyu Kim[1], Blake Simpkins[2], Hong Guo[1], Joshua Hendrickson[3]
[1]*University of Alabama in Huntsville (USA),* [2]*Naval Research Laboratory (USA),* [3]*Air Force Research Laboratory (USA)*

Hyperuniform disordered gap plasmon metasurfaces are investigated for wideband light absorption in visible and near-infrared spectrum. Optical reflectance spectra from fabricated hyperuniform disordered, periodic, and randomly disordered gap plasmon metasurfaces reveal the physical origins of a localized gap plasmon resonance mode and a non-localized optical resonance mode.

17:00 : Invited talk
Deep-Neural-Network-Enabled Freeform Flat Optics
Sensong An, Bowen Zheng, Mikhail Shalaginov, Clayton Fowler, Hong Tang, Hang Li, Yunxi Dong, Mohammad Haerinia, Tian Gu, Juejun Hu, Hualiang Zhang

Massachusetts Institute of Technology (USA)

We have proposed a Deep Learning (DL) approach for the inverse design of freeform metasurfaces. We first trained a Deep Neural Network (DNN) that can generate freeform meta-atom designs based on target electromagnetic (EM) responses. The generated design can be used to assemble large-scale meta-optical devices. Moreover, another DNN was constructed and trained to quantify the unavoidable mutual coupling effects between neighboring meta-atoms. Combining these two DNN approaches, freeform flat optical devices can be quickly designed and inversely optimized.

17:20 : Keynote talk
Keynote Talk of Dorota Anna Pawlak
Dorota Anna Pawlak
Ensemble3 Centre of Excellence (Poland)

Keynote Talk of Dorota Anna Pawlak

17:50 : Invited talk
Polarization-Multiplexed Metagrating In-Coupler for 3D waveguide AR display, and Seep Learning Enabled Inverse Optical Design
L. Jay Guo, Haozhu Wang, Zeyang Liu
University of Michigan (USA)

We developed a stereo waveguide display based on metagrating to provide unidirectional polarization-multiplexed in-coupling depending on the right or left circular polarization. In this way, two stereoscopic images encoded in opposite circular polarizations can be projected into two eyes separately to form stereo vision. For optical design tasks, numerical optimization methods for optical coating are often time-consuming. Here we show that combining machine learning with optimization can improve efficiency and even lead to better designs.

18:10 : Invited talk
Coupling optical antennas with directional hypersonic surface waves
Andrea Bragas[1], H. D. Boggiano[1], G. Grinblat[1], M. Poblet[1], R. Berte[2], Y. Li[2], E. Cortes[2], S. A. Maier[2]
[1]*Universidad de Buenos Aires (Argentina)*, [2]*Ludwig-Maximilians-Universitat Munchen (Germany)*

In this work, plasmonic nanoantennas are designed to generate directional hypersonic surface acoustic waves, acting as a coupler to a second nanoantenna located in the acoustic far-field. Proper design allows controlling the directionality of the surface wave to reach the position of a desired second nanoantenna, and whose effect on it can be optically read. We demonstrate the directionality of these acoustic waves with V-shaped generators coupled to disk-shaped receptors.

16:40 - 18:20 — Room 3

Session 3A23

Machine learning for metamaterials and metasurfaces

Organized by: Willie Padilla

Chaired by: Willie Padilla

16:40 : Invited talk
Inverse Design and Machine Learning for Passive and Active Metasurfaces
Mohammadrasoul Taghavi, Samad Jafar-Zanjani, Hossein Mosallaei
Northeastern University (USA)

Metasurfaces have been of great interest for various applications thanks to their full control over the light-matter interaction with nanoscale building blocks. Increasing demand for multifunctional compact photonic metasurfaces necessitates proper utilization of inverse design and optimization methods for achieving desired characteristics. We illustrate our recent works in this area on utilization of optimization and Machine learning to passive and active metasurfaces, namely for inverse design of all-dielectric large-scale metasails and active plasmonic metasurfaces.

17:00 : Invited talk
Deep Learning Metamaterials
Willie Padilla
Duke University (USA)

We discuss the use and impact of deep learning on metamaterials and metasurfaces, including both forward and inverse design. We show inverse results on three benchmark datasets and discuss the future of this exciting field.

17:20 : Multi-layered radiative cooling metamaterial design applying genetic algorithms
Carlos Lezaun[1], Tania Jorajuria[2], Alicia E. Torres-Garcia[1], Pilar Herrera[2], Miguel Beruete[1]
[1]*Public University of Navarra (Spain),* [2]*Navarra Industry Association (Spain)*

A genetic algorithm (GA) has been developed to design three different multi-layered radiative cooling metamaterials. Under direct sunlight, the best structure theoretically achieves a net cooling power above 61 W/m2 with 24 layers and a total height of no more than 5 μm. This design method is cost free due to the use of analytical computations for the metamaterials. Moreover, automated design of multi-layered metamaterials in the infrared range can be developed based on this approach.

17:35 : Deep Learning Accelerated Multi-Objective Optimization for Highly Performant and Mechanically Robust Nanophotonic Devices
Ronald Jenkins, Sawyer Campbell, Pingjuan Werner, Douglas Werner
The Pennsylvania State University (USA)

Deep Learning has proven successful in accelerating electromagnetic simulations of complex structures thus greatly reducing the computational burden of inverse-design problems. Exploiting this acceleration allows for exhaustive sensitivity analysis of candidate designs that would otherwise be intractable to perform. When combined with multiobjective optimization, this enables a framework where meta-device performance and robustness to fabrication uncertainties can be simultaneously optimized.

17:50 : Inverse matching method based on deep neural networks for design of hybrid metal-dielectric filters
Ruoyu Shen[1], Rong He[1], Liangyao Chen[1], Junpeng Guo[2]
[1]*Fudan University (China),* [2]*University of Alabama (USA)*

In this work, hybrid metal-dielectric guided mode resonance optical transmission filters are designed by using a trained neural network and inverse matching method. A forward neural network is trained to generate a large data set of three million filter design samples for inverse matching. Then, a preliminary selection is implemented to reduce candidate designs. Finally, an inverse matching method with Fano functions is used to design hybrid filters with narrow linewidth as small as 6.8 nm in the visible spectrum.

18:05 : Bezier Curve enabled Metasurfaces for Deep Learning controlled Inverse-Design
Liam Shelling Neto, J. Dickmann, S. Kroker
Technische Universitat Braunschweig (Germany)

Metasurfaces, two-dimensional subwavelength structures enable unique control of light with unprecedented applications in nano-optics. With this power comes the ever so famous curse of dimensionality that severely hinders intuitive control of the electromagnetic response of the individual meta-atoms based on their topology. In this study, we introduce a new design approach for meta-atoms using Bezier curves. The resulting canvas for metasurface design combined with a sophisticated deep learning framework paves the way for multifunctional metasurfaces.

16:40 - 18:10 — Room 4

Session 3A24

Symposium V: Phononics and acoustic metamaterials

Organized by: Jensen Li and Guoliang Huang

Chaired by: Jensen Li and Guoliang Huang

16:40 : Invited talk
Metamaterial pattern enabling control over sound produced by flapping artificial wings
Anastasiia Krushynska[1], **Igor Zhilyaev**[2], **Dimitry Krushinsky**[3], **Nitesh Anerao**[1], **Mustafa Cihat Yilmaz**[4], **Mostafa Ranjbar**[4]
[1] *University of Groningen (The Netherlands),* [2] *University of Applied Sciences Northwestern Switzerland FHNW (Switzerland),* [3] *Wageningen University and Research (The Netherlands),* [4] *Yildirim Beyazit University (Turkey)*
Artificial wings composed of rigid and flexible materials enable flapping flight accompanied by sound. Understanding the acoustics of natural insect wings allowed explaining basic mechanisms of sound generation by artificial wings. This work proposes to use metamaterial surface patterns for controlling the acoustic and aerodynamic characteristics of a wing. For this, we developed multi-parameter and machine-learning optimization procedures aimed at increasing the lift and manipulating the produced sound by tuning the pattern design.

17:00 : Invited talk
Topological states and nonlinearity-induced states in magneto-mechanical metamaterials
G. Liu, I. H. Grinberg, J. Noh, M. Lin, W. A. Benalcazaar, C. W. Peterson, T. L. Hughes, Gaurav Bahl
University of Illinois at Urbana-Champaign (USA)
We have recently developed magneto-mechanical metamaterials as a platform with which to explore protected edge states in topological insulators, protected transport with topological pumping, and spontaneously induced defect states due to nonlinearity. These metamaterials offer extremely good control over both nonlinearity and time-dynamics based on designer requirements.

17:20 : Guiding audible sound by sonic crystals
Yuanyan Zhao, Sriram Subramanian, Gianluca Memoli
University of Sussex (United Kingdom)
In this study, we propose novel sonic crystals with nonsymmetric shape, which results in complete bandgap in audible frequencies. By utilizing these sonic crystals, we construct a system, which guides audible sound through one-way channel. Numerical simulations and preliminary measurements are obtained to demonstrate their acoustic performances.

17:35 : Highly tunable metamaterial cavity for vibration localizing
Hong Woo Park[1], **Hong Min Seung**[2], **Won Jae Choi**[2], **Miso Kim**[3], **Joo Hwan Oh**[1]
[1] *Ulsan National Institute of Science and Technology (Korea),* [2] *University of Science and Technology (UST) (Korea),* [3] *Sungkyunkwan University (Korea)*
Metamaterial cavity has been highlighted due to its capability to localize the wave inside the cavity. However, technical problems, such as the lack of tunability in frequency and the lack of a method to optimize the performance prevent metamaterial from being used in practical applications. To solve these problems, we propose a highly tunable elastic metamaterial cavity which can easily tune the operating frequency and performance by adjusting simple geometry parameters.

17:50 : Invited talk
Willis couplings in periodic thermoacoustic amplifiers *online*
Côme Olivier[1], **Gaëlle Poignand**[1], **Matthieu Mallejac**[1], **Vicente Romero-Garcia**[1], **Guillaume Penelet**[2], **Aurelien Merkel**[3], **Daniel Torrent**[4], **Jensen T. H. Li**[5], **Johan Christensen**[6], **Jean-Philippe Groby**[1]
[1] *Universite du Mans (France),* [2] *Le Mans Universite (France),* [3] *Universite de Lorraine (France),* [4] *Universitat Jaume I (Spain),* [5] *The Hong Kong University of Science and Technology (Hong Kong),* [6] *Universidad Carlos III de Madrid (Spain)*
Thermoacoustic amplifiers are analyzed in the framework of nonreciprocal Willis coupling. The closed form expressions of the effective properties are derived, showing that an applied temperature gradient causes the

appearance of a nonreciprocal Willis coupling. These Willis couplings cause a coalescence point in the k space, which deviates from Re(k) = 0 (with k the wave number) and is thus a zero-group-velocity point, as well as the opening of an amplification gap at low frequency.

16:40 - 17:50 — Room 5

Session 3A25

Parity-Time and quasi-normal modes in Photonics, Plasmonics, Acoustics

Organized by: Anatole Lupu and Henri Benisty

Chaired by: Anatole Lupu and Henri Benisty

16:40 : Invited talk
Discovering phase transitions in PT-symmeric systems through Machine Learning methods
Giorgos Tsironis
University of Crete (Greece)

In this work we investigate phase transitions in parity-time- (PT)-symmetric non-linear systems described by the discrete non-linear Schrodinger. We generalise the physics-informed machine learning (PIML) method proposed in Refs [1,2] that successfully finds the parameters for the targeted energy transfer (TET) of an electron (or photon) to a target state and the parameters for the self-trapping (ST) transition in a nonlinear dimer.

17:00 : Invited talk
Forging the topological states
Hamidreza Ramezani
University of Texas Rio Grande Vally (USA)

I will demonstrate the observation and origin of robust bulk states in a disordered non-Hermitian system. In contrast to topological edge states, the robust bulk states are distributed all over the system and thus allow us to access the whole system [1]. This subject opens a new direction for a new form of robust states that are not necessarily localized on one side of the system.

17:20 : Non-Hermitian state-switching mechanism and its application to optical modulator technology
Jae Woong Yoon[1], Youngsun Choi[1], Yu Sung Choi[1], Kyungsik Yu[2], Moiseyev Nimrod[3]
[1] *Hanyang University (Korea),* [2] *Korea Advanced Institute of Science and Technology (Korea),* [3] *Technion-Israel Institute of Technology (Israel)*

We propose a novel wave-modulation principle enabled by characteristic non-Hermitian dynamics associated with a branch-point singularity known as exceptional point (EP). We show an adiabatic process narrowly bypassing an EP produces a robust switching effect between two orthogonal final states possibly with indefinitely small physical stimuli. Application of this state-switching effect to a plausible optical waveguide structure demonstrates intriguing possibility of realizing Tbit/s-level high-extinction optical modulators, which are unavailable from the conventional interferometric approaches thus far.

17:35 : Parity-Time Symmetry breaking in First-order Distributed Feedback Lasers
Yaoyao Liang[1], Quentin Gaimard[1], Jean-Rene Coudevylle[1], Alexandre Garreau[2], Arnaud Wilk[2], Henri Benisty[1], Abderrahim Ramdane[1], Anatole Lupu[1]
[1] *Universite Paris-Saclay (France),* [2] *III-V Lab (France)*

It is of fundamental significance to effectively manipulate the cavity resonant modes in laser physics. Recent explorations of parity-time symmetry provide an opportunity to realize stable single-mode lasing by strategically structuring gain and loss in the laser cavity. Here we experimentally report, for the first time, high-output single-mode lasing with relatively low threshold current in first-order distributed feedback cavities with broken parity-time symmetry structure.

16:40 - 18:10 — Room 6

Session 3A26

Plasmonics and nano-optics

16:40 : Plasmon resonances in biocompatible nanoparticles

Michal Horak[1], **Filip Ligmajer**[1], **Vojtech Calkovsky**[1], **Ales Danhel**[2], **Peter Kepic**[1], **Jindrich Mach**[1], **Tomas Sikola**[1]

[1]*Brno University of Technology (Czech Republic)*, [2]*Czech Academy of Sciences (Czech Republic)*

We present a study of biocompatible nanoparticles made of silver amalgam and gallium using STEM-EELS on a single particle level. Silver amalgam nanoparticles exhibit strong plasmon resonances in ultraviolet to infrared spectral region depending on the particle size which establishes them as promising candidates for applications within photochemistry and spectroelectrochemistry. Gallium nanoparticles then support plasmon resonances in ultraviolet to visible spectral region. Finally, we introduce biocompatible and phase-changing nanoparticles of vanadium dioxide supporting plasmon resonances in near-infrared spectral region.

16:55 : Evolutionary Optimization of Nanophotonic Design for Optoelectronic Applications

Ping Bai, Stan ter Huurne, Mohamed M. S. Abdelkhalik, Jaime Gomez Rivas

Eindhoven University of Technology (The Netherlands)

Periodic nanophotonic structures provide a wide range of opportunities for applications in optoelectronic devices due to the lattice resonances that display strong electromagnetic field confinement, exciton-polaritons originating from strong light-matter coupling or bound-states in the continuum with infinite lifetimes and vanished radiation losses. In this contribution, we introduce an evolutionary optimization method to inverse design periodic arrays of nanoparticles for the optimization of the coupling strength in strongly coupled organic materials and the short-circuit current of organic solar cells.

17:10 : Inverse-designed whispering-gallery nanolasers with axial emission and customized beam shape and polarization

Iago Diez, I. Luxmoore

University of Exeter (United Kingdom)

Here we present whispering-gallery nanodisc lasers that were inverse-designed to emit along their axial direction and whose laser beam shape and polarization is determined by the cavity geometry. We experimentally demonstrate the validity of the inverse design method by making three cavities, each one emitting into a different laser radiation mode: a linearly polarized gaussian-like beam, an azimuthally polarized doughnut beam and a radially polarized doughnut beam.

17:25 : Ultrathin Metals on a Transparent Seed and their Optoelectronic Applications

Daniel Martinez-Cercos[1], **B. Paulillo**[1], **R. A. Maniyara**[1], **A. Rezikyan**[1], **I. Bhattacharyya**[2], **P. Mazumder**[2], **V. Pruneri**[1]

[1]*ICFO (Spain)*, [2]*Corning Research and Development Corporation (USA)*

Ultrathin metal films (UTMFs) are emerging as game-changing optoelectronic materials for many applications in transparent electronics and plasmonic metasurfaces. In this talk we will discuss our recent work on the development of ultrathin Au and Ag films with percolation thickness close to 1nm using a fully transparent sub-nm cupric oxide seed to promote 2D-like growth on the receiving substrate. We will analyse the developed UTMFs optoelectronic properties and some applications such as electrically tunable infra-red reflector and plasmonic resonant structures.

17:40 : Light-driven microdrones

Xiaofei Wu, Raphael Ehehalt, Gary Razinskas, Thorsten Feichtner, Jin Qin, Bert Hecht

University of Wurzburg (Germany)

We present microscopic robotic devices with four plasmonic nanomotors that are remotely controlled in 2D in all three independent degrees of freedom by unfocused light of two wavelengths. The nanomotors are individually addressed by respective circular polarization components and wavelengths. The microdrones can be maneuvered by only adjusting the optical power for each of the four motors, analogous to macroscopic quadcopters.

17:55 : Tunable plasmonic surface lattice resonances *online*

Jose Francisco Algorri[1], Jose Manuel Sanchez-Pena[2], Jose Miguel Lopez-Higuera[1], Dimtiris Zografopoulos[3]
[1] *Universidad de Cantabria (Spain),* [2] *Universidad Carlos III de Madrid (Spain),* [3] *IMM-CNR (Italy)*

In this work, a plasmonic metasurface with an ultra-high Q factor (~3.103) is designed and demonstrated to be tunable by liquid crystals (LC). The high-Q factor is produced by collective surface lattice resonances (SLRs). This type of resonance is very dependent on the surrounding refractive index, and for this reason, the LC birefringence produces a broad spectral tunability (50 nm). Furthermore, the simple voltage control opens new avenues for applying SLR in wavelength control.

16:40 - 17:55 — Room 7

Session 3A27

Emerging applications, nanophotonic devices, plasmonics for health

16:40 : Photonic Crystal Sensors via Holographic Photolithography

Yubing Hu, Ali Yetisen
Imperial College London (United Kingdom)

Optical techniques have achieved significant contributions to modern healthcare, where lasers and optical devices have been daily used in clinical practice to diagnosis and treat disease. Recent development of plasmonic and photonic structures has enabled numerous high-tech applications - in particular, the integration with biochemical sensors. A facile and efficient holographic photolithography technique has been developed to fabricate photonic crystal sensors with quantitative and continuous response to chemical analytes and physical changes in aqueous solutions.

16:55 : Bioinspired Microstructures for Optical Detection of Vapors

Javier Pazos[1], Shaimum Shahriar[2], Stephen Kuebler[2], Jimmy Touma[3]
[1] *Electro Magnetic Applications, Inc. (USA),* [2] *University of Central Florida (USA),* [3] *Air Force Research Laboratory (USA)*

We report on an ongoing effort to develop optical sensors based on biologically inspired microstructures for the detection of chemical vapors. We focus on a design inspired by the periodic nanostructure found on the morpho rhetenor butterfly wing. Microstructures were fabricated by multiphoton lithography and designed to have a strong optical response in the near infrared and visible wavelengths. The optical performance of these structures was predicted via simulations using Meep. The results are being referenced against experimental data.

17:10 : All-Optical Nanosensor for Mechanical Vibrations

Lorena Escandell[1], Carlos Alvarez-Rodriguez[1], Angela I. Barreda[2], Braulio Garcia-Camara[1]
[1] *Carlos III University (Spain),* [2] *Friedrich-Schiller-Universitat Jena (Germany)*

A nanosensor based on two parallel high-refractive index nanowires has been designed. The high sensitivity of the scattered field on the inter-distance between the nanowires provides a remarkable sensing parameter of any mechanical vibration of the nanowires. The proposed sensor has been designed such that it works at a wavelength of commercial lasers (e.g. 1310 nm). and the sensing point avoids the incident field, strongly reducing the complexity of the illumination and detection systems.

17:25 : Lateral permittivity patterning by ion irradiation in CdO thin films for mid-IR plasmonics

Angela Cleri[1], Mingze He[2], Joshua Caldwell[2], Jon-Paul Maria[1]
[1] *Pennsylvania State University (USA),* [2] *Vanderbilt University (USA)*

Donor doped CdO films demonstrate excellent mid-infrared optoelectronic behavior due to tunable transport properties which enable low-loss plasmon resonances between 2-9 μm wavelengths. While doping during deposition determines optical properties throughout the entire film or within film layers, in-plane permittivity control is possible by locally inducing native donor defects through ion irradiation patterning. This novel method creates lateral patterns which are free of physical interfaces but exhibit sharp contrast in permittivity.

17:40 : Optical computation of a spin glass dynamics with adaptive optics

Marco Leonetti[1], Luca Leuzzi[2], Erik Hormann[3], Giorgio Parisi[3], Giancarlo Ruocco[4]
[1] *IIT CLNS (Italy),* [2] *CNR nanotec IT (Italy),* [3] *Univ Di Roma Sapienza (Italy),* [4] *Istituto Italiano di Tecnologia (Italy)*

Spin glasses (SGs) are paradigmatic physical models whose dynamics computation is nondetermistic polynomial-time hard and extremely difficult to simulate. Here we report on a recent implementation of the optical simulation of an SG, exploiting the N segments of a wavefront-shaping device to play the role of the spin variables. These optical SG, where interaction is performed by interference occurring at the speed of light, can be employed to perform ultrafast simulations.

16:40 - 17:55 — Room 8

Session 3A28

New materials for photonics

16:40 : All-dielectric nanophotonics with quantum emitters in Transition Metal Dichalcogenides semiconductors

Luca Sortino[1], Stefan Maier[2]
[1] *LMU Munich (Germany),* [2] *Monash University (Australia)*

Transition metal dichalcogenides (TMDs) semiconductors offer a platform for merging nanophotonics and two-dimensional (2D) materials. They are exceptional quantum materials in the monolayer form and possess appealing optical properties as bulk materials, such as a high index of refraction and giant anisotropy. Here we show that the combination of monolayer TMDs and all-dielectric nanostructures, also made from bulk TMDs, provides new approaches for enhanced light-matter interaction of 2D excitons and quantum emitters with Mie-resonant nanophotonic devices.

16:55 : THz Generation in the Graphene-Dielectric Metamaterial Structure with Electron Drift, Substrate Dispersion Influence and Control by External Magnetic Field

Yuriy Rapoport[1], Vladimir Grimalsky[2], Sergey Tarapov[3], Andrzej Krankowski[4], Jesus Escobedo-Alatorre[2], Svetlana Koshevaya[2], Artem Kachur[1]
[1] *Taras Shevchenko National University (Ukraine),* [2] *Autonomous Univ. of State Morelos (UAEM) (Mexico),* [3] *Usikov Institute for Radiophysics and Electronics of NAS (Ukraine),* [4] *University of Warmia (Poland)*

The possibility of extremely effective generation of THz surface plasmon-polaritons in the atructure "Dielectric-Graphene"with electron drift is demonstrated, accounting for an influence of the substrate dispersion and a control by external magnetic field.

17:10 : Dynamic polarization control with nanostructured monolayer black phosphorus for broadband terahertz applications

Nikolaos Matthaiakakis[1], Sotiris Droulias[2], Georgios Kakarantzas[1]
[1] *The National Hellenic Research Foundation (Greece),* [2] *FORTH (Greece)*

Dynamically tunable polarization conversion at the nanoscale based on resonant metallic or dielectric structures is in many cases limited to narrowband, non-tunable operation. In this work, by taking advantage of the strong anisotropic surface conductivity of black phosphorus, we propose a flexible, ultrathin, platform for broadband wave manipulation in the terahertz regime. We theoretically demonstrate controllable and dynamic polarization conversion via the coherent excitation of localized surface plasmons in symmetrically patterned monolayer black phosphorus nanosquare arrays.

17:25 : Plasmonic-enhanced graphene-based modulator on silicon photonics

Tingting Zhai[1], Binbin Wang[1], Kuan-Ting Wu[1], Jinbong Seok[2], Sera Kim[2], Wei-Yen Woon[3], Remi Vincent[1], Heejun Yang[4], Rafael Salas-Montiel[1]
[1] *UTT (France),* [2] *Sungkyunkwan University (Korea),* [3] *National Central University (Taiwan),* [4] *KAIST (Korea)*

Chip-scale photonic modulators have attracted great interest in telecommunication and data processing due to its ultra-fast speed, high bandwidth, and low energy consumption properties. However, it still suffers from low modulation depth and bulky footprint attributed to the inherently weak light-matter interaction in photonic systems. In this work, we proposed a subwavelength plasmonic enhanced graphene-based modulator with state-of-art performance. Our research can pave the way for application in intensive active PICs and graphene integrated nanophotonic devices.

17:40 : Structural and Optical Properties of Ge2Sb2Te5

Angel-Theodor Buruiana, Iosif Daniel Simandan, Florinel Sava, Aurelian Catalin Galca, Claudia Mihai, Alin Velea

National Institute of Materials Physics (Romania)

GST-225 thin films were prepared using: magnetron sputtering (MS), pulsed laser deposition (PLD) and a combination of the two, namely MSPLD. MS has the advantage of easily leading to fully amorphous films and to a single crystalline phase after annealing and produces the highest optical contrast between the as-deposited and annealed films. PLD leads to the best stoichiometric transfer, whereas the annealed MSPLD films have the highest mass density. The properties of GST-225 are significantly influenced by the deposition technique.

Conference Dinner and Horse Show!

Departure by bus from Kenzi Rose Garden Hotel at 19:30

19:30 - 23:30

Friday 22nd July, 2022

8:30 - 10:30 — Room 1

Session 4A1

Photonic bandgap structures, laser and cavities

08:30 : Silicon Photonic Crystal Cavities for Integrated Quantum Photonics

Andrea Barone[1], Thanavorn Poempool[2], Marco Clementi[1], Alessandro Marcia[1], Marco Liscidini[1], Daniele Bajoni[1], Dario Gerace[1], Thomas Fromherz[2], Matteo Galli[1]
[1]Universita degli Studi di Pavia (Italy), [2]Johannes Kepler University Linz (Austria)

We report the generation of nonclassical states of light through parametric fluorescence in a silicon photonic crystal cavity with equally spaced resonances. A bichromatic cavity design was adopted to obtain a comb-like resonance spectrum, while mode-selective tuning by laser-assisted local oxidation was used to fine adjustment of the resonance frequencies after fabrication, thus achieving almost perfect equally-spaced modes. Both stimulated and spontaneous four-wave mixing were observed. The generation of correlated single photon pairs was confirmed through coincidence measurements.

08:45 : Engineering high Q/V photonic modes in correlated disordered systems

Nicoletta Granchi[1], Richard Spalding[2], Kris Stokkereit[2], Matteo Lodde[3], Andrea Fiore[3], Riccardo Sapienza[4], Francesca Intonti[1], Marian Florescu[2], Massimo Gurioli[1]
[1]University of Florence (Italy), [2]University of Surrey (United Kingdom), [3]Eindhoven University of Technology (The Netherlands), [4]Imperial College London (United Kingdom)

Hyperuniform disordered (HuD) photonic materials have recently been shown to display several localized states with relatively high Q factors. However, their spatial position is not predictable a priori. Here we experimentally benchmark through near-field spectroscopy the engineering of high Q/V resonant modes in a defect inside a HuD pattern. These deterministic modes, coexisting with Anderson-localized modes, are a valid candidate for implementations in optoelectronic devices due to the spatial isotropy of the HuD environment upon which they are built.

09:00 : Carbon Nanotube Emitter Coupled in Hybrid Photonic Crystal Cavity

Anna Ovvyan[1], Felix Pyatkov[2], Min-Ken Li[2], Helge Gehring[1], Fabian Beutel[1], Sandeep Kumar[2], Ralph Krupke[2], Wolfram Pernice[1]
[1]University of Munster (Germany), [2]Karlsruhe Institute of Technology (Germany)

We developed hybrid silicon nitride photonic crystal cavity devices, which strengthen the emission of the integrated carbon nanotube resulting in generation of an enhanced signal in telecom wavelength band.

09:15 : Microstructured photonic crystal fibers infiltrated with metallic nanoparticles-doped liquid crystals for promising sensing and tunable photonic devices applications

Tomasz Wolinski[1], Kamil Orzechowski[1], W. Lewandowski[2], O. Strzezysz[3], M. Tupikowska[2], Ch. -T. Wang[4], T- M. Feng[4], W. -Y. Chen[4], L. -Y. Wu[4]
[1]Warsaw University of Technology (Poland), [2]Warsaw University (Poland), [3]Military University of Technology (Poland), [4]National Sun Yat-Sen University (Taiwan)

Spectral properties of microstructured photonic crystal fibers filled with metallic nanoparticles-doped liquid crystals in nematic or blue phases are demonstrated. It is presented that the investigated complex photonic systems can provide promising tunable properties for particular wavelengths in the visible light spectrum. Importantly, the presence of gold nanoparticles with an appropriate organic coating and mesogenic ligands in a blue phase liquid crystal matrix can enhance the external electric field sensitivity and temperature stability of the examined photonic liquid crystal fibers.

09:30 : DNA-origami based diamond type lattice with visible wavelength periodicity

Gregor Posnjak, Xin Yin, Arthur Ermatov, Mihir Dass, Tim Liedl
LMU Munich (Germany)

Inverse diamond lattice is one of the photonic crystal structures with potentially widest photonic band gaps. We use a DNA origami approach to self-assemble monomers which polymerize into an inverse diamond lattice with a periodicity of 160 nm. With co-crystalization of extension struts the unit cell can be expanded to at least 400 nm. The DNA origami lattice can be chemically modified to adjust the refractive index and the volume fill ratio to tune the photonic properties of the structure.

09:45 : Refractive index sensor based on Silicon Nitride photonic crystal operating on Hybrid External Cavity Laser configuration

Jesus Hernan Mendoza Castro[1], S. Iadanza[2], T. Oliveira[2], S. M. Butler[2], A. Tedesco[1], G. Giannino[1], B. Lendl[3], M. Grande[1], L. O'Faolain[2]

[1] *Politecnico di Bari (Italy),* [2] *Tyndall National Institute (Ireland),* [3] *Technische Universitat Wien (Austria)*

A high-Q factor 1D photonic crystal cavity (PhC) based on Silicon Nitride is presented, achieving calculated Q-factors above 106 over a wide range of upper-cladding refractive index values (1 to 1.45), angle sidewalls (0°, 5° and 7°) and stick widths. The 1D PhC devices experimental results demonstrate their suitability in external cavity laser configuration for integrated sensing platforms for gases and liquids at telecom wavelengths (1.4-1.6 um).

10:00 : Photonic Crystal with Two Photon Absorption: an all optical limiter *online*

Geraldine Guida[1], Frederique Gadot[2], Ramez Hamie[2]

[1] *Universite Paris Nanterre (France),* [2] *Guida (Geraldine)*

In this conference, we will present 2D PCs consisting of materials with TPA property (ZnO defects) to obtain an efficient all optical limiter in the visible range. Both triangular and hexagonal 2D PC are studied to facilitate its robustness to a variation of the incidence angle due to the symmetry of the structures. The TPA nonlinear properties of ZnO material are issued from a 1D PC experimental study.

10:15 : Transmission characteristics and anisotropy of epsilon near zero behaviour in Photonic Hypercrystal *online*

Munazza Zulfiqar Ali

Punjab University (Pakistan)

Photonic Hypercrystal is a recently studied novel phenomenon that incorporates the characteristics of hyperbolic metamaterial and photonic crystals. Three types of transmission gaps each emerging from different mechanism is investigated here. We also report two frequency regions where parallel or perpendicular components of permittivity tensor become nearly zero and anisotropic epsilon near zero (AENZ) phenomenon takes place. Dependence of these gaps and the AENZ behaviour of the crystal on the layer widths, incident angle, incident radiation polarisation is studied theoretically.

8:30 - 10:15 — Room 2

Session 4A2

Metamaterial-based devices

08:30 : Tailoring of Fano Resonances for Strongly Enhanced Third Harmonic Generation in Silicon Metasurfaces with Symmetric Structures

David Hahnel, Christian Golla, Maximilian Albert, Thomas Zentgraf, Viktor Myroshnychenko, Cedrik Meier, Jens Forstner

Paderborn University (Germany)

We present strongly enhanced third harmonic generation in amorphous silicon metasurfaces consisting of elliptical nanoresonators. Our numerical analysis shows that the interplay of Mie resonances leads to narrow Fano features producing ultra-high THG. The theoretical findings are in good agreement with experimental linear and nonlinear results obtained with transmission spectroscopy showing amplification factors up to ~900, much higher than current literature reports. Experimentally, an absolute conversion efficiency of ηmax=$2{,}8$ imes$10{-}7$ at a peak power intensity of $1{,}2GWcm{-}2$ is achieved.

08:45 : Improvement of calcium silicate hydrate using metamaterials for radiative cooling

Carlos Lezaun[1], **Jorge S. Dolado**[2], **Alicia E. Torres-Garcia**[1], **Jose M. Perez-Escudero**[1], **Iñigo Liberal**[1], **Miguel Beruete**[1]
[1] *Public University of Navarra (Spain),* [2] *Centro de Fisica de Materiales (CFM) (Spain)*

Calcium silicate hydrate (CSH) gel is the main compound in the concrete paste. In this work we enhance the solar reflection of this composite using metal bars that are compatible with current manufacturing techniques to achieve good radiative cooling properties. Two periodic structures have been studied and interestingly, it is found that lattice effects may be transcendent to attain radiative cooling properties. A further study will be performed with a fully developed concrete permittivity model.

09:00 : Designing Multi-Functional Metamaterials

James Capers[1], **Stephen Boyes**[2], **Alastair Hibbins**[1], **Simon Horsley**[1]
[1] *University of Exeter (United Kingdom),* [2] *DSTL Porton Down (United Kingdom)*

Passive manipulation of light is key to several new technologies, from optical computing to beam-steering. However, designing metamaterials that manipulate different waves in different ways remains challenging. In this work, we present a simple and efficient semi-analytic method for designing multi- functional metamaterials within the discrete dipole approximation. This is relevant to a wide class of experimental systems, across electromagnetics. We demonstrate our method by engineering the radiation pattern of an emitter, while also increasing its power emission.

09:15 : Electrically tuned optical phenomena in metal-oxide-semiconductor multilayer

Alexander Korneluk, Julia Szymczak, Tomasz Stefaniuk
University of Warsaw (Poland)

We present the numerical and experimental study on the process of electrically controlled formation of carrier accumulation layers on the oxide-semiconductor interface. We show that the effect can be utilized in multilayer metamaterial, leading to changes in the device's effective linear and nonlinear optical properties. In particular, the temporal frequency filtering, dispersion, and refractive index can be modified across the VIS and NIR spectral ranges simply by tuning the applied voltage.

09:30 : Ge metasurfaces for wavelength-selective photodetection

Jon Schlipf[1], **Fritz Berkmann**[2], **Yuji Yamamoto**[3], **Florian Morz**[2], **Inga Fischer**[1]
[1] *BTU Cottbus-Senftenberg (Germany),* [2] *University of Stuttgart (Germany),* [3] *IHP-Leibniz-Institut fur Innovative Mikroelektronik (Germany)*

We present a design of all-dielectric germanium metasurfaces for facile integration into silicon-compatible, wavelength-selective photodetectors. The structures were fabricated in a top-down process in a complex heterostructure layer stack that offers the possibility of electrical contacting. Optical properties were measured spectroscopically and separated from the effects of the substrate. Assisted by simulations, we describe the correlation between spectra and resonant modes in the metasurfaces. This allows for further optimization towards fully integrated wavelength-selective detectors for on-chip spectrometers or hyperspectral imaging.

09:45 : Metafoils with extreme mechano-optical properties for solar radiation isolation

Angelos Xomalis[1], **Barbara Putz**[2], **Xuezhi Zheng**[3], **Aexander Groetsch**[1], **Johann Michler**[1], **Jakob Schwiedrzik**[1]
[1] *Empa (Switzerland),* [2] *Montanuniversitat Leoben (Austria),* [3] *KU Leuven (Belgium)*

Metal-polymer interfaces are used widely in satellite missions as they show extreme thermal isolation and elevated interface strength. Here we show metafoils with ultrastable plasmon resonances allowing transmission of visible radiation while reflect the unwanted infrared responsible for device heating. Electromagnetic and nanomechanical simulations showing extreme resilient resonances with strains up to $20\,\%$, equivalent to thermal expansion in temperatures of $textgreater$10000 K. Such small footprint and lightweight devices are highly desirable for solar isolation and spectroscopic applications in harsh environments.

10:00 : Metasurface of Capacitively Loaded Rings for Local Enhancement of the Signal-to-Noise Ratio of Surface Coils in Magnetic Resonance Imaging

Manuel Freire, Ricardo Marques
Universidad de Sevilla (Spain)

An analysis is shown for the optimization of metasurfaces of capacitively loaded rings to provide a local enhancement of the SNR of surface coils. As the mutual coupling between rings increases, the losses introduced by the rings in the coil reduce, and then the SNR increases.

8:30 - 09:30 — Room 3

Session 4A3

Micro/Nano fabrication and characterization techniques

08:30 : All-on-fiber generation of higher-order Poincare sphere beams via 3D laser-nanoprinted metasurfaces

Chenhao Li[1], **Markus Schdmit**[2], **Stefan Maier**[1], **Haoran Ren**[3]
[1]*Ludwig-Maximilians University Munich (Germany)*, [2]*Leibniz Institute of Photonic Technology (Germany)*, [3]*Macquarie University (Australia)*

We present a new metafiber platform for all-on-fiber polarization manipulation through implementing 3D laser-nanoprinted metasurfaces on the end face of polarization-maintaining fibers. The unlocked height degree of freedom in 3D polymer meta-atoms eases the simultaneous polarization and phase control, leading to the generation of arbitrary higher-order Poincare sphere beams carrying different orbital angular momentum modes.

08:45 : High throughput testing of nanophotonic devices

Adarsh Ananthachar, Ganga Chinna Rao Devarapu, Liam O'Faolain
Munster Technological University (Ireland)

Te proposed Resonance Scattering Spectroscopy (RSS) technique is a fully automated, non-invasive, and high throughput wafer-scale characterisation system. In the RSS technique, the laser source of fixed polarisation is tightly focused on the device. Light with a wavelength matching that of the device's resonance wavelength is scattered into the orthogonal polarisation giving a signal that is characteristic of the resonator which can be rapidly acquired. The prototype is tested on chip scale which further is to be implemented on wafer-scale.

09:00 : Metasurface wave front metrology using a quadriwave lateral shearing interferometery

Benoit Wattellier[1], **Matthieu Ansquer**[1], **Yanel Tahmi**[1], **Patrice Genevet**[2], **Samir Khadir**[2]
[1]*PHASICS (France)*, [2]*Universite Cote d'Azur (France)*

We present the characterization of metasurface optical function in phase and intensity by use of a wave front sensor, based on quadriwave lateral shearing interferometry. It is applied to metalenses where aberrations and manufacturing defects are measured in a single shot. Studying vortex metasurface also reveals phase substructures due to the design strategy.

09:15 : Some numerical results for monochromatic aberrated metalenses in terms of intensity-based moments

Sorina Iftimie, Ana-Maria Raduta, Daniela Dragoman
University of Bucharest (Romania)

In this study, through comprehensive numerical simulations, we demonstrate that intensity-based moments and the associated parameters adequately capture changes in beam shapes induced by aberration of metalenses with a hyperbolic phase profile. Starting from the fact that the aberration of metalenses should be derived in wave optics and not ray tracing [1,2], we discuss the average position, spatial extent, Skewness, and Kurtosis.

8:30 - 10:15 — Room 4

Session 4A4

Photothermal and photoelectric nanophotonics

08:30 : Real-time Interfacial Nanothermometry Using DNA-PAINT Microscopy

Sjoerd Nooteboom, Yuyang Wang, Swayandipta Dey, Peter Zijlstra
Eindhoven University of Technology (The Netherlands)

Biofunctionalized nanoparticles are increasingly used in biomolecular studies, but laser-induced heating may alter the structure and interactions of conjugated biomolecules. Here, we present a nanothermometer based on reversible DNA interactions. The surface temperature of many single nanoparticles can be probed in parallel by the temperature-dependent dissociation rate of double-stranded DNA. The reversible nature of the method enables us to probe surface temperatures in real-time. No prior knowledge of the optical and thermal properties of the sample is required.

08:45 : Flow Control with Electro-Thermo-Plasmonic effect
Raul Rica[1], **Carlos David Gonzalez Gomez**[1], **Emilio Ruiz Reina**[2]
[1]*Universidad de Granada (Spain),* [2]*Escuela de Ingenierias (Spain)*

Pumping liquids is still an open challenge in microfluidics. Here, we provide a detailed study of the electro-thermo-plasmonic (ETP) effect in a microfluidic platform where gold nanoparticles dispersed in suspension are illuminated with a laser close to plasmonic resonance, and therefore act as sources of heat. In combination with an AC electric field, we show that strong convection can be achieved. Our experimental results are supported by 3D numerical simulations including the heat generation and the obtained flow patterns.

09:00 : Nanopatterned substrates for application in organic photovoltaic cell structures
Oana Rasoga[1], **Anca Stanculescu**[1], **Marcela Socol**[1], **Geanina Popescu-Pelin**[2], **Gabriela Petre**[1], **Carmen Breazu**[1]
[1]*National Institute of Materials Physics (Romania),* [2]*National Institute for Lasers, Plasma and Radiation Physics (Romania)*

The present study is focused on the fabrication of different nanopatterned surfaces by UV-Nanoimprint lithography technique and on the of the nanostructuring effect on the properties of some organic heterostructures prepared on them. We report that the surface modification by nanopatterning affects both the optical properties by multiple reflections on the walls of nanostructures and the electrical properties by enlarging the organic/electrode contact area and facilitating the charge carrier transport towards electrodes.

09:15 : Photoconductivity in InAs Quantum Dot Layers on GaAs substrate
Vladimir Kulbachinskii, Galib Galiev
Lomonosov Moscow State University (Russia)

We investigated the photoconductivity of InAs quantum dot layers on GaAs substrate in the temperature range 0.05*textless*T*textless*300 K in magnetic fields up to 6 T. We observed a positive persistent photoconductivity at T *textless* 250 K. The Shubnikov-de Haas effect was observed in heavy doped samples while a hopping conductivity in slightly doped samples at low temperatures. The Shklovskii-Efros law for hopping conductivity in the presence of the Coulomb gap in the density of states was observed at low temperatures.

09:30 : Deep-UV Plasmonic Rhodium Concave Nanocubes for SERS Detection
Govind Kumar, Ravi Soni
IIT Delhi (India)

We have synthesized rhodium concave nanocubes using a modified hot-injection method with trimethylene glycol as polyol solvent. The extinction spectra and near-field distribution of concave nanocubes of varying concavities in water are calculated using the 3D-FDTD technique. A deep UV-SERS platform based on rhodium concave nanocubes is presented which produces a strong SERS signal from explosive molecules, a low detection limit of ∼10-10 M, and excellent uniformity at 266 nm excitation.

09:45 : Polarization singularities induced by small particles *online*
Jie Peng, Shiqi Jia, Shubo Wang
City University of Hong Kong (China)

In this talk, I will discuss the properties and applications of polarization singularities (PSs) emerging in the scattering fields of small particles. We show that these PSs possess interesting topological properties in both the near fields and the far fields. The spatial evolutions of the PSs give rise to complex morphologies of light polarization with potential applications in chiral sensing and optical manipulations.

10:00 : Investigation of the mechanisms of plasmon-mediated photocatalysis: synergistic contribution of near-field and charge transfer effects *online*
Zelio Fusco, Kylie Catchpole, Fiona J. Beck
Australian National Universtity (Australia)

Plasmonic catalysis is an attractive way to drive and enhance chemical reactions. However, the relativecontribution of thermal and nonthermal effects is still an object of debate. Here, we investigate the transformation ofmethylene blue (MB) to thionine on disordered Au NPs arrays. Supported by extensive experimental results andtheoretical models, we demonstrate that near-fields and hot-electrons synergistically cooperate in enhancing thereaction yield and show that photothermal effects do not play a dominant role.

8:30 - 10:10 — Room 5

Session 4A5

Symposium IV: Chirality, magnetism, and magnetoelectricity: Separate phenomena and joint effects in metamaterial structures

Organized by: Eugene Kamenetskii

Chaired by: Eugene Kamenetskii

08:30 : Invited talk
Magnetoelectric-field electrodynamics: Search for magnetoelectric point scatterers
Eugene Kamenetskii
Ben Gurion University of the Negev (Israel)

The "first-principle", "microscopic-scale"ME effect of a structure composed by "glued"pairs of electric and magnetic dipoles raise questions on the ways of local probing the dynamic ME parameters, since the near field structure of such a probe should violate both the spatial and temporal inversion symmetries. Since the observed effects of ME coupling are not associated with the near-field manipulation properties caused by intrinsic magnetoelectricity, the question arises whether ME point scatterers of electromagnetic radiation really exist.

08:50 : Invited talk
Exotic chiral structures of azo-polymers with light possessing optical angular momentum
Takashige Omatsu
Chiba University (Japan)

We report on light induced chiral structures in azo-polymers through a single or two photon absorption process. Such chiral structured materials reflect the spatial intensity profile, wavefront and polarization of the irradiated light field, and they will provide us new fundamental physical insights for future studies of interaction between light fields with orbital angular momentum and materials.

09:10 : Invited talk
Origin of the Chirality Induced Spin-Selectivity Effect
S. Alwan, Yonatan Dubi
Ben-Gurion University of the Negev (Israel)

We present a theory for the origin of the chirality-induced spin selectivity effect, namely the appearance of a polarized current through chiral molecular junctions. The theory is based on spin-torque interactions at the interface between the molecule and the electrode. As opposed to other theoretical suggestions, this theory does not require any unrealistic renormalization of physical parameters, and can provide a quantitative fits to experimental data.

09:30 : Invited talk
Gate-tuneable and chirality-dependent charge-to-spin conversion in tellurium nanowires
Marco Gobbi
CIC nanoGUNE BRTA (Spain)

Chiral compounds are an ideal material platform for exploring the relation between structural symmetry and electronic spin transport. Here, we show that a charge current flowing in chiral single-crystalline Tellurium nanowires acquires a net spin polarization, which generates a large and gate-tunable unidirectional magnetoresistance (up to 7 %). The electrically generated spins are parallel to the chiral axis of Te and point in opposite directions in left- and right-handed nanowires. Our results pave the way for chirality-based spintronic devices.

09:50 : Invited talk
Measures of optical vortex chirality and their application in chiral metamaterials
Kayn Forbes
University of East Anglia (United Kingdom)

Optical vortex beams are inherently chiral due to their helical wavefront. The engagement of this optical chirality in chiroptical effects with chiral media in an analogous fashion to that of circularly polarized light requires certain conditions to be met. This talk outlines such requirements with a view in mind of currently untapped future applications in chiral metamaterials.

8:30 - 09:30 — Room 6

Session 4A6

Metasurfaces and flat optics, FSS and HIS

08:30 : Electrical access to an exceptional point of non-Hermitian graphene metasurfaces
Soojeong Baek[1], Sang Hyun Park[2], Donghak Oh[1], Kanghee Lee[1], Hosub Lim[2], Taewoo Ha[2], Bumki Min[1], Teun-Teun Kim[3]
[1]*KAIST (Korea),* [2]*Sungkyunkwan University (Korea),* [3]*University of Ulsan (Korea)*

We propose a simple electrical and spectral way of resolving an EP of THz non-Hermitian graphene metasurfaces. Experimentally, the non-Hermitian Jones matrix is reconstructed in parameter space spanned by the input frequency and gate voltage. At the EP, the coalescence of polarization eigenstates makes one of the cross-polarised transmission amplitudes vanish, resulting in maximal asymmetric polarisation conversion.

08:45 : Ultra-wideband wide-angle deflection enabling multifunctionality for a simple unitary meta-grating at near-infrared
Andriy Serebryannikov[1], Majid Aalizadeh[2], Ekmel Ozbay[3]
[1]*Adam Mickiewicz University (Poland),* [2]*University of Michigan (USA),* [3]*Hanyang University (Korea)*

The objective of this work is theoretical justification, design, and experimental validation of reflective unitary meta-gratings with unusually ultra-wideband and simultaneously wide-angle deflection that serves as the main enabler of the high multifunctional capability at the near-infrared. The design is based on the silicon nanorods that are periodically placed at a large distance from each other and may show the functionality enabling Mie resonances, and a dielectric spacer between the nanorods and a metallic reflector.

09:00 : A Transmission Optimized LWIR Metalens
Halil Can Nalbant, Fatih Balli, Arda Eren, Tolga Yelboga, Ahmet Sozak
Aselsan Inc. (Turkey)

This work details the design and fabrication of high transmission metalens operating at long-wave infrared wavelength regime. We minimize the reflection losses by an anti-reflection coating while maintaining the full wavefront control at the design wavelength 9.07 μm. We use a hole structure as a unit cell on a square lattice. Our novel unit cell structure provides an average transmission of 97.5 %. We verify the simulation results by a 0.27 numerical aperture and 12.5 mm focal length metalens.

09:15 : Deep subwavelength resonant meta-optics enabled by high-index topological insulators
Danveer Singh, Sukanta Nandi, Shany Cohen, Pilkhaz Nanikashvili, Doron Naveh, Tomer Lewi
Bar-Ilan University (Israel)

We study the optical properties of Bi2Te3 and Bi2Se3 topological insulators (TI) nanostructures of various morphologies and geometries, by examining both Far-field and Near-field responses. We find that both the bulk and surface states contribute to the extremely large optical constants of this family. We demonstrate deep subwavelength resonant structures for Bi2Se3 nanobeams and Bi2Te3 metasurfaces.

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