EOS SIOF CAPRI MEETINGS 2017

10 > 14 September

7th EOS Topical Meeting on
Optical MicroSystems (OμS'17)

3rd EOS Topical Meeting on
Optics at the NanoScale (ONS'17)

FINAL PROGRAM

EOS European Optical Society

SIOF Società Italiana di Ottica e Fotonica

Consiglio Nazionale delle Ricerche

Sapienza Università di Roma

General Information

VENUE

Capri is a beautiful and picturesque island in the Gulf of Naples, in the South of Italy. It has two towns: Capri and Anacapri. If the Piazzetta of Capri is the unrivalled focus of the island's glamorous social life, filled with elegant sidewalk cafes, the pretty historic centre of **Anacapri** located on the slopes of Mount Solaro is the exact opposite, with its peaceful piazzas and bougainvillea and geranium festooned lanes. It is a concentration of Mediterranean colours, scents, and sounds.

The EOS Topical Meetings in Capri will be held at the Conference Centre of the Consiglio Nazionale delle Ricerche, the former Royal Swedish Academy Solar Observatory, Via Ceselle, Anacapri (Na), Italy.

EOS Topical Meetings (OμS'17&ONS'17)

take place at the:

Conference Centre of the Consiglio Nazionale delle Ricerche
(former Royal Swedish Academy Solar Observatory)
Via Ceselle, Anacapri (Na), Italy

PLENARY SESSIONS

take place at the:

Sala Ipogea del Comune di Anacapri
Piazza Edwin Cerio
Anacapri

DISTANCE BETWEEN THE VENUES

GETTING AROUND AT CAPRI AND ANACAPRI

Getting around at Capri and Anacapri:
www.capri.com/en/come-muoversi

By car
Please note that during the tourist season (from Easter to the first weekend of November) non-resident vehicles are not allowed to circulate on the island of Capri. It is advisable to leave cars in one of the attended car parks close to the points of embarkation.

Further information

> Directions to Capri island (by plane, car or train)
www.capritourism.com/en/how-to-reach-capri

> Map of the island
www.capri.net/en/map

> Tourist information
www.capritourism.com

SYNOPSIS

OμS'17 is the 7th edition of the international conference wholly dedicated to optical microsystems organized by the European Optical Society (EOS) and the Italian Society of Optics and Photonics (SIOF), Italian Branch of the EOS.

Optical microsystems are now able to perform complex sensing and actuation functions, taking advantage of the progress in micro- and nano-technologies to integrate in a smart way optical devices with electronic, mechanical and sensing components. The increasing interest in this field arises from the perspective applications that would significantly improve the quality of life. The list of possibilities offered by these enabling technologies is long and seems to increase day by day. Optical microsystems are finding applications not only in ICT, but also in biotechnologies, medicine, food and environmental monitoring, aerospace and automotive, homeland security, etc. The conference programme will focus on fundamental as well as more applied topics. Biosensors, biochips and lab-on-chip, microfluidic and optofluidic systems, non-linear and quantum optical devices, silicon-based optoelectronics and MOEMS, chemical and physical optical microsensors, new characterization methods for materials and devices, novel imaging techniques, biomimetic devices and systems are among the hot topics of the conference.

GENERAL CHAIRS

Ivo Rendina
Consiglio Nazionale delle Ricerche (IT)

Eugenio Fazio
Università di Roma La Sapienza (IT)

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OμS'17 is organised in cooperation with the Italian Branch of the EOS:

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INVITED SPEAKERS

Monday, 11 September 2017 | Session 1: Silicon-based photonics

14:30-15:00 **Ion Implantation to form devices for Silicon Photonics advancement**
Graham Reed
University of Southampton, UK
Invited speaker

Ion Implantation of Germanium into Silicon is used to cause amorphisation, which in turn leads to a substantial increase in refractive index. This change is used to facilitate the realization of optical devices for wafer scale testing of silicon photonics circuits and devices, and for post-fabrication trimming of Mach-Zehnder interferometers and ring resonators. The former is possible because the devices can be erased after wafer scale testing is complete, and the latter is viable because partial annealing results in a partial change in refractive index.

15:00-15:30 **Integrated optics in 3C silicon carbide**
Alberto Politi
University of Southampton, UK
Invited speaker

The development of novel photonic materials can offer new capabilities for non-linear and quantum optics. I will present a photonic platform in 3C-SiC that provides high-confinement waveguides at telecommunication wavelengths. These devices are used to study the third-order non-linear response in 3C SiC. Finally I will discuss the use of SiC for quantum optics and for nanophotonics in the mid-IR.

Monday, 11 September 2017 | Session 2: Optical microscopy and imaging 1

17:00-17:30 **Terapixel hyperspectral whole slide imaging**
Gouan Zengh
University of Connecticut, USA
Invited speaker

Whole slide imaging (WSI) has recently been cleared for primary diagnosis in the US. In this talk, I will discuss the development of a terapixel hyperspectral whole slide imaging system with 300 megapixel per second throughput. This system employs a novel autofocusing strategy requires no axial scanning, no additional camera and lens, works for stained and transparent samples, and allows continuous sample motion in the focus surveying process.

17.50- 18.20 **Imaging transparent neuronal cells in the retina**
Christophe Moser[1], Timothé Laforest[1], Dino Carpentras[1], Mathieu Kunzi[1], Laura Kowalczuk[1] and Francine Behar-Cohen[2]

[1] *Université de Montpellier (Montpellier, France)*
[2] *Institut national de la santé et de la recherche médicale, France*
Invited speaker

Light entering the eye needs to pass through several transparent layers before reaching the photodetectors. These layers contain many different types of cells which are essential for vision. Their observation can provide crucial information on the development of eye disease in early stages. However, due to their transparency, these cells cannot be observed with standard imaging techniques such as Optical Coherence Tomography and Confocal Imaging with Adaptive Optics. We will show a major advance by proposing and demonstrating a method to visualize retinal neuronal cells with high contrast and resolution.

Tuesday, 12 September 2017 | Special Session: Flexible Photonics

Chair: Giuseppe Coppola

09:00-09:20 **All-Polymer Waveguides and Laser Resonators from Conjugated Polymer and Cellulose Acetate**

Juan Cabanillas Gonzales
IMDEA Nanociencia, Spain
Invited speaker

We report all plastic planar fluorescent waveguides and laser resonators exhibiting low threshold values for amplified spontaneous emission (ASE) and lasing. These devices are based on micro and nanostructured mechanically flexible cellulose acetate (CA) coated with highly fluorescent conjugated polymers: poly(9,9-dioctylfluorenealt-benzothiadiazole) (F8BT), regioregular poly(3-hexylthiophene) (rr-P3HT), poly(9,9-dioctylfluorene) (PFO) and mechanically flexible cellulose acetate (CA) are reported. The replication by nanoimprint lithography of patterned substrates in CA, onto which high quality semiconductuncting polymer films can be easily processed by spin coating, is exploited to fabricate full plastic systems that exhibit high net gain and low optical loss coefficients. As a result, highly transparent and free-standing distributed feedback (DFB) lasers and waveguides are obtained, with excellent optical properties that remain unaltered after bending, allowing them to be adapted in various pliable photonics devices.

09:20-09:40 **Wearable sensors in biomedical applications: opportunities and challenges for the next future**

Carlo Iorio
Ecole polytechnique de Bruxelles, Belgium
Invited speaker

To be defined.

09:40-10:00 **Optical fibre sensing in textiles**

Stephen Morgan
University of Nottingham, UK
Invited speaker

Optical fibre sensors integrated within textiles offers the potential for next generation wearable devices. Two important applications in healthcare are in monitoring the status of chronic wounds and in prediction of tissue breakdown in those with vulnerable skin. Examples of optical fibres sensing technologies will be

presented. For example textile based heart rate monitoring, oximetry and capillary refill monitoring in a sock and a wound dressing incorporating an optical fibre humidity sensor.

10:00-10:20 **Flexible Holographic Optical Elements: state of the art and perspectives**

Maria Antonietta Ferrara[1], Valerio Striano[2], Giuseppe Coppola[1]
[1] CNR –IMM
[2] OHB S.p.A.
Invited speaker

Volume phase holograms with high light efficiency recorded on a flexible substrate allows to produce flexible holographic optical elements (F-HOEs). F-HOEs can be used in a wide variety of applications, ranging from solar concentrators, wearable sensors, displays for virtual and augmented reality, etc. An overview of these applications and of the potentialities offered by F-HOEs are reported.

10:20-10:40 **Flexible photonic sensors realized using printing technologies**

Jeroen Missinne
Centre for microsystems technology, Ghent University and imec, Technologiepark 15, B-9052 Gent, Belgium.
Invited speaker

Making sensors flexible and thin, is key to apply them on curved, moving surfaces, e.g. for wearable applications or to embed them in mechanical structures. Photonic sensor systems require the integration of microstructures (e.g. polymer waveguides), nanostructures (e.g. gratings), which can be realized using nanoimprint lithography, but may also need additional active or passive optical components, which can be integrated using laser printing technologies.

Tuesday, 12 September 2017 | Session 3: Sensors

11:20-11:50 **Photo-activated plasmonic nanostructures for controlled drug release and advanced detection**

Roberto Pini, Paolo Matteini, Marella de Angelis, Martina Banchelli, Maximilien Cottat, Cristiano D'Andrea and Emmanuel Ruggiero
Institute of Applied Physics "Nello Carrara", National Research Council of Italy (IFAC CNR), Italy
Invited speaker

We review our research activities on the exploitation of plasmonic nanoparticles as light-activated nanotransducers for "on demand" drug release from implantable tools and as effective nanoplatforms for sensing and diagnostic applications of neurodegenerative disorders.

Tuesday, 12 September 2017 | Session 4: Optical microscopy and imaging 2

14:30-15:00 **3D Flow Field Mapping in Microfluidic Devices by means of Spatio-temporal Image Correlation Analysis**

Giuseppe Chirico[1], Maddalena Collini[1], Laura Sironi[1], Laura D'Alfonso, Nicolo' Ceffa[1] and Ferdinando Auricchio[2]
[1] Dipartimento di Fisica, Universita di Milano-Bicocca, Italy
[2] Dipartimento di Ingegneria Civile e Architettura, Università degli Studi di Pavia, Italy
Invited speakers

Microfluidic devices reproducing 3D networks are particularly valuable for nanomedicine applications such as tissue engineering and active cell sorting. There is however a gap in the possibility to measure how the flow evolves in such 3D structures. We will show how it is possible to map 3D flows in complex micro-channels networks by combining wide field illumination to image correlation approaches. To this purpose we have derived a spatio-temporal image correlation analysis of time stacks of single plane illumination microscopy images. From the detailed analytical and numerical analysis of the resulting model we developed a fitting method that allows to measure, besides the in-plane velocity, the out-of-plane velocity component down to vz = 50 microm/s. We have applied successfully this method to the 3D reconstruction of flows in micro-channel networks with planar and 3D ramifications. These different network architectures have been realized by exploiting the great prototyping ability of a 3D printer, whose precision can reach few tens of micrometers, coupled to poly-di-methyl-siloxane soft printing lithography.

Tuesday, 12 September 2017 | Session 5: Photonics Technologies

16:30-17:00 **Optical manipulation and imaging of single cells in optofluidic devices**

Roberto Osellame
Istituto di Fotonica e Nanotecnologie (IFN) – CNR, Italy
Invited speaker

Single cell analysis aims at unravelling the biological complexity due to the well-recognized diversity in cell populations. The integration of optical forces with microfluidic networks, in so-called optofluidic chips, allows advanced cell manipulation and characterization. In addition, the development of microscopy on a chip for the 3D tomography of single to few cells agglomerates paves the way to rapid analysis of a large quantity of samples for drug screening and personalized medicine.

18:00-18:30 **Label-free in-vitro drug and toxicity testing utilizing digital holographic microscopy**

Björn Kemper
Biomedical Technology Center of the Medical Faculty, University of Muenster, Germany
Invited speaker

In an overview, digital holographic microscopy (DHM) principles and systems for label-free quantitative live cell imaging are presented. Quantitative DHM phase images provide data for simplified image segmentation and automated object tracking. Moreover, absolute biophysical parameters such as volume, refractive index and dry mass can be extracted that are related to various cellular features and functions. Selected results demonstrate how the retrieved data sets can be applied to quantify the influence of drugs, toxic substances and nanomaterials on living cell cultures.

Wednesday, 13 September 2017 | Session 6: Optical microscopy and imaging 3

09:00-09:30 **Liquid Tunable Microscopy**

Alberto Diaspro [1,2,3]
[1] *Nanoscopy, Nanophysics, Istituto Italiano di Tecnologia, Italy*
[2] *Department of Physics, University of Genoa, Italy*
[3] *Nikon Imaging Center, Istituto Italiano di Tecnologia, Italy*
Invited speaker

Taking inspiration from the philosophical and sociological speculation by Zygmunt Bauman (Bauman Z., Liquid modernity, Polity Press, Cambridge, 2000), a new paradigm for optical microscopy is proposed in terms of design, implementation and applications. Current advances in optical microscopy (Diaspro A., van Zandvoort M.A.M.J. (eds) Super-resolution Imaging in Biomedicine, CRC press, 2016), related to the accessibility of data at the nanoscale in living systems or in matter physics studies, made super resolved microscopy, label free approaches, time and space encoding and decoding strategies, single molecule imaging and tracking approaches impregnated with a liquidity capable of condensing in itself the most significant aspects of the status of the art: a new paradigm for microscopy (Diaspro A., Circumventing the diffraction limit, Il Nuovo Saggiatore, 2014). The Liquid Tunable Microscopy perspective is related to the integration of gated STED, light sheet microscopy, image scanning microscopy, expansion microscopy and label free "new" approaches in a unique architecture. Three different directions will be also discussed, namely: i) intrinsic fluorescence of biological macromolecules; II) converging technologies for fluorescence unlimited super resolved microscopy; iii) label free microscopy based on Mueller matrix signature coming from angular scattering processes and exploiting differential polarisation interactions and refractive index mismatches in the VIS-IR regions (Diaspro A. et al, Polarized Light Scattering of Nucleosomes and Polynucleosomes: in Situ and in Vitro Studies, IEEE Trans. Biomedical Engineering, 1991; Mazumder N., Diaspro A. et al, Mueller matrix signature in advanced fluorescence microscopy imaging, J. Opt, 2017). Such technologies will converge to the liquid tunable microscope. It is liquid because it overlaps in an efficient and optimised way different mechanisms of contrast and it is tunable because it offers a real time scalability in terms of spatial and temporal resolution like a radio tuned on the preferred radio station. It is smart because is able to adapt its architecture to the current scientific question and is open to additional light-matter interaction modules. The liquid tunable microscope will find its application in deciphering how macromolecular complexes dynamically change in structure and transiently interact each other to perform the vital functions of a cell towards the understanding human diseases.

09:30-09:50 **Raman spectroscopic identification and discrimination of normal and leukemia cells from peripheral blood**

Stefano Managò[1], Peppino Mirabelli[2], Gianluigi Zito[1], Michela Napolitano[1], Carmen Valente[1] and Anna Chiara De Luca[1]

[1] IBP-CNR, Italy

[2] IRCSS-SDN, Italy

Invited talk

In this work, we used Raman spectroscopy and statistical methods to identify and discriminate the white blood cells (B cells, T cells, NK cells, monocytes and granulocytes) and acute lymphoblastic leukemia cells. Without any label or marker, our spectroscopic approach allows the identification and discrimination of normal/leukemia cells, leukemia cell classification (maturation stage) and their follow-up after the chemotherapy treatment.

Wednesday, 13 September 2017 | Session 8: Plasmonic devices

14:30-15:00 **Plasmonic modulators and detectors for communications**

Ping Ma and Juerg Leuthold

Institute of Electromagnetic Fields (IEF), ETH Zurich, 8092 Zurich, Switzerland

Invited speaker

Plasmonics has emerged as a solution for monolithic integration of high-speed photonic components at the micrometer scale. In this talk we review our recent advances in high-performance optical communication devices enabled by plasmonics. Plasmonic modulators promise ultimate RC-limited speed, good power efficiency, and smallest footprint thanks to a highly confined optical mode. Recently,

we realized plasmonic-organic hybrid modulators with a bandwidth of up to 170 GHz and data rates exceeding 100 Gbit/s. In addition to utilizing the nonlinear organic materials, we also demonstrate for the first time a plasmonic ferroelectric BaTiO3 Mach-Zehnder modulator on silicon operating in a NRZ 72 Gbit/s experiment without pre- and post-equalization and biterror ratios well below the standard FEC limit. The active section of this modulator is as short as 10 μm, and no degradation due to temperature exposure beyond 250°C has been found. As for photodetectors, a fully integrated plasmonic detector has recently been demonstrated. It is based on amorphous germanium. The device consists of a silicon waveguide evanescently coupled with an Au- αGe-Au plasmonic slot waveguide. In order to overcome the small mean drift path of electrons and holes in the defect-like material, we used the sub-wavelength confinement of light in plasmonic waveguides to shorten the drift path of electrons and holes to about 100 nm. The measured bandwidth is beyond 50 GHz. The device is CMOS compatible and features a responsivity as high as 0.16 A/W.

15:20-15:40 **Lab-on-Fiber bio-probes integrated with Microgels**

Martino Giaquinto[1], Alberto Micco[1], Armando Ricciardi[1], Anna Aliberti[1], Eugenia Bobeico[2], Vera La Ferrara[2], Menotti Ruvo[3], Antonello Cutolo[1] and Andrea Cusano[1]

[1] University of Sannio, Optoelectronic Division, Department of Engineering, Italy

[2] ENEA, Italy

[3] CNR - Istituto di Biostrutture e Bioimmagini, Italy

Invited speaker

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This work deals with the development of a biosensing platform based on the combination between two intriguing technologies such as Lab-on Fiber and Microgels for overcoming limitations associated to standard label free approaches in case of small molecules. We demonstrate that glucose molecules binding event induces a thickness increase of a microgel layer integrated on the fiber tip, and consequently a refractive index reduction, which, in turn, induce a resonance blue shift of about 10nm.

Thursday, 14 September 2017 | Special Session: Optical biosensors and biochips

Chair: Luca De Stefano

09:00-09:30 **Extreme Sensitivity Biosensing Platform Based on Hyperbolic Metamaterials**

K. V. Sreekanth[1], Y. Alapan[2], M. ElKabbash[1], E. Ilker[1], M. Hinczewski[1], U. A. Gurkan[2], A. De Luca[3] ,N.F. Steinmetz[4] and Giuseppe Strangi[1,3]

[1] Department of Physics, Case Western Reserve University, 10600 Euclid Av,Cleveland, USA

[2] Mechanical and Aerospace Engineering Department, Case Western Reserve University, Cleveland, Ohio, USA.

[3] CNR-NANOTEC Istituto di Nanotecnologia and Department of Physics, University of Calabria, Rende, Italy

[4] Biomedical Engineering Department Case Western Reserve University Cleveland, OH 44106, USA

Keynote speaker

In recent years significant efforts have been made to design and fabricate functional nanostructures for biomedical applications and precision medicine. These research activities unlocked a complete new research field known as nano-theranostics, clinical diagnostics and therapies based on nanotechnologies. Optical sensor technology based on plasmonic metamaterials offers significant opportunities in the field of clinical diagnostics, particularly for the detection of lower-molecular-weight (<500 Da) biomolecules in highly diluted solutions. On the other hand, many research groups are extensively addressing unmet clinical needs by functionalizing bizarre nanostructures aimed to increase their biocompatibility and to provide them with extraordinary functionalities. Hybrid nano-carriers, viral cargos, organic and inorganic vectors among others represent only a fraction of a large variety of systems proposed to achieve local drug-delivery, photo-thermal and photodynamic therapies, high resolution imaging and stimulated

specific immune response to treat and monitor neurodegenerative diseases and cancers. In this context, we have developed a miniaturized plasmonic biosensor platform based on hyperbolic metamaterials supporting highly confined bulk plasmon guided modes that outperform current detection technologies. Upon using a grating technique to couple the optical radiation, different extreme sensitivity modes with a maximum of 30,000 nm per refractive index unit (RIU) and a record figure of merit (FOM) of 590 have been achieved

09:30-09:50 **Multifunctional Microsystems for Quality of Life in Home Environment**
P. Siciliano, A. Leone, L. Francioso
Institute for Microelectronics and Microsystems, Italian National Research Council, Lecce, Italy
Invited speaker

Social changes and needs, demographic change and an aging population, the need to improve the quality of life and well being of citizens as well as environmental sustainability require a redesign and a radical transformation of living conditions - urban space, domestic space, work environments, mobility, accessibility of services, welfare - according to a user-centric approach. In this context, "Key Enabling Technologies" aim to make all the environments in which people spend their time, be it business, social, and at home, etc., more adapted to the needs of those persons, whether they are in good physical condition in terms of frailty and disability, disease and social exclusion, in different age groups (children, adults or elderly people, in poor health, etc., ...). In particular, this work refers to the realization and application of Multifunctional Microsystems for the development of advanced technological solutions for products and services which, according to a pattern of "Ambient Intelligence", enable to redesign the sense of "Home Environment" to ensure inclusion, safety, welfare, comfort, care, health care, environmental sustainability.

09:50-10:10 **10000-Fold Improvement in (Bio)Sensing Using Nanostructured Porous Silicon Interferometers by Interferogram Average Over Wavelength Spectroscopy**
Giuseppe Barillaro
University of Pisa, Italy
Invited speaker

In this talk, development, characterization, and application (to both refractometry and biosensing) of a novel ultrasensitive technique for the non-amplified label-free discrimination of either bulk or surface refractive index changes (namely, Interferogram Average over Wavelength – IAW –reflectance spectroscopy) using nanostructured PSi interferometer is discussed. As to refractometric applications, a minimum bulk refraction index variation of 10-7 RIU was experimentally measured using NaCl aqueous solutions, with a theoretical limit of detection of 10-8 RIU. As to biosensing applications, a minimum concentration of TNFa, a protein biomarker of inflammation and sepsis, at concentration of 3 nM was experimentally monitored, with high selectivity and limit of detection of 200 pM. Both these results represent a 10000-fold improvement with respect to the commonly used fast Fourier Transform reflectance spectroscopy for PSi interferometers used in non-amplified label-free mode. The IAW reflectance spectroscopy envisages bringing PSi optical (bio)sensors at the forefront of ultrasensitive label-free biosensing techniques with ultimate limit of detection in the order of pM level. This enables porous silicon targeting real application for point-of-care clinical analysis where low analyte concentrations are required to be detected in small volume of biological samples

Thursday, 14 September 2017 | Session 10: Holography

11:20-11:50 **Raman spectroscopy and digital holography as multimodal approach to cells discrimination and imaging**

A. De Angelis[1], M.A. Ferrara[2], S. Managò[1], M. Napolitano[1], G. Coppola[2], A. C. De Luca[1]
1 Institute of Protein Biochemistry, National Research Council, Via P. Castellino, 111, 80131 Naples, Italy
2 Institute for Microelectronics and Microsystems, National Research Council, Via P. Castellino, 111, 80131 Naples, Italy
Invited speaker

Raman spectroscopy and digital holography are complementary characterization methods, able to perform a simultaneous and correlative morphological and biochemical cells analysis in a fast, reliable and low cost way. Moreover, they are particularly suitable for biological applications as both take advantage of intrinsic optical properties of the sample, without the need for labelling. A demonstration of their multimodal capability is provided by our recent works on sperm cells analysis.

SYNOPSIS

New properties in nanoscale structures can be dramatically tuned with size and shape of the nanostructures. Completely different optical behaviors are produced compared to the bulk counterparts, such as narrow line widths for emission, solar energy conversion, etc. Indeed materials and applications require strong effort to develop spectroscopy and microscopy tools allowing visualization and manipulation of optical properties with nanoscale resolution. Optics at Nanoscale is a Topical Meeting that covers a spectrum from applied to basic research of this domain providing a forum for all the aspects with the purpose of advancing the state-of-the-art of nanoscale optics.

Special Session: COST action MP1403 Nanoscale Quantum Optics Work Group 2 Meeting

The COST action MP1403 on Nanoscale Quantum Optics serves as European platform to enhance networking and research collaboration in the rapidly evolving field of quantum nanooptics that has substantial overlap with the topics covered in the UNO workshop series. The second half of the 3rd EOS Topical Meeting on Optics at the Nanoscale (ONS'17) will host the work group meeting on Nonlinearities and Ultrafast Processes in Nanostructured Media (WG2).

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Vito Mocella
Consiglio Nazionale delle Ricerche (IT)

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ONS'17 is organised in cooperation with the Italian Branch of the EOS:

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Walter Pfeiffer, Bielefeld University (G)
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Niek van Hulst, ICFO (ES)
Anatoly Zayats, King's College (GB)

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INVITED SPEAKERS

Monday, 11 September 2017 | Plasmonics I

14:30-15:00 **Polaritonic Figure of Merit of Plane Structures**

Jose Ordonez-Miranda
Institut Pprime, CNRS(Poitiers, France)
Invited speaker

Based on the ability of plane structures to simultaneously optimize the propagation, confinement, and energy of surface plasmon-polaritons or surface phonon-polaritons, we develop the polaritonic figure of merit Z = B*L^2/D, where B, L and D are the longitudinal wave vector, propagation length, and penetration depth, respectively. Explicit and analytical expressions of Z are derived for a single interface and a suspended thin film, as functions of the material permittivities and the film thickness. Higher Z are obtained for thinner films and smaller energy losses. The application of the obtained results for a SiC-air interface and a SiC thin film suspended in air shows that both structures are able to maximize the presence of polaritons at a frequency near to, but dierent than that at which the real part of the SiC permittivity exhibits a dip. Furthermore, using the temperature change of this dip, we show that the strength of polaritons increases with its height, which provides an effective way to enhance the overall Z of polaritonic structures.

15.20- 15.50 **Robust entanglement and giant interatomic energy-transport amplification with nonreciprocal photonic topological insulators**

Mauro Antezza
Université de Montpellier (Montpellier, France)
Invited speaker

We investigate both entanglement and energy transport properties for two-level systems in the vicinity of a photonic topological insulator (PTI) interface, which supports a nonreciprocal (unidirectional), scattering-immune and topologically-protected surface plasmon polariton in the bandgap of the bulk material. Moreover, we demonstrate that despite the presence of considerable imperfections at the interface of the PTI, the efficiency of the SPP-assisted energy transport is almost unaffected by discontinuities. We also show that the SPP properties allow energy transport over considerably much larger distances then in the reciprocal case, and we point out a particularly simple way to tune the transport. Finally, we analyze the specific case of a two-emitter-chain and unveil the origin of the efficiency amplification. The efficiency amplification and the practical advantages highlighted in this work might be particularly useful in the development of new devices intended to manage energy at the atomic scale, e.g. in quantum technologies.

Tuesday, 12 September 2017 | Plasmonics II

09:00-09:30 **Helix-Shaped nanostructures for tailored chiro-optical properties in the Visible range**

A. Passaseo[1], M. Esposito[1,2], V. Tasco[1]
1CNR - Institute of Nanotechnology, c/o campus Ecotekne (Lecce, Italy)
2Dipartimento Mat-Fis Ennio De Giorgi, Università del Salento (Lecce, Italy)

Invited speakers

Chiral metamaterials, allowing the manipulation of circular polarization states of light could represent a disruptive breakthrough for advanced optical devices.
In this work, helix-shaped nanostructures are presented, underlying the possibility to effectively modulate their optical performances in the linear regime at optical frequencies. This result is accomplished by exploiting different 3D spatial architecture and material choice (metal or dielectrics). Advanced designs for improved functionality, envisaged to match practical applications, will be discussed.

Tuesday, 12 September 2017 | Light manipulation

11:20-11:50 **Design and Engineering of Complex Aperiodic Metamaterials**

Luca Dal Negro
Boston University (Boston, USA)
Invited speaker

The ability to manipulate light-matter interactions using complex, aperiodic electromagnetic media is at the heart of current nanoplasmonics and metamaterials technologies. Efficient approaches for multiscale electromagnetic field enhancement, concentration and manipulation of fields with designed spatial-frequency spectra in complex media enable the control of propagating and non-propagating electromagnetic modes in optical nanostructures with broadband/multi-band enhanced responses. Besides its fundamental interest, photonic-plasmonic coupling in complex electromagnetic environments is also of great importance for device applications such as nano-antennas, ultrafast optical switchers, nanoscale energy concentrators, laser nano-cavities, and optical biochemical sensors. In this talk, I will discuss our recent work on the design and engineering of field localization, resonant scattering phenomena, and light transport in metal-dielectric deterministic aperiodic nanostructures. In particular, I will introduce our activities on the design and engineering of plasmonic antennas with fractal geometry for near-infrared and mid-infrared surface enhanced spectroscopy. I will then introduce the distinctive light scattering and localization properties of a new class of aperiodic media generated from prime numbers in complex quadratic fields, and discuss their potential for active plasmonics and metamaterials devices.

Tuesday, 12 September 2017 | Materials for photonics

14:30-15:00 **Transition metal dichalcogenides: a new material for photonic structures**

Adam Schwartzberg
Lawrence Berkeley National Labs (Berkeley, USA)
Invited speakers

Photonic structures require materials with a high index of refraction that can also be patterned with high resolution without degradation, silicon being the point of reference. In this talk I will present the transition metal dichalcogenide (TMD) tungsten disulfide as a new photonic material with properties surpassing silicon in the near-infrared and a set simple fabrication techniques enabling 3D photonic structures never before possible. Atomic layer deposition of transition metal oxides followed by chalcogen annealing allows for conformal patterning and high-resolution structuring while maintaining material quality. Three exemplar structures and their optical behaviors are demonstrated: 2D patterned, 2D templated, and 3D templated photonic crystals. We have modeled these results and present a theoretical framework which

we hope will aid the photonics community in developing new structures that can take advantage of this new material and flexibility of fabrication.

15:20-15:50 **Semiconductor nanowires for photonic integration and miniaturization**

T.V. Hakkarainen
Optoelectronics Research Centre, Tampere University of Technology (Tampere, Finland)
Invited speakers

III-V semiconductor nanowires (NW) are capturing increased interest as building blocks in future electronic and photonic devices. GaAs NWs can be grown directly on Si by self-catalyzed molecular beam epitaxy using a lithography-free technique for defining the NW nucleation sites, leading to a record high size uniformity. Such NWs exhibit diameter-dependent resonant absorption that can be detected by photo-acoustic technique. When coated asymmetrically by Au, the NWs provide chiral optical response in both absorption and emission.

Tuesday, 12 September 2017 | Nanoscale Phenomena

16:30-17:00 **Aspects of ultrafast thermomechanics at the nanoscale**

F. Banfi, [1,2] M. Gandolfi,[1,2,3] S. Peli,[1,2] F. Medeghini,[4] P. Maioli,[4] A. Crut[4] , F. Vallée[4], N. Del Fatti[4], C. Giannetti,[1,2] G. Ferrini,[1,2]
[1]Università Cattolica del Sacro Cuore, Dipartimento di Matematica e Fisica (Brescia, Italy)
[2]Università Cattolica del Sacro Cuore, Interdisciplinary Laboratories for Advanced Materials Physics (I-LAMP), (Brescia, Italy)
[3]Laboratory of Solid State Physics and Magnetism (Leuven, Belgium)
[4]FemtoNanoOptics group, Institut Lumière Matière, Université Lyon, CNRS (Lyon, France)
Invited speaker

17:20-17:50 **Light scattering by periodic rough surfaces - equivalent jump conditions**

A. Maurel[1], J.-J. Marigo[2], B. Gallas[3], A. Ourir[1]
[1]Institut Langevin (Paris, France)
[2]Laboratoire de Mécanique des Solides | LMS - Ecole polytechnique (Palaiseau, France)
[3]IInstitut des NanoSciences de Paris (Paris, France)
Invited speaker

The scattering of light by a periodic rough air-dielectric interface is analyzed in terms of equivalent jump conditions provided by two scale homogenization. Results are validated using direct numerics and experimental measurements on a Si substrate. In particular, we show the ability of the model to predict, without any adjustable parameter, the shift in the Brewster effect.

Wednesday, 13 September 2017 | Nonlinear optics

Special Session: COST action MP1403 Nanoscale Quantum Optics Work Group 2 Meeting

09:00-09:30 **Engineering nanoantennas for efficient nonlinear photon conversion at the nanoscale**

M. Celebrano,[1] A. Locatelli,[2] L. Ghirardini,[1] G. Pellegrini,[1] P. Biagioni,[1] X. Wu,[3] S.Grossman,[3] L. Carletti,[2] C. De Angelis[2], L. Duò,1 B. Hecht,3 M. Finazzi1
[1]Politecnico di Milano, Physics Department (Milano, Italy)
[2]University of Brescia, Department of Information Engineering (Brescia, Italy)
[3]University of Würzburg, Nano-Optics & Biophotonics Group - Department of Physics- Experimental Physics (Würzburg, Germany)
Invited speaker

We have recently devised a plasmonic nanoantenna working in the near infrared region of the electromagnetic spectrum, which allows boosting the second harmonic generation SHG efficiency. This is achieved by optimizing the nanoantenna geometry to feature (i) a double resonant response at both the fundamental and emission wavelengths, (ii) a spatial overlap between the modes involved in the process and (iii) a broken symmetry, to enable dipole-allowed SHG. We found that this nanoantenna concept behaves like a strongly coherent nanoscale light source, featuring extremely low uncoherent photoluminescence in the visible range and a marked third harmonic generation along with an intense SHG.

Wednesday, 13 September 2017 | Quantum Phenomena

Special Session: COST action MP1403 Nanoscale Quantum Optics Work Group 2 Meeting

11:00-11:30 **Ultrafast electron dynamics in plasmonic nanostructures for quantum active control of nanophotonics**

J. Aizpurua[1], G. Aguirregabiria[1], M. Zapata[1], R. Esteban[1,2], A.K. Kazansky[1,2],D. C. Marinica[3] and A.G. Borisov[3]
[1]Center for Materials Physics (CSIC-UPV/EHU) and DIPC (San Sebastián, Spain)
[2]IKERBASQUE, Basque Foundation for Science (Bilbao, Spain)
[3]Institut des Sciences Moléculaires d'Orsay, CNRS-Université Paris Sud (Paris, France)
Invited speaker

The optical response of plasmonic nanostructures can be strongly affected by the quantum nature of the conduction electrons in the metal, particularly in small particles and narrow gaps. Effects such as quantum size, nonlocal dynamical screening, atomistic features, electron spill-out, or electron tunneling ultimately determine the optics of subnanometric metallic structures and interconnects. To address these effects, a quantum treatment of the electron gas within time-dependent density functional theory (TDDFT) is able to fully account for the dynamical screening of the electrons confined by the boundaries in a metallic nanostructure. TDDFT in time domain allows to trace the ultrafast evolution of the electronic density as well as to address the linear and nonlinear optical response in metallic nanoantennas, thus showing how to exploit these building blocks in applications of active control in nanophotonics.

11.30-12.00 **On chip intrasystem Quantum Entangled States Generator**

Fabio Antonio Bovino
Leonardo & University of Rome "Sapienza" (Rome, Italy)
Invited speaker

Quantum technology is a fundamental new way of harnessing Nature and it has potential for a truly revolutionary innovation and promise the next generation of products with exciting and astounding properties that will affect our lives profoundly. They will have a great influence in defence, aerospace, energy and telecommunications sectors. If this process is to continue in the future, new, quantum technology must replace or supplement what we have now. In particular, Quantum Information Technology can support entirely new model of information processing based on so called quantum bits or qbits. Its eventual impact may be as great as greater than that of its classical predecessor. There is almost daily progress in developing promising technologies for realizing quantum information processing with various advantages over its classical counterpart.

Wednesday, 13 September 2017 | Imaging & Spectroscopy

Special Session: COST action MP1403 Nanoscale Quantum Optics Work Group 2 Meeting

14:30-15:00 **Coherent multidimensional spectroscopy of nanomaterials**

K. J. Karki, [1] N. Lenngren,[1] K. Zidek,[1] J. Chen, [1] M. J. Al-Marri,[2] D. Zigmantas,[1] O. Kühn,[3] T. Pullerits[1]
[1]Lund University, Chemical Physics and NanoLund (Lund, Sweden)
[2]Qatar University, Gas Processing Center (Doha, Qatar)
[3]Universität Rostock, Institut für Physik (Rostock, Germany)
Invited speaker

Coherent 2D spectroscopy is the most complete third order nonlinear optical technique. Together with conventional photon echo-based 2D spectroscopy, we apply incoherent action based 2D spectroscopy in the studies of various nanomaterials as QDs, plasmonic particles and light harvesting pigment proteins.

Wednesday, 13 September 2017 | Plasmonics III

Special Session: COST action MP1403 Nanoscale Quantum Optics Work Group 2 Meeting

16:50-17:20 **Control of optical emitters quantum efficiency by near-field coupling with plasmonic and pre-plasmonic nanostructures**

T. Cesca, B. Kalinic, N. Michieli, C. Scian, G. Mattei
1University of Padova, Dept. of Physics and Astronomy, NanoStructures Group (Padova)
Invited speaker

The capability to control and enhance the emission efficiency of optical emitters by near-field coupling with plasmonic and pre-plasmonic nanostructures is reported. An intense boost of the photoluminescence of Er3+ ions in silica is obtained with ultra-small sub-nanometric metal clusters. Moreover, it was demonstrated that extended plasmonic nanostructures, in the form of gold nanohole arrays, can be efficiently used to control their energy relaxation rates.

Thursday, 14 September 2017 Ultrafast phenomena

Special Session: COST action MP1403 Nanoscale Quantum Optics Work Group 2 Meeting

09:00-09:30 **Femtosecond and attosecond dynamics in carbon-based structures studied with ultrashort XUV pulses**

Franck Lepine
Université Claude Bernard Lyon 1, LASIM (Lyon , France)
Invited speaker

10:10-10:40 **Free-electron quantum state tomography for the characterization of attosecond electron pulse trains**

K.E. Priebe,[1] C. Rathje,[1] S.V. Yalunin,[1] T. Hohage,[2] A. Feist,[1] S. Schäfer,[1] C. Ropers[1]
[1]University of Göttingen, 4th Physical Insitute – Solids and Nanostructures (Göttingen, Germany)
[2]University, of Göttingen, Institute for Numerical and Applied Mathematics (Göttingen, Germany)
Invited speaker

Coherent electron-light scattering in tailored optical near-fields allows for the manipulation and reconstruction of free-electron Wigner functions. We developed a quantum state reconstruction scheme for free electrons – "SQUIRRELS" – which we apply to experimentally demonstrate attosecond electron pulse trains in an ultrafast transmission electron microscope.

OμS'17 & ONS'17 at a Glance

Sunday, 10 September 2017

18:00>20:00 REGISTRATION OPENING

Monday, 11 September 2017

09:00 REGISTRATION OPENING
CNR Conference Centre

10:30>11:30 PLENARY TALK I
Super-Oscillatory Optical Imaging Technology
Nikolay I. Zheludev
Sala Ipogea del Comune di Anacapri

11:30>12:30 PLENARY TALK II
Plasmonic Biosensors for Medical and Food Safety Applications
Jiří Homola
Sala Ipogea del Comune di Anacapri

OμS'17	ONS'17
CNR Conference Centre	CNR Conference Centre
13:00>14:30 LUNCH BREAK	13:00>14:30 LUNCH BREAK
14:30>16:30 SILICON BASED PHOTONICS	14:30>16:30 PLASMONICS I
16:30>17:00 COFFEE BREAK	16:30>16:50 COFFEE BREAK
17:00>18:20 OPTICAL MICROSCOPY AND IMAGING I	16:50>17:30 PLASMONICS I
	17:30>18:30 TERAHERTZ OPTICS

18:00>19:30 POSTER SESSION&WELCOME COCKTAIL

Tuesday, 12 September 2017

CNR Conference Centre	CNR Conference Centre
09:00>10:50 FLEXIBLE PHOTONICS *Special Session*	09:00>10:50 PLASMONICS II
10:50>11:20 COFFEE BREAK	10:50>11:20 COFFEE BREAK
11:20>13:00 SENSORS	11:20>12:50 LIGHT MANIPULATION
13:00>14:30 LUNCH BREAK	13:00>14:30 LUNCH BREAK

OμS'17 & ONS'17 at a Glance

OμS'17	ONS'17
CNR Conference Centre	CNR Conference Centre
14:30>16:00 OPTICAL MICROSCOPY AND IMAGING II	14:30>16:10 MATERIALS FOR PHOTONICS
16:00>16:30 COFFEE BREAK	16:10>16:30 COFFEE BREAK
16:30>18:00 PHOTONICS TECHNOLOGIES	16:30>18:30 NANOSCALE PHENOMENA

20:30 SOCIAL DINNER at "Da Gelsomina" Restaurant

CNR Conference Centre	CNR Conference Centre
	Special Session: COST action MP1403 Nanoscale Quantum Optics Work Group 2 Meeting
09:00>10:30 OPTICAL MICROSCOPY AND IMAGING III	09:00>10:50 NONLINEAR OPTICS
10:30>11:00 COFFEE BREAK	10:50>11:20 COFFEE BREAK
11:00>12:50 SENSING TECHNOLOGIES	11:20>13:00 QUANTUM PHENOMENA
13:00>14:30 LUNCH BREAK	13:00>14:30 LUNCH BREAK
14:30>16:20 PLASMONIC DEVICES	14:30>16:20 IMAGING&SPECTROSCOPY
16:20>16:50 COFFEE BREAK	16:20>16:50 COFFEE BREAK
16:50>18:00 OPTICAL MICROSCOPY AND IMAGING IV	16:50>18:20 PLASMONIC III

Thursday, 14 September 2017

CNR Conference Centre	CNR Conference Centre
	Special Session: COST action MP1403 Nanoscale Quantum Optics Work Group 2 Meeting
09:00>10:50 OPTICAL BIOSENSORS AND BIOCHIPS *Special Session*	09:00>10:50 ULTRAFAST PHENOMENA
10:50>11:20 COFFEE BREAK *Special Session*	10:50>11:20 COFFEE BREAK
11:20>13:00 HOLOGRAPHY	

END OF EOS TOPICAL MEETING

ORAL PRESENTATIONS OμS'17

PLENARY SPEAKERS

Monday, 11 September 2017

10:30-11:30 **Super-Oscillatory Optical Imaging Technology**

Nikolay I. Zheludev
Optoelectronics Research Centre, Univ. of Southampton (United Kingdom)
Nanyang Technological University (Singapore)

Super-oscillation is a physical phenomenon that band-limited functions can oscillate much faster than its highest Fourier component over arbitrarily large intervals. It breaks the common belief that optical resolution in far-field is diffraction-limited and the smallest focal spot size cannot be smaller than half effective wavelength. A super-oscillatory field with sub-diffraction features can be generated by delicate interference of propagating waves without any evanescent wave contributions. Proliferation of nanofabrication and beam shaping technologies now allows us to embrace superoscillatory approaches to focusing and imaging that beat the diffraction limit of conventional refractive lenses. In this talk I review recent progress in developing superoscillations optical focusing devices and techniques for super-resolution imaging applications.

11:30-12:30 **Plasmonic Biosensors for Medical and Food Safety Applications**

Jiří Homola
Institute of Photonics and Electronics , The Czech Academy of Sciences (Czech Republic)

Optical biosensors hold vast potential for applications in medical diagnostics, food safety and security. This paper presents selected recent advances in optical biosensors based on surface plasmons. These include advances in the development of plasmonic nanostructures, optical platforms, microfluidic systems, functional coatings and detection methodologies. Applications of plasmonic biosensors for the detection of analytes related to medical diagnostics and food safety are also discussed.

Sala Ipogea del Comune di Anacapri
Piazza Edwin Cerio
Anacapri

Important note: All EOS presentations scheduled will be held at

CNR Conference Centre (former Royal Swedish Academy Solar Observatory) | via Fraita/via Ceselle, Anacapri

Monday, 11 September 2017 | Session 1: Silicon-based photonics | Sala Montalcini

14:30-15:00 **Ion Implantation to form devices for Silicon Photonics advancement**

Graham Reed
University of Southampton, UK
Invited speaker

OμS17_paper_01

Ion Implantation of Germanium into Silicon is used to cause amorphisation, which in turn leads to a substantial increase in refractive index. This change is used to facilitate the realization of optical devices for wafer scale testing of silicon photonics circuits and devices, and for post-fabrication trimming of Mach-Zehnder interferometers and ring resonators. The former is possible because the devices can be erased after wafer scale testing is complete, and the latter is viable because partial annealing results in a partial change in refractive index.

15:00-15:30 **Integrated optics in 3C silicon carbide**

Alberto Politi
University of Southampton, UK

Invited speaker

OμS17_paper_02

The development of novel photonic materials can offer new capabilities for non-linear and quantum optics. I will present a photonic platform in 3C-SiC that provides high-confinement waveguides at telecommunication wavelengths. These devices are used to study the third-order non-linear response in 3C SiC. Finally I will discuss the use of SiC for quantum optics and for nanophotonics in the mid-IR.

15:30-15:50 **Grating based multi-wavelength filter in TiO2 coated SOI platform**

Somnath Paul, Toni Saastamoinen, Seppo Honkanen, Matthieu Roussey and Markku Kuittinen
University of Eastern Finland, Finland

OμS17_paper_03

We demonstrate an on-chip multi-wavelength waveguide grating filter in amorphous titanium dioxide coated silicon-on-insulator platform. Iterative Fourier Transform Algorithm (IFTA) is used to calculate an optimum phase function for a desired output spectrum. The carrier grating is been modulated according to the phase function.

15:50-16:10 **CMOS compatible Terahertz Rectifier**

Fabrizio Palma[1], Fernanda Irrera[1], Rosario Rao[1], Andrea Del Monte[2] and Giovanni Del Monte[2]
[1] Rome University La Sapienza, Italy
[2] LFoundry, Italy

OμS17_paper_04

We present a new semiconductor device, CMOS compatible, for the rectification of Terahertz signal in direct conversion terahertz detectors operating at room temperature. The semiconductor substrate constitutes the antenna ground plane. Together with the rectifying devices constitute a rectenna structure.

16:10-16:30 **Electro-optical modulation in a Silicon Carbide waveguiding Schottky structure.**

Francesco Giuseppe Della Corte, Ignazio Giglio, Giovanni Pangallo and Sandro Rao
[1] Università Mediterranea Reggio Calabria, Italy

OμS17_paper_05

Silicon carbide is attracting plenty of interest in the field of high-power semiconductor devices, due to its excellent electrical, thermal and mechanical characteristics. 4H-SIC is today the preferred crystalline form of SiC, performing a wide bandgap (Eg=3.2 eV), a high critical electric field (4×106 V/cm), a high thermal conductivity (4.9 W/cmK), and a high electron saturation speed (2×107 cm/s). In this paper we report about electro-optical modulation observed in a 6 μm thick epitaxial layer made of 4H-SiC forming the drift region of a standard 600-V Schottky rectifier.

16:30-17:00 **Coffee break**

Monday, 11 September 2017 | Session 2: Optical microscopy and imaging 1 | Sala Montalcini

17:00-17:30 **Terapixel hyperspectral whole slide imaging**
Gouan Zengh
University of Connecticut, USA
Invited speaker
OμS17_paper_06

Whole slide imaging (WSI) has recently been cleared for primary diagnosis in the US. In this talk, I will discuss the development of a terapixel hyperspectral whole slide imaging system with 300 megapixel per second throughput. This system employs a novel autofocusing strategy requires no axial scanning, no additional camera and lens, works for stained and transparent samples, and allows continuous sample motion in the focus surveying process.

17:30-17:50 **Depth-resolution characterization of optical tomography using virtual phase conjugation**
Yuta Goto[1], Atsushi Okamoto[1], Atsushi Shibukawa[2], Kazuhisa Ogawa[1] and Akihisa Tomita[1]
[1] Hokkaido University, Japan
[2] California Institute of Technology, USA
OμS17_paper_07

Virtual phase conjugation for optical tomography (VPC-OT) has been proposed for obtaining the 3D tomographic image with a single exposure and detection. In this report, we experimentally clarified the depth-resolution characterization of VPC-OT. The depth resolution of VPC-OT was proportionately improved by increasing the numerical aperture (NA) of an objective lens. The depth resolution of 11.41 μm was achieved when the NA of 0.24.

17.50- 18.20 **Imaging transparent neuronal cells in the retina**
Christophe Moser[1], Timothé Laforest[1], Dino Carpentras[1], Mathieu Kunzi[1], Laura Kowalczuk[1] and Francine Behar-Cohen[2]
[1] Université de Montpellier (Montpellier, France)
[2] Institut national de la santé et de la recherche médicale, France
Invited speaker

Light entering the eye needs to pass through several transparent layers before reaching the photodetectors. These layers contain many different types of cells which are essential for vision. Their observation can provide crucial information on the development of eye disease in early stages. However, due to their transparency, these cells cannot be observed with standard imaging techniques such as Optical Coherence Tomography and Confocal Imaging with Adaptive Optics. We will show a major advance by proposing and demonstrating a method to visualize retinal neuronal cells with high contrast and resolution.

18:30-20:00 Welcome cocktail and Poster Session

P1 **Hot pixels in CMOS Image Sensors due to metal contamination**

Felice Russo[1], Giancarlo Nardone[1], Angelo D'Ercole[1], Fabrizio Pennella[1], Massimo Di Felice[1], Andrea Del Monte[1], Antonio Matarazzo[1], Giuseppe Moccia[1], Gianpaolo Polsinelli[1], Antonio D'Angelo[1], Massimo Liverani[1], Maria Luisa Polignano[2] and Fernanda Irrera[3]
[1]Lfoundry a SMIC Company, 67051 Avezzano (AQ), Italy
[2]STMicroelectronics, 20864 Agrate Brianza (MB), Italy
[3]DIET - Università La Sapienza, 00184 Rome, Italy
OμS17_poster_01

The effect of metal contaminants on the occurrence of hot pixels in CMOS Image Sensors is systematically investigated. The impact of specific contaminant specie commonly used in the production process line is definitely assessed.

P2 **A new approach for Plasmonic sensing with POFs and Slab waveguide**

Nunzio Cennamo, Francesco Mattiello and Luigi Zeni
Department of Industrial and Information Engineering, University of Campania Luigi Vanvitelli, Aversa, 81031, Italy
OμS17_poster_02

The use of plasmonic sensor devices often requires replaceable parts and disposable chips for easy, fast and on-site detection analysis. In light of these requests, we propose a novel low-cost surface plasmon resonance (SPR) sensor platform for possible selective detection of analytes in aqueous solutions. It is based on two plastic optical fibers (POFs) and a Polymethyl methacrylate (PMMA) slab waveguide with a thin gold film on the top surface inserted in a special holder, designed to produce the plasmonic resonance at the gold-dielectric interface. This novel approach has presented the same performances obtained with other SPR sensors used in biochemical applications.

P3 **Electromagnetic Fields & Coherent Symmetric Light Interferometers**

Mario Medugno and Ivo Rendina
Institute for Microelectronics and Microyistems, Naples, 80131, Italy
OμS17_poster_03

We propose an optical integrated coherent light device enabling an affordable electromagnetic field sensing in the Fresnel region from the ELF band up to the GHz UHF band, suitable for near-field monitoring of critical communication structures.

P4 **Brillouin Sensors with Refractometer Capabilities**

Aldo Minardo, Agnese Coscetta, Ester Catalano and Luigi Zeni
Department of Industrial and Information Engineering, University of Campania Luigi Vanvitelli, Aversa, 81031, Italy
OμS17_poster_04

In this paper, we investigate the capability of a distributed Brillouin Optical Time-Domain Analysis (BOTDA) sensor to perform, for specific fiber sections, as a refractometer. Refractometer capabilities have been achieved by use of one (or more) single mode – multimode – single mode (SMS) structures, inserted in a standard telecommunication grade optical fiber.

P5 **Tomography of live cells in microfluidic channels**

Francesco Merola, Pasquale Memmolo, Lisa Miccio, Martina Mugnano and Pietro Ferraro
CNR – ISASI, Istituto di Scienze Applicate e Sistemi Intelligenti "E. Caianiello", Via Campi Flegrei 34, 80078 Pozzuoli (NA), Italy
OμS17_poster_05

We exploit random rolling of live cells flowing along a microfluidic channel showing that it is possible to obtain high-throughput phase-contrast tomography of single cells by adopting different strategies for smart wavefronts analysis. Demonstration is given for different classes of biosamples, i.e. red-blood-cells (RBCs), diatom algae and fibroblast cells. Accurate 3D reconstruction and characterization of each type of cell is reported.

P6 **Two-step electric field poling process for engineering multiperiodic microstructure in LN**

Vito Pagliarulo, Oriella Gennari, Romina Rega, Laura Mecozzi, Simonetta Grilli and Pietro Ferraro
CNR – ISASI, Istituto di Scienze Applicate e Sistemi Intelligenti "E. Caianiello", Via Campi Flegrei 34, 80078 Pozzuoli (NA), Italy
OμS17_poster_06

This work presents the TEFP process as a tool for fabricating multi-scale PPLN samples avoiding cross drawbacks between over-poling and under-poling. The two EFP steps were applied with two different photoresist gratings. Since the pitch of the two gratings have periods with different scales, the final result is intriguing as it allows one to fabricate a sort of satellite structures.

P7 **Superprism-based optical beam deflector**

Valentina Di Meo[1,2], Alessio Crescitelli[2], Emanuela Esposito[2], Vito Mocella[2], Ivo Rendina[2], Caterina Summonte[3] and Giuseppe Cocorullo[1]
[1]D.I.M.E.S. Department, University of Calabria, Via P. Bucci, Rende, Italy
[2]Institute for Microelectronic and Microsystems, CNR, Via P. Castellino, 111, Napoli, Italy
[3]Institute for Microelectronic and Microsystems, CNR, Via Gobetti, 101, Bologna, Italy
OμS17_poster_07

In this work, we propose an optical beam deflector realized on silicon chip based on the superprism effect. The proposed device consists of a dielectric material (Silicon Carbide) and air grating, which is capable to deflect light without mechanical parts in movement.

P8 **Lab-on-Chip System for Detection of Fluorescence**

N. Lovecchio[1], M. Nardecchia[1,2], F. Costantini[2,3], A. Nascetti[3], G. de Cesare[1], D. Caputo[1]
[1]D.I.E.T., Sapienza University of Rome, via Eudossiana, 18 - 00184 - Rome, Italy
[2]S.A.E., Sapienza University of Rome, via Salaria, 851/881 - 00138 - Rome, Italy
[3]Dept. of Chemistry, Sapienza University of Rome, P.le A. Moro, 5 - 00185 - Rome, Italy
OμS17_poster_08

In this work, we present an optoelectronic Lab-on-Chip suitable for detection of fluorescent molecules. It integrates, on the same glass substrate, an array of amorphous silicon (a-Si:H) photosensors and a thin film interferential filter. The electro-optical characterization of the photodiodes demonstrated the efficacy of the filter in reducing the excitation light. The system has been successfully tested in order to quantify dsDNA using a ruthenium complex as fluorescent die.

P9 **Measurement of Selective Solar Absorbers up to Stagnation Temperature**

Matteo Monti[1], Francesco Di Giamberardino[1], Vittorio G. Palmieri[1], Roberto Russo[2]
[1] TVPSolar SA, Geneva, Switzerland
[2] CNR-Istituto per la Microelettronica ed i Microsistemi, Via Pietro Castellino 111, 80131 Napoli, Italy

We measure the total absorption and emission coefficients of selective solar absorbers under high vacuum conditions from room temperature up to stagnation temperature. The measurement of the emissivity is

usually performed at room temperature or at 100°C. The development of innovative flat-plate evacuated solar thermal collectors able to reach stagnation temperatures in excess of 300°C and operating condition up to 200°C demand to determine the emissivity properties of the selective absorber at such temperatures. To measure these quantities we used a calorimetric approach. The sample area and weight are carefully measured and four small springs of known and negligible thermal conductance keep the sample under examination suspended in a vacuum envelop. A turbomolecular pump keep the vacuum pressure below 1x10E-4 mbar in order to eliminate convection and to reduce thermal conductivity of gases to a negligible level. In such configuration the sample temperature variation are only due the absorbed power and emitted power. A glass window placed above the absorber allows to an array of Led lights to supply a controllable input power to the absorber. The power provided by the LEDs is calibrated using a class 1 solarimeter and it is carefully controlled using the current supplied to the LEDs. A thermocouple is connect to the samples under investigation using a conductive glue. The increase of the absorber temperature during illumination is related to the fraction of light power absorbed, and it provides a measure of the absorbance. On the other hand, the measurement of the temperature decrease during cool down provides a measure of the emitted power at a given temperature and allow estimating the emissivity. The temperature of the glass window and of the vacuum envelop are also monitored. The results will be useful to determine evacuated solar panel performances in operating conditions.

P10 **Characterization of a photopolymer holographic recording material for volume transmission and reflection elements**

G. Coppola[1], G. Bianco[1], M. A. Ferrara[1], F. Borbone[2], R. Centore[2], V. Striano[3], I. Naydenova[4]

[1] National Research Council, Institute for Microelectronics and Microsystems-Unit of Napoli, Via P. Castellino 111, 80131 Napoli, Italy

[2] Department of Chemical Sciences, University of Naples Federico II, Via Cinthia, 80126 Napoli, Italy

[3] CGS S.p.A, Via Tiengo snc,82100 Benevento, Italy

[4]Centre for Industrial and Engineering Optics, School of Physics and Clinical & Optometric Sciences, College of Sciences and Health, Dublin Institute of Technology, Dublin 8, Ireland

OμS17_poster_09

We report the characterization of new photopolymer material for writing holographic optical elements (HOEs) for use in solar concentration and for space applications. The material was based on a sol-gel matrix formed by condensation of alkoxysilanes functionalized with organic pendant groups and they are characterized by interpenetrating organic and inorganic networks. In particular, we will present a detailed characterization of this material. We will evaluate the diffraction efficiency dependence on the temperature of the photopolymer, on the incident light energy and on the exposure times [1]. Finally, will perform other three characterizations which consist of a study of the material refractive index variation as a function of the exposure energy, a surface characterization of the HOE with the Atomic Force Microscope (AFM) and an outgassing test to verify the use of this material for space applications . In conclusion, we will present a comprehensive characterization of a new material and the possibility of its use as recording material for efficient holographic solar concentrators that could be used in space applications.

P11 **Graphene/Silicon photodetectors operating at 2 micron**

M. Casalino[1], R. Russo[1], M. Iodice[1], C. Russo[2], A. Ciajolo[2] and G. Coppola[1]

[1]Istituto per la Microelettronica e Microsistemi IMM-CNR – Via P. Castellino, Napoli (Italy)

[2]Istituto di Ricerche sullaCombustione IRC-CNR - P.le V. Tecchio n. 80 – 80125,Napoli (Italy)

OμS17_poster_10

In this work, the design, fabrication and characterization of a graphene/silicon photodetector working at both 2 μm and room temperature, is reported. The device is a Schottky diode and the absorption mechanism is based on the internal photoemission effect. Devices are characterized by an internal

(external) responsivity of 10.3 mA/W (0.16 mA/W) in an excellent agreement with the theory. We believe that our devices pave the way for developing hybrid graphene-Si free-space illuminated PDs operating at 2 μm, for free-space optical communications, coherence optical tomography and light-radars.

P12 **Photothermal effects in colloidal plasmonic nanoparticles: computational analysis and preliminary results.**

Mario Iodice[1], Luca De Stefano[1], Marilena Musto[2], Giuseppe Rotondo[2], Enrica Malfi[1], Ilaria Rea[1], Monica Terracciano[1] , Maurizio Indolfi[1] and Principia Dardano[1]

[1] CNR IMM sez. Napoli, Italy

[2] University of Naples "Federico II", Department of industrial engineering, Italy

Strong local absorption in plasmonic nanoparticles leads to a temperature increase, usually avoided in pure photonic applications. Recently, this heating in metal NPs has been exploited in nanomedicine science as nanosurgery tool, local thermal assisted drugs delivery systems or in cancer therapy. An innovative nano-heater source with a remote control is obtained by irradiating plasmonic NP solutions at their resonance frequency. In this work, thermodynamics computing of temperature profiles inside and outside plasmonic NPs under illumination has been analyzed. Photoinduced temperature increasing of a single nanosphere and a single nanorod suspended in water have been investigated. In order to measure the temperature increasing of a NPs colloidal solution, a Quartz Crystal Microbalance (QCM) has been used. To calibrate the temperature response, the QCM has been insert inside a thermal insulated aluminum box, in turn put inside a PLA box, obtained with a 3D printer. Using four resistors fed by a power supply and controlled by means of a PID, the temperature is imposed to grow up from 28 °C to 45 °C and its increase has been registered. At the same time, the increasing in resonance frequency of the QCM quartz $\Delta f(t)$ has been registered, to obtain the experimental $\Delta f(T)$ dependence. Finally, experimental thermodynamic characterization of a colloidal NPs solution, casted on the quartz crystal microbalance and lit up at plasmonic resonance frequency, has been performed exploiting the individuated frequency/temperature relationship of quartz piezoelectric resonance

Tuesday, 12 September 2017 | Special Session: Flexible Photonics | Sala Montalcini

Chair: Giuseppe Coppola

09:00-09:20 **All-Polymer Waveguides and Laser Resonators from Conjugated Polymer and Cellulose Acetate**

Juan Cabanillas Gonzales
IMDEA Nanociencia, Spain
Invited speaker
OμS17_paper_08

We report all plastic planar fluorescent waveguides and laser resonators exhibiting low threshold values for amplified spontaneous emission (ASE) and lasing. These devices are based on micro and nanostructured mechanically flexible cellulose acetate (CA) coated with highly fluorescent conjugated polymers: poly(9,9-dioctylfluorenealt-benzothiadiazole) (F8BT), regioregular poly(3-hexylthiophene) (rr-P3HT), poly(9,9-dioctylfluorene) (PFO) and mechanically flexible cellulose acetate (CA) are reported. The replication by nanoimprint lithography of patterned substrates in CA, onto which high quality semiconductuncting polymer films can be easily processed by spin coating, is exploited to fabricate full plastic systems that exhibit high net gain and low optical loss coefficients. As a result, highly transparent and free-standing distributed feedback (DFB) lasers and waveguides are obtained, with excellent optical properties that remain unaltered after bending, allowing them to be adapted in various pliable photonics devices.

09:20-09:40 **Wearable sensors in biomedical applications: opportunities and challenges for the next future**

Carlo Iorio
Ecole polytechnique de Bruxelles, Belgium
Invited speaker

To be defined.

09:40-10:00 **Optical fibre sensing in textiles**

Stephen Morgan
University of Nottingham, UK
Invited speaker
OμS17_paper_09

Optical fibre sensors integrated within textiles offers the potential for next generation wearable devices. Two important applications in healthcare are in monitoring the status of chronic wounds and in prediction of tissue breakdown in those with vulnerable skin. Examples of optical fibres sensing technologies will be presented. For example textile based heart rate monitoring, oximetry and capillary refill monitoring in a sock and a wound dressing incorporating an optical fibre humidity sensor.

10:00-10:20 **Flexible Holographic Optical Elements: state of the art and perspectives**

Maria Antonietta Ferrara[1], Valerio Striano[2], Giuseppe Coppola[1]
[1] CNR –IMM
[2] OHB S.p.A.
Invited speaker

Volume phase holograms with high light efficiency recorded on a flexible substrate allows to produce flexible holographic optical elements (F-HOEs). F-HOEs can be used in a wide variety of applications, ranging from solar concentrators, wearable sensors, displays for virtual and augmented reality, etc. An overview of these applications and of the potentialities offered by F-HOEs are reported.

10:20-10:40 **Flexible photonic sensors realized using printing technologies**

Jeroen Missinne
Centre for microsystems technology, Ghent University and imec, Technologiepark 15, B-9052 Gent, Belgium.

Invited speaker

Making sensors flexible and thin, is key to apply them on curved, moving surfaces, e.g. for wearable applications or to embed them in mechanical structures. Photonic sensor systems require the integration of microstructures (e.g. polymer waveguides), nanostructures (e.g. gratings), which can be realized using nanoimprint lithography, but may also need additional active or passive optical components, which can be integrated using laser printing technologies.

10:50-11:20 **Coffee break**

Tuesday, 12 September 2017 | Session 3: Sensors | Sala Montalcini

11:20-11:50 **Photo-activated plasmonic nanostructures for controlled drug release and advanced detection**

Roberto Pini, Paolo Matteini, Marella de Angelis, Martina Banchelli, Maximilien Cottat, Cristiano D'Andrea and Emmanuel Ruggiero
Institute of Applied Physics "Nello Carrara", National Research Council of Italy (IFAC CNR), Italy

Invited speaker

OμS17_paper_10

We review our research activities on the exploitation of plasmonic nanoparticles as light-activated nanotransducers for "on demand" drug release from implantable tools and as effective nanoplatforms for sensing and diagnostic applications of neurodegenerative disorders.

11:50-12:10 **Quasi-droplet Whispering Gallery Resonator for Nanoparticle Trapping and Control**

Jonathan Ward, Yong Yang and Sile Nic Chormaic
Okinawa Institute of Science and Technology, Japan

OμS17_paper_11

Highly sensitive single nanoparticle detection and efficient nanoparticle propulsion and trapping is demonstrated for the first time in a quasi-droplet whispering gallery resonator. We also observe a number of interesting effects, such as regenerative self-modulation driven by the particle motion and an optical sling shot effect arising from strong scattering at the waveguide/cavity coupling junction.

12:10-12:30 **Optical resonator based methods for interrogation and readout of Surface Plasmon Resonance sensors**

A. Giorgini[1], S. Avino[1], P. Malara[3], R. Zullo[1], P. De Natale[2], K. Mrkvová[3], J. Homola[3], G. Gagliardi[1]
[1] Consiglio Nazionale delle Ricerche, Istituto Nazionale di Ottica, Pozzuoli, 80078, Italy
[2] Consiglio Nazionale delle Ricerche, Istituto Nazionale di Ottica, Firenze, 50125, Italy
[3] Institute of Photonics and Electronics, Czech Academy of Sciences, Prague, 182 51, Czech Republic

OμS17_paper_12

Surface Plasmon Resonance based sensors are a key tool for Bio-Chemical investigations. Beside the efforts in performances improvement, by development new strategies for immobilization protocols or by sensitivity enhancement due to chip engineering or to the integration of new meta-materials, the interrogation and readout method of these sensors represent the ultimate limiting factor for the detection of small molecules at low concentrations. We propose two new improved resolution approaches based on the integration of the sensing unit in an optical resonator.

12:30-12:50 **Phostimulation of semiconducting polymer nanoparticles to control physiological functions in vivo**

Claudia Tortiglione[1], Maria Rosa Antognazza[2], Angela Tino[1], Caterina Bossio[2], Maria Moros[1], Antonella Bauduin[1], Giada Onorato[1], Valentina Marchesano[1], Mattia Zangoli[3] and Guglielmo Lanzani[2]
[1]Consiglio Nazionale delle Ricerche, Istituto di Scienze applicate e sistemi intelligenti "E.Caianiello", Italy
[2] Center for Nano Science and Technology@PoliMi, Istituto Italiano di Tecnologia, Italy
[3] Istituto per la Sintesi Organica e la Fotoreattivita', Consiglio Nazionale delle Ricerche, Italy
OμS17_paper_13

Biocompatible light nanotransducers may allow fine tuning of biological functions. Here we exploit the possibility to modulate cell function by photostimulation of polymer nanoparticles based on poly(3-hexylthiophene) (NP-P3HT). By using an invertebrate model organism we show that NP-P3HT enhances animal photosensitivity. The possibility to artificially enhance light sensitivity in eyeless animals put forward the potential of this approach toward the control of physiological functions in vivo.

12:50-13:10 **Photonic crystal on fiber tip: toward humidity sensor**

Chiara Taddei[1,2], Lucia Sansone[3], Pasquale Di Palma[4], Agostino Iadicicco[4], Michele Giordano[3] and Stefania Campopiano[4]
[1] Dept. of Chemical Materials and Production Engineering Univ. of Naples Federico II, Italy
[2] Institut Charles Sadron (ICS) UPR 22CNRS, Strasbourg, France
[3] Institute for Polymers, Composites and Biomaterials, National Research Council, Italy
[4] Department of Engineering, University of Naples Parthenope, Italy
OμS17_paper_14

We report our latest results about the fabrication and characterization of an optical fiber humidity sensing probe based on 3-D photonic crystal structure (based on nanospheres of polystyrene (PS) with hydrogel shell of poly(N-isopropyl acrylamide) (PNIPAM)) directly deposited on the tip of a multimode optical fiber through the self-assembly of colloidal crystals (CCs) via a vertical deposition technique.

13:10-14:30 **Lunch**

Tuesday, 12 September 2017 | Session 4: Optical microscopy and imaging 2 | Sala Montalcini

14:30-15:00 **3D Flow Field Mapping in Microfluidic Devices by means of Spatio-temporal Image Correlation Analysis**

Giuseppe Chirico[1], Maddalena Collini[1], Laura Sironi[1], Laura D'Alfonso, Nicolo' Ceffa[1] and Ferdinando Auricchio[2]
[1] Dipartimento di Fisica, Universita di Milano-Bicocca, Italy
[2] Dipartimento di Ingegneria Civile e Architettura, Università degli Studi di Pavia, Italy
Invited speakers
OμS17_paper_15

Microfluidic devices reproducing 3D networks are particularly valuable for nanomedicine applications such as tissue engineering and active cell sorting. There is however a gap in the possibility to measure how the flow evolves in such 3D structures. We will show how it is possible to map 3D flows in complex micro-channels networks by combining wide field illumination to image correlation approaches. To this purpose we have derived a spatio-temporal image correlation analysis of time stacks of single plane illumination microscopy images. From the detailed analytical and numerical analysis of the resulting model we developed a fitting method that allows to measure, besides the in-plane velocity, the out-of-plane velocity component down to vz = 50 microm/s. We have applied successfully this method to the 3D reconstruction of flows in micro-channel networks with planar and 3D ramifications. These different network architectures have been realized by exploiting the great prototyping ability of a 3D printer, whose precision can reach few tens of micrometers, coupled to poly-di-methyl-siloxane soft printing lithography.

15:00-15:20 **Diatomite nanoparticles uptake in lung cancer cells by Raman imaging**

Stefano Managò[1], Nunzia Migliaccio[2], Monica Terracciano[3], Michela Napolitano[1], Nicola Martucci[2], Luca De Stefano[3], Ivo Rendina[3], Annalisa Lamberti[2], Ilaria Rea[3] and Anna Chiara De Luca[1]
[1] IBP – CNR, Italy)
[2] Department of Molecular Medicine and Medical Biotechnology, University Federico II of Naples, Italy
[3] IMM -CNR, Italy
OμS17_paper_16

In this work, we have investigated the internalization kinetics and spatial distribution of small interfering RNA (siRNA)-diatomite nanoparticles (DNPs) complex in human lung epidermoid carcinoma cell line (H1355) up to 72 h by Raman imaging. Raman data are compared with confocal fluorescence microscopy and photoluminescence (PL) results. The Raman analysis provides that the siRNA-DNPs are internalized and co-localized in lipid vesicles within 18 h, after that equilibrium is achieved.

15:20-15:40 **Pocket Module for High-throughput Holographic Optofluidic Imaging and 3D Tracking**

Biagio Mandracchia[1], Vittorio Bianco[1], Zhe Wang[1,2], Melania Paturzo[1], Alessia Bramanti[1,3], Giovanni Pioggia[1,3] and Pietro Ferraro[1]
[1] CNR-ISASI, Italy
[2] Beijing University of Technology, China
[3] IRCCS Centro Neurolesi Bonino Pulejo, Italy
OμS17_paper_17

We designed a LoC platform with optofluidic holographic microscopy functionalities embedded onboard chip. The engineered LoC constitutes a compact holographic microscope slide implementing a wavefront division interferometric microscope.

16:00-16:30 **Coffee break**

Tuesday, 12 September 2017 | Session 5: Photonics Technologies | Sala Montalcini

16:30-17:00 **Optical manipulation and imaging of single cells in optofluidic devices**

Roberto Osellame
Istituto di Fotonica e Nanotecnologie (IFN) – CNR, Italy
Invited speaker

Single cell analysis aims at unravelling the biological complexity due to the well-recognized diversity in cell populations. The integration of optical forces with microfluidic networks, in so-called optofluidic chips, allows advanced cell manipulation and characterization. In addition, the development of microscopy on a chip for the 3D tomography of single to few cells agglomerates paves the way to rapid analysis of a large quantity of samples for drug screening and personalized medicine.

17:00-17:20 **On the analysis of the polarization state of 3D electromagnetic waves within a reverberating chamber**

M. Migliaccio, S. Cappa, A. Sorrentino and F. Nunziata
Dipartimento di ingegneria, Università degli Studi di Napoli Parthenope, Italy

When dealing with electromagnetic waves whose propagation direction is constant In time at the point r considered, the well-established two-dimensional (2D) formalism can be considered. However, there are a number of cases where the 2D formalism can no longer be adopted and the three components of the electric field vector E of the electromagnetic wave should be considered in order to describe the evolution of the end point of E (which determines the polarization state). This description – which is mandatory, for instance, when dealing with near field or non-paraxial configurations – is here adopted to describe propagation and scattering in complex environments that generate random 3D electromagnetic fields. In order to emulate such random electromagnetic fields, we use the reverberating chamber (RC), i.e.; a cost effective and reliable facility. The latter, when a proper stirring is performed, generates a field structure that is no longer planar. In this study, we discuss a new theoretical framework to describe the degree of polarization of the 3D em waves within the RC in some selected test cases.

17:20-17:40 **Mode evolution in heat-loaded Yb-doped microstructured fibers**

Carlo Molardi[1], Federica Poli[1], Lorenzo Rosa[2,3], Annamaria Cucinotta[1] and Stefano Selleri[1]
[1] University of Parma, Italy
[2] University of Modena and Reggio Emilia, Italy
[3] Swinburne University of Technology, Australia
OμS17_paper_18

The mode discrimination criterion for single mode operation has been investigated for three different Yb-doped large mode area photonic crystal fibers, a large pitch fiber and two symmetry free ones, designed for high power applications. Simulation results, obtained with a numerical tool based on the Finite Element Method, have shown that the criterion is helpful but not strictly necessary to obtain an effective single mode behaviour through the differential amplification.

17:40-18:00 **AlGaAs waveguide microresonators for efficient generation of quadratic frequency combs**

Maria Parisi[1], Natalia Morais[2], Iolanda Ricciardi[1], Simona Mosca[1], Tobias Hansson[3], Stefan Wabnitz[4], Giuseppe Leo[2] and Maurizio De Rosa[1]
[1] CNR-INO, Istituto Nazionale di Ottica, Italy
[2] Université Paris Diderot & CNRS, France
[3] INRS-EMT , Canada
[4] Università di Brescia
OμS17_paper_19

We propose a new design for directional quasi-phase matching in AlGaAs waveguide resonators, for implementing recently demonstrated optical frequency combs in cavity enhanced second-harmonic

generation systems, by combining a sequence of arc- and S-shaped segments in a closed loop, modular resonant. Supported by numerical simulations, we show the possibility to generate coherent frequency combs with pump power threshold in the microwatt range.

18:00-18:30 **Label-free in-vitro drug and toxicity testing utilizing digital holographic microscopy**
Björn Kemper
Biomedical Technology Center of the Medical Faculty, University of Muenster, Germany
Invited speaker
OμS17_paper_20

In an overview, digital holographic microscopy (DHM) principles and systems for label-free quantitative live cell imaging are presented. Quantitative DHM phase images provide data for simplified image segmentation and automated object tracking. Moreover, absolute biophysical parameters such as volume, refractive index and dry mass can be extracted that are related to various cellular features and functions. Selected results demonstrate how the retrieved data sets can be applied to quantify the influence of drugs, toxic substances and nanomaterials on living cell cultures.

20:30 Social dinner at "Da Gelsomina" Restaurant

Wednesday, 13 September 2017|Session 6: Optical microscopy and imaging 3|Sala Montalcini

09:00-09:30 **Liquid Tunable Microscopy**

Alberto Diaspro [1,2,3]
[1] *Nanoscopy, Nanophysics, Istituto Italiano di Tecnologia, Italy*
[2] *Department of Physics, University of Genoa, Italy*
[3] *Nikon Imaging Center, Istituto Italiano di Tecnologia, Italy*
Invited speaker

Taking inspiration from the philosophical and sociological speculation by Zygmunt Bauman (Bauman Z., Liquid modernity, Polity Press, Cambridge, 2000), a new paradigm for optical microscopy is proposed in terms of design, implementation and applications. Current advances in optical microscopy (Diaspro A., van Zandvoort M.A.M.J. (eds) Super-resolution Imaging in Biomedicine, CRC press, 2016), related to the accessibility of data at the nanoscale in living systems or in matter physics studies, made super resolved microscopy, label free approaches, time and space encoding and decoding strategies, single molecule imaging and tracking approaches impregnated with a liquidity capable of condensing in itself the most significant aspects of the status of the art: a new paradigm for microscopy (Diaspro A., Circumventing the diffraction limit, Il Nuovo Saggiatore, 2014). The Liquid Tunable Microscopy perspective is related to the integration of gated STED, light sheet microscopy, image scanning microscopy, expansion microscopy and label free "new" approaches in a unique architecture. Three different directions will be also discussed, namely: i) intrinsic fluorescence of biological macromolecules; II) converging technologies for fluorescence unlimited super resolved microscopy; iii) label free microscopy based on Mueller matrix signature coming from angular scattering processes and exploiting differential polarisation interactions and refractive index mismatches in the VIS-IR regions (Diaspro A. et al, Polarized Light Scattering of Nucleosomes and Polynucleosomes: in Situ and in Vitro Studies, IEEE Trans. Biomedical Engineering, 1991; Mazumder N., Diaspro A. et al, Mueller matrix signature in advanced fluorescence microscopy imaging, J. Opt, 2017). Such technologies will converge to the liquid tunable microscope. It is liquid because it overlaps in an efficient and optimised way different mechanisms of contrast and it is tunable because it offers a real time scalability in terms of spatial and temporal resolution like a radio tuned on the preferred radio station. It is smart because is able to adapt its architecture to the current scientific question and is open to additional light-matter interaction modules. The liquid tunable microscope will find its application in deciphering how macromolecular complexes dynamically change in structure and transiently interact each other to perform the vital functions of a cell towards the understanding human diseases.

09:30-09:50 **Raman spectroscopic identification and discrimination of normal and leukemia cells from peripheral blood**

Stefano Managò[1], *Peppino Mirabelli*[2], *Gianluigi Zito*[1], *Michela Napolitano*[1], *Carmen Valente*[1] *and Anna Chiara De Luca*[1]
[1] *IBP-CNR, Italy*
[2] *IRCSS-SDN, Italy*
Invited speaker
OμS17_paper_21

In this work, we used Raman spectroscopy and statistical methods to identify and discriminate the white blood cells (B cells, T cells, NK cells, monocytes and granulocytes) and acute lymphoblastic leukemia cells. Without any label or marker, our spectroscopic approach allows the identification and discrimination of normal/leukemia cells, leukemia cell classification (maturation stage) and their follow-up after the chemotherapy treatment.

09:50-10:10 **Label free imaging of small lipids droplets by Stimulated Raman microscopy**

Annalisa D'Arco[1], Maria Antonietta Ferrara[1], Maurizio Indolfi[1], Vitaliano Tufano[1], and Luigi Sirleto[1]
[1] National Research Council (CNR), Institute for Microelectronics and Microsystems, 80131 Naples, Italy

Recently, there has been an increasing in the level of interest in label-free bioimaging. Despite, confocal and multiphoton fluorescence microscopy are important and powerful techniques for biological imaging, they show some limitations that could be overcome with the implementation of a real time, three-dimensional imaging with high spatial resolution, high sensitivity, and high chemical selectivity of unlabeled living cells. Therefore, in order to comply with these issues, nonlinear optical effects are investigated, such as the basics of novel microscopy techniques. In particular Stimulated Raman Scattering (SRS) was studied as an alternative way to provide vibrational contrast mechanism. The Raman signal, generated by the nonlinear interaction among pump and probe signals and the sample, is much more intense respect to linear Raman microscopy, being coherent and propagating along the axis of oscillating molecules. SRS is a shot-noise limited and non-resonant background technique, exhibiting an identical spectrum as the spontaneous Raman it is linearly proportional to the concentration of the analyte, reducing considerably the acquisition times and allowing fast image acquisition rates. In this paper, we outline the implementation of a microscope based on the femtosecond Stimulated Raman scattering (f-SRS) not commercially available, and we propose a methodology for the studying and identification of small structures. In the life science field, there is interest in the studying of lipids and densely packed structure of them, lipid droplets (LDs), since participating in a broad variety of physiological processes and being in many different cell types. The relatively isolated Raman peaks associated with vibrational states of the C-H bond, which are abundant in fatty acid molecules, provide a unique signature for lipids inside a cell. This has suggested and proven that SRS is particularly powerful for studying lipids. We study the LDs present in fixed adipocytes, detecting microstructures inside the cells and evaluating the sizes

10:10-10:30 **Experiment on spatial mode demultiplexer based on angularly multiplexed volume hologram at 850 nm wavelength with dual-wavelength method**

Shimpei Shimizu[1], Atsushi Okamoto[1], Fumiya Mizukawa[1], Kazuhisa Ogawa[1], Akihisa Tomita[1], Taketoshi Takahata[2], Satoshi Shinada[3] and Naoya Wada[3]
[1] Hokkaido University, Japan
[2] OPTOQUEST Co., Ltd., Japan
[3] National Institute of Information and Communications Technology, Japan
OμS17_paper_22

In a mode division multiplexing transmission, mode demultiplexers are required. A volume holographic demultiplexer (VHDM) provides the mode demultiplexing function with a single device by utilizing angularly multiplexed volume holograms. In this paper, for applying the VHDM to the infrared region including optical transmission bands, we demonstrated the VHDM operating at a wavelength of 850 nm by using a dual-wavelength method. As a result, modal cross-talks were below −20 dB for any modes.

10:30-11:00 **Coffee break**

Wednesday, 13 September 2017|Session 7: Sensing and spectroscopic technologies|Sala Montalcini

11:00-11:20 **Photonic Crystal for Label free Optical Biosensors**

Lucia Sansone[1], Chiara Taddei[1], Michele Giordano[1], Eleonora Macchia[2] and Luisa Torsi[2]
[1] Institute for Polymers, Composites and Biomaterials (IPCB), National Research Council, Italy

[2] *Chemistry Department of University of Bari "Aldo Moro", Italy*
OμS17_paper_23

We report the fabrication and characterization of an optical fiber biosensing probe based on 3-D photonic crystal dielectric structure directly deposited on the tip of a multimode optical fiber through the self-assembly of colloidal crystals (CCs) via a vertical deposition technique.

11:20-11:40 **Optical drug delivery system based on microneedles and reflective window.**

Principia Dardano, Monica Terracciano, Ilaria Rea and Luca De Stefano
Institute for Microelectronics and Microsystems, National Research Council, Naples, Italy

In this work we report on fabrication and characterization of a microneedle based optical system for local administration of chemical or biological molecules. The patch is constituted by a free-standing porous silicon membrane, that acts both as a physical reservoir of substances and a optical window of the amount of drug released, and a microneedle array, made of swelling polymer, that is the perfect interface between the body and the delivery system.

11.40-12.00 **Optical Fiber Sensors for Epidurals**

Benito Carotenuto[1], Alberto Micco[1], Armando Ricciardi[1], Ezio Amorizzo[2], Marco Mercieri[2], Antonello Cutolo[1] and Andrea Cusano[1]
[1] University of Sannio, Dept. of Engineering, Optoelectronics Group, Italy
[2] Sapienza University, Pain Medicine Unit, Sant'Andrea Hospital, Italy
OμS17_paper_24

This work deals with the development of a novel device that assists physicians in regional anesthesia. The device consists of an optical fiber pressure sensor judiciously integrated in the lumen of a standard epidural needle. Experimental tests carried out on an epidural phantom tissue revealed that our system is able to alarm anesthesiologists as the ES is correctly localized, thus avoiding false readings.

12:00-12:20 **Optical microresonators for chemical and biological sensing applications**

Dario Laneve[1], Mario Christian Falconi[1], Giuseppe Palma[1], Francesco Chiavaioli[2], Gualtiero Nunzi Conti[2], Giancarlo Cesare Righini[2], Cosimo Trono[2] and Francesco Prudenzano[1]
[1] Polytechnic University of Bari, Department of Electrical and Information Engineering, Italy
[2] Institute of Applied Physics "Nello Carrara", IFAC-CNR, Italy
OμS17_paper_25

An accurate model for the simulation of microsphere and microbubble sensing set-ups is illustrated. The model validation is performed via the comparison with the experiment. The set-up includes microsphere and microbubble resonators coupled via a tapered fibre. A good agreement between experimental and simulated results is found.

12:20-12:40 **Micro-fluidic channel fabrication through pyro-EHD printing**

Veronica Vespini[1], Sara Coppola[1], Giuseppe Nasti[1], Federico Olivieri[2], Simonetta Grilli[1] and Pietro Ferraro[1]
[1] Istituto di Scienze Applicate e Sistemi Intelligenti- Cnr
[2] Department of Chemical Materials and Production Engineering. University of Naples Federico II

We illustrate the use of pyro-EHD printing combined with the replica molding to accurately print microfluidic channels at the high resolution achievable by pyro-printing, from hundreds of nanometer to hundreds of micron. The goal is the fabrication of printed structures, used to design footpaths embedded in a soft, transparent and flexible polymeric matrix and integrated into lab-on-chip devices.

13:00-14:30 **Lunch**

Wednesday, 13 September 2017|Session 8: Plasmonic devices|Sala Montalcini

14:30-15:00 **Plasmonic modulators and detectors for communications**

Ping Ma and Juerg Leuthold
Institute of Electromagnetic Fields (IEF), ETH Zurich, 8092 Zurich, Switzerland

Invited speaker

OμS17_paper_26

Plasmonics has emerged as a solution for monolithic integration of high-speed photonic components at the micrometer scale. In this talk we review our recent advances in high-performance optical communication devices enabled by plasmonics. Plasmonic modulators promise ultimate RC-limited speed, good power efficiency, and smallest footprint thanks to a highly confined optical mode. Recently, we realized plasmonic-organic hybrid modulators with a bandwidth of up to 170 GHz and data rates exceeding 100 Gbit/s. In addition to utilizing the nonlinear organic materials, we also demonstrate for the first time a plasmonic ferroelectric BaTiO3 Mach-Zehnder modulator on silicon operating in a NRZ 72 Gbit/s experiment without pre- and post-equalization and biterror ratios well below the standard FEC limit. The active section of this modulator is as short as 10 μm, and no degradation due to temperature exposure beyond 250°C has been found. As for photodetectors, a fully integrated plasmonic detector has recently been demonstrated. It is based on amorphous germanium. The device consists of a silicon waveguide evanescently coupled with an Au- αGe-Au plasmonic slot waveguide. In order to overcome the small mean drift path of electrons and holes in the defect-like material, we used the sub-wavelength confinement of light in plasmonic waveguides to shorten the drift path of electrons and holes to about 100 nm. The measured bandwidth is beyond 50 GHz. The device is CMOS compatible and features a responsivity as high as 0.16 A/W.

15:00-15:20 **Nanowire-Based Opto-Plasmonics for Heterogeneous Integration with Silicon**

Zhihuan Wang[1], Pouya Dianat[2], Kiana Montazeri[1], Baris Taskin[1], Marc Currie[3], Paola Prete[4], Nico Lovergine[5] and Bahram Nabet[1]
[1] Drexel University, Philadelphia, USA
[2] Northwestern University, Illinois, USA
[3] Naval Research Laboratory, USA
[4] Institute for Microelectronics and Microsystems, Italy
[5] University of Salento, Italy

OμS17_paper_27

In this paper, we present core-shell nanowires (CSNWs) as versatile low-dimensional opto-plasmonic systems as a replacement to their conventional thin film counterparts in heterogeneous integration in silicon photonics. These CSNWs have extraordinary performance in light generation, absorption, light modulation, energy generation, and high-speed optical detection. Finally, we elaborate on a vision for a low-cost high-performance silicon photonics chip based on a CSNW platform.

15:20-15:40 **Lab-on-Fiber bio-probes integrated with Microgels**

Martino Giaquinto[1], Alberto Micco[1], Armando Ricciardi[1], Anna Aliberti[1], Eugenia Bobeico[2], Vera La Ferrara[2], Menotti Ruvo[3], Antonello Cutolo[1] and Andrea Cusano[1]
[1] University of Sannio, Optoelectronic Division, Department of Engineering, Italy
[2] ENEA, Italy
[3] CNR - Istituto di Biostrutture e Bioimmagini, Italy
Invited speaker
OμS17_paper_28

This work deals with the development of a biosensing platform based on the combination between two intriguing technologies such as Lab-on Fiber and Microgels for overcoming limitations associated to standard label free approaches in case of small molecules. We demonstrate that glucose molecules binding event induces a thickness increase of a microgel layer integrated on the fiber tip, and consequently a refractive index reduction, which, in turn, induce a resonance blue shift of about 10nm.

15:40-16:00 **Tunable plasmonic nanostructures based on nano sphere lithography**

Adriano Colombelli[1], Maria Grazia Manera[1], Elisabetta Primiceri[1], Silvia Rizzato[2], Anna Grazia Monteduro[2], Giuseppe Maruccio[2] and Roberto Rella[1]
[1] Institute for Microelectronics and Microsystems, Italy
[2] University of Salento, Italy
OμS17_paper_29

In this work different fabrication methods based on low cost lithographic techniques have been developed in order to create planar distributions of plasmonic nanostructures with tailored optical functionalities. In order to achieve sharp LSPR resonances in the visible and IR range, the geometry of the fabricated nanostructures have been optimized through numerical modeling. The optical properties and the sensing capabilities of different metal nanostructures have been investigated, exploring several key parameters for sensitivity enhancement of traditional LSPR biosensors.

16:20-16:50 **Coffee break**

Wednesday, 13 September 2017|Session 9: Optical microscopy and imaging 4|Sala Montalcini

16:50-17:10 **The latest Light Robotics breakthroughs**

J. Glückstad, D. Palima, A. Banas
DTU Fotonik, Dept. of Photonics Engineering, Programmable Phase Optics, Technical University of Denmark, Denmark
OμS17_paper_30

Contemporary nanoscopy provides functionalities, not only for observing life science on the smallest scales but also for actively reaching into and manipulating at subcellular levels. This post-deadline contribution describes the latest generation of 3D-printed micro-tools for enabling light-activated robotics on sub-diffraction scales: Light Robotics.

17:10-17:30 **Emission properties of functionalized porous silicon nanoparticles for in vivo imaging**

Chiara Schiattarella[1,2], Monica Terracciano[1], Thomas Defforge[3], Gaël Gautier[3], Claudia Tortiglione[4], Rosalba Moretta[1,5], Bartolomeo Della Ventura[2], Luca De Stefano[1], Raffaele Velotta[2] and Ilaria Rea[1]
[1] Italian National Research Council, Institute for Microelectronics and Microsystems, Italy
[2] University of Naples "Federico II", Department of Physics, Italy
[3] University of Tours "François Rabelais", France
[4] Italian National Research Council, Institute of Applied Sciences and Intelligent Systems, Italy
[5] University of Naples "Federico II", Department of Chemistry, Italy
OμS17_paper_31

A study on the emission properties of biocompatible porous silicon nanoparticles (NPs) treated via hydrosilylation is herein presented. The results show remarkable stability, bright photoluminescence and long fluorescence lifetime. This opens a promising perspective towards in vivo imaging applications, probed by tentative internalisation in Hydra Vulgaris.

17:30-17:50 **Analysis of cancer cell membranes by surface enhanced Raman spectroscopy**
Angela Capaccio[1], Giulia Rusciano[1], Emanuele Sasso[2,3], Nicola Zambrano[2,3] and Antonio Sasso[1]
[1] Università di Napoli "Federico II", Dipartimento di Fisica "E. Pancini", Italy
[2] Università di Napoli "Federico II", Dipartimento di Medicina Molecolare e Biotecnologie Mediche, Italy
[3] CEINGE Biotecnologie Avanzate S.C.aR.L., Italy
OμS17_paper_32

Surface-Enhanced Raman Spectroscopy (SERS) is a variant of spontaneous Raman spectroscopy based on localized surface plasmon resonances. The most peculiar features of this technique are the huge amplification of inelastic Raman photons (by as much as 6 to 12 orders of magnitude) and the strong distance dependence of the near-field effect (~10-20 nm) which make effective SERS signal only for molecules in proximity to the metal surface. Both these characteristics make SERS ideally suited for studying cell membranes. Herein, we propose to use highly reproducible SERS substrates produced in our laboratory for the analysis of cancer cells. In particular, we focus on carbonic anhydrase IX (CA-IX), a transmembrane enzyme able to catalyze the reversible hydration of carbon dioxide. CA-IX is thought to be involved in cell proliferation and transformation of malignant cells under the condition of hypoxia.

Thursday, 14 September 2017 | Special Session: Optical biosensors and biochips | Sala Montalcini

Chair: Luca De Stefano

09:00-09:30 **Extreme Sensitivity Biosensing Platform Based on Hyperbolic Metamaterials**

K. V. Sreekanth[1], Y. Alapan[2], M. ElKabbash[1], E. Ilker[1], M. Hinczewski[1], U. A. Gurkan[2], A. De Luca[3] ,N.F. Steinmetz[4] and Giuseppe Strangi[1,3]

[1] Department of Physics, Case Western Reserve University, 10600 Euclid Av,Cleveland, USA

[2] Mechanical and Aerospace Engineering Department, Case Western Reserve University, Cleveland, Ohio, USA.

[3] CNR-NANOTEC Istituto di Nanotecnologia and Department of Physics, University of Calabria, Rende, Italy

[4] Biomedical Engineering Department Case Western Reserve University Cleveland, OH 44106, USA

Keynote speaker

In recent years significant efforts have been made to design and fabricate functional nanostructures for biomedical applications and precision medicine. These research activities unlocked a complete new research field known as nano-theranostics, clinical diagnostics and therapies based on nanotechnologies. Optical sensor technology based on plasmonic metamaterials offers significant opportunities in the field of clinical diagnostics, particularly for the detection of lower-molecular-weight (<500 Da) biomolecules in highly diluted solutions. On the other hand, many research groups are extensively addressing unmet clinical needs by functionalizing bizarre nanostructures aimed to increase their biocompatibility and to provide them with extraordinary functionalities. Hybrid nano-carriers, viral cargos, organic and inorganic vectors among others represent only a fraction of a large variety of systems proposed to achieve local drug-delivery, photo-thermal and photodynamic therapies, high resolution imaging and stimulated specific immune response to treat and monitor neurodegenerative diseases and cancers. In this context, we have developed a miniaturized plasmonic biosensor platform based on hyperbolic metamaterials supporting highly confined bulk plasmon guided modes that outperform current detection technologies. Upon using a grating technique to couple the optical radiation, different extreme sensitivity modes with a maximum of 30,000 nm per refractive index unit (RIU) and a record figure of merit (FOM) of 590 have been achieved

09:30-09:50 **Multifunctional Microsystems for Quality of Life in Home Environment**

P. Siciliano, A. Leone, L. Francioso

Institute for Microelectronics and Microsystems, Italian National Research Council, Lecce, Italy

Invited speaker

Social changes and needs, demographic change and an aging population, the need to improve the quality of life and well being of citizens as well as environmental sustainability require a redesign and a radical transformation of living conditions - urban space, domestic space, work environments, mobility, accessibility of services, welfare - according to a user-centric approach. In this context, "Key Enabling Technologies" aim to make all the environments in which people spend their time, be it business, social, and at home, etc., more adapted to the needs of those persons, whether they are in good physical condition in terms of frailty and disability, disease and social exclusion, in different age groups (children, adults or elderly people, in poor health, etc., ...). In particular, this work refers to the realization and application of Multifunctional Microsystems for the development of advanced technological solutions for products and services which, according to a pattern of "Ambient Intelligence", enable to redesign the sense of "Home Environment" to ensure inclusion, safety, welfare, comfort, care, health care, environmental sustainability.

09:50-10:10 **10000-Fold Improvement in (Bio)Sensing Using Nanostructured Porous Silicon Interferometers by Interferogram Average Over Wavelength Spectroscopy**

Giuseppe Barillaro
University of Pisa, Italy
Invited speaker

In this talk, development, characterization, and application (to both refractometry and biosensing) of a novel ultrasensitive technique for the non-amplified label-free discrimination of either bulk or surface refractive index changes (namely, Interferogram Average over Wavelength – IAW –reflectance spectroscopy) using nanostructured PSi interferometer is discussed. As to refractometric applications, a minimum bulk refraction index variation of 10-7 RIU was experimentally measured using NaCl aqueous solutions, with a theoretical limit of detection of 10-8 RIU. As to biosensing applications, a minimum concentration of TNFa, a protein biomarker of inflammation and sepsis, at concentration of 3 nM was experimentally monitored, with high selectivity and limit of detection of 200 pM. Both these results represent a 10000-fold improvement with respect to the commonly used fast Fourier Transform reflectance spectroscopy for PSi interferometers used in non-amplified label-free mode. The IAW reflectance spectroscopy envisages bringing PSi optical (bio)sensors at the forefront of ultrasensitive label-free biosensing techniques with ultimate limit of detection in the order of pM level. This enables porous silicon targeting real application for point-of-care clinical analysis where low analyte concentrations are required to be detected in small volume of biological samples

10:10-10:30 **A Study of Bloch-Surface-Wave Sensing Platforms for Lab-on-Fiber Technology**

Michele Scaravilli[1,2], Alberto Micco[1], Giuseppe Castaldi[2], Mariano Gioffrè[3], Giuseppe Coppola[3], Vincenzo Galdi[2] and Andrea Cusano[1]
[1] Optoelectronics Group, Department of Engineering, University of Sannio, Benevento, Italy
[2] Waves Group, Department of Engineering, University of Sannio, Benevento, Italy
[3] Institute for Microelectronics and Microsystems, National Research Council, Naples, Italy
OμS17_paper_33

We investigate the possibility to excite Bloch surface waves on the tip of single-mode optical fibers, by exploring two grating-coupling configurations. Our designs reveal intriguing potentials for the development of miniaturized low-detection-limit surface-wave fiber-optic biosensors, paving the way to a significant advance within the "lab-on-fiber" technology framework.

10:30-10:50 **Implementation of pure frequency modulation of quantum cascade laser via two optimized near-infrared excitations**

Chen Peng[1], Lei Gao[2], Tao Chen[1], Detian Wang[1], Qiao Liu[1] and Zeren Li[1]
[1] China Academy of Engineering Physics, China
[2] Chongqing University, China
OμS17_paper_34

Quantum cascade lasers (QCLs) have generated tremendous interests in recent decades. High speed modulation of QCLs has shown enormous potential in gas sensing and free space optical communication (FSOC) applications. In this letter, we present purified FM of QCL realized via an all-optical approach. The all-optical purified FM is achieved on a middle-infrared (MIR) QCL by illuminating its front facet with two near-infrared (NIR) beams without any additional changes to the laser structure.

10:50-11:20 **Coffee break**

Thursday, 14 September 2017 | Session 10: Holography|Sala Montalcini

11:20-11:50 **Raman spectroscopy and digital holography as multimodal approach to cells discrimination and imaging**

A. De Angelis[1], M.A. Ferrara[2], S. Managò[1], M. Napolitano[1], G. Coppola[2], A. C. De Luca[1]
1 Institute of Protein Biochemistry, National Research Council, Via P. Castellino, 111, 80131 Naples, Italy
2 Institute for Microelectronics and Microsystems, National Research Council, Via P. Castellino, 111, 80131 Naples, Italy
Invited speaker

Raman spectroscopy and digital holography are complementary characterization methods, able to perform a simultaneous and correlative morphological and biochemical cells analysis in a fast, reliable and low cost way. Moreover, they are particularly suitable for biological applications as both take advantage of intrinsic optical properties of the sample, without the need for labelling. A demonstration of their multimodal capability is provided by our recent works on sperm cells analysis.

11:50-12:10 **Experiment on spatial mode separation and conversion technique using volume hologram**

Fumiya Mizukawa, Atsushi Okamoto, Yuta Goto, Shimpei Shimizu, Kazuhisa Ogawa and Akihisa Tomita
Hokkaido University, Japan
OμS17_paper_35

In a mode division multiplexing network, spatial mode control techniques including the (de-)multiplexing and the conversion are needed for switching and routing the spatial modes. We have proposed the spatial mode separation and conversion technique using volume holograms. In this paper, we demonstrated the separation and conversion among three modes. As a result, proposed method achieved the separation and conversion simultaneously with the modal cross-talks of –15dB or less.

12:10-12:30 **Holographic Measurement of Film Thickness during Bubble Growth**

Zhe Wang[1,2], Biagio Mandracchia[1], Vincenzo Ferraro[3], Daniele Tammaro[3], Ernesto Di Maio[3] and Pietro Ferraro[1]
[1] CNR-ISASI, Italy
[2] Beijing University of Technology, China
[3] Università di Napoli Federico II, Italy
OμS17_paper_36

In this paper, we propose digital holography in transmission configuration as an effective method to measure the time-dependent thickness of polymeric films during bubble blowing, and, we designed a complete set of experiments to measure bubble thickness.

12:30-12:50 **Photochromic materials: the tool for making a reconfigurable platform for rewritable phase and amplitude holograms**

Andrea Bianco
INAF- Osservatorio Astronomico di Brera, Via Bianchi 46, 23807, Merate (LC), Italy

Phase and amplitude holographic optical elements find applications in different fields as dispersing elements, beam shapers, coding masks, etc. In many cases, it would be useful to change the holographic pattern to adapt to the different situations, such as a change in the optical set-up or to provide a different functionality. Photochromic materials are able to change their color in a reversible way, by means of a light stimulus. Usually, they can be converted from an uncolored form to a colored form with UV light and the way back with visible light. The change in color is the result of a change in transparency in the visible; therefore, an amplitude modulation occurs that can be exploited to make amplitude holograms. Beyond

the change in color, the photochromic materials show a change in the refractive index also in the NIR where a pure phase modulation takes place. In a similar manner, such modulation can be exploited to make phase holograms. With such materials, it is therefore possible to make thin films where phase and amplitude holograms can be optically written, erased and re-written. The optimization of high performance photochromic materials and films based on diarylethenes will be show together with examples of application as both phase and amplitude holograms.

ORAL PRESENTATIONS ONS'17

PLENARY SPEAKERS

Monday, 11 September 2017

10:30-11:30 **Super-Oscillatory Optical Imaging Technology**

Nikolay I. Zheludev
Optoelectronics Research Centre, Univ. of Southampton (United Kingdom)
Nanyang Technological University (Singapore)

Super-oscillation is a physical phenomenon that band-limited functions can oscillate much faster than its highest Fourier component over arbitrarily large intervals. It breaks the common belief that optical resolution in far-field is diffraction-limited and the smallest focal spot size cannot be smaller than half effective wavelength. A super-oscillatory field with sub-diffraction features can be generated by delicate interference of propagating waves without any evanescent wave contributions. Proliferation of nanofabrication and beam shaping technologies now allows us to embrace superoscillatory approaches to focusing and imaging that beat the diffraction limit of conventional refractive lenses. In this talk I review recent progress in developing superoscillations optical focusing devices and techniques for super-resolution imaging applications.

11:30-12:30 **Plasmonic Biosensors for Medical and Food Safety Applications**

Jiří Homola
Institute of Photonics and Electronics , The Czech Academy of Sciences (Czech Republic)

Optical biosensors hold vast potential for applications in medical diagnostics, food safety and security. This paper presents selected recent advances in optical biosensors based on surface plasmons. These include advances in the development of plasmonic nanostructures, optical platforms, microfluidic systems, functional coatings and detection methodologies. Applications of plasmonic biosensors for the detection of analytes related to medical diagnostics and food safety are also discussed.

Sala Ipogea del Comune di Anacapri
Piazza Edwin Cerio
Anacapri

Important note: All EOS presentations scheduled will be held at

CNR Conference Centre (former Royal Swedish Academy Solar Observatory) | via Fraita/via Ceselle, Anacapri

Monday, 11 September 2017 | Plasmonics I | Sala Marconi

14:30-15:00 **Polaritonic Figure of Merit of Plane Structures**

Jose Ordonez-Miranda
Institut Pprime, CNRS(Poitiers, France)
Invited speaker

ONS17_paper_01

Based on the ability of plane structures to simultaneously optimize the propagation, confinement, and energy of surface plasmon-polaritons or surface phonon-polaritons, we develop the polaritonic figure of merit Z = B*L^2/D, where B, L and D are the longitudinal wave vector, propagation length, and penetration depth, respectively. Explicit and analytical expressions of Z are derived for a single interface and a suspended thin film, as functions of the material permittivities and the film thickness. Higher Z are obtained for thinner films and smaller energy losses. The application of the obtained results for a SiC-air interface and a SiC thin film suspended in air shows that both structures are able to maximize the presence of polaritons at a frequency near to, but dierent than that at which the real part of the SiC permittivity exhibits a dip. Furthermore, using the temperature change of this dip, we show that the strength of polaritons increases with its height, which provides an effective way to enhance the overall Z of polaritonic structures.

15:00-15:20 **Tunneling junctions as source of electrically excited surface plasmons for sensing applications**

André Dathe,[1] Mario Ziegler,[2] Uwe Hübner,[2] Andrea Csáki,[1] Wolfgang Fritzsche,[1] Ondrej Stranik[1]
[1] Leibniz-Institute of Photonic Technologies, Department of Nano Biophotonics (Jena, Germany)
[2] Leibniz-Institute of Photonic Technologies, Department of Quantum Detection (Jena, Germany)
ONS17_paper_02

Electrical excitation of surface plasmons by inelastic tunneling in thin film stacks is evaluated in respect to spectral tunability, plasmon propagation, implementation of nanostructures as plasmonic transducer and the transferability from biomolecular detection schemes of established systems utilizing external illumination.

15.20- 15.50 **Robust entanglement and giant interatomic energy-transport amplification with nonreciprocal photonic topological insulators**

Mauro Antezza
Université de Montpellier (Montpellier, France)
Invited speaker

We investigate both entanglement and energy transport properties for two-level systems in the vicinity of a photonic topological insulator (PTI) interface, which supports a nonreciprocal (unidirectional), scattering-immune and topologically-protected surface plasmon polariton in the bandgap of the bulk material. Moreover, we demonstrate that despite the presence of considerable imperfections at the interface of the PTI, the efficiency of the SPP-assisted energy transport is almost unaffected by discontinuities. We also show that the SPP properties allow energy transport over considerably much larger distances then in the reciprocal case, and we point out a particularly simple way to tune the transport. Finally, we analyze the specific case of a two-emitter-chain and unveil the origin of the efficiency amplification. The efficiency amplification and the practical advantages highlighted in this work might be particularly useful in the development of new devices intended to manage energy at the atomic scale, e.g. in quantum technologies.

15:50-16:10 **Bio-based Nanostructures as Efficient Substrates in Surface Enhanced Raman Spectroscopy: Application to Cell Biology**

S. Managò, [1] G. Zito,[1] A. Rogato, [2,3] M. Casalino,[4] E. Esposito,[4] A. C. De Luca,[1] E. De Tommasi[4]
[1] Institute of Protein Biochemistry, Italian National Research Council (Naples, Italy)
[2] Institute of Biosciences and Bioresources, Italian National Research Council, (Naples, Italy)
[3] Stazione Zoologica Anton Dohrn, (Naples, Italy)
[4] Institute for Microelectronics and Microsystems, Italian National Research Council, (Naples, Italy)
ONS17_paper_03

Diatoms are micro-algae contained in a porous silica armor provided with periodic patterns of pores, whose dimensions (from some microns to tens of nanometers) vary from species to species. Due to their high replication rate, we can look at a diatom culture as a near-zero cost nano-factory where complex, three-dimensional structures self-replicate with high reproducibility. We made use of metalized frustules from Pseudonitzchia multistriata diatoms as Surface Enhanced Raman Spectroscopy (SERS) substrates, applying them in spectroscopic discrimination of acute lymphoblastic leukemia type B cells.

16:30-16:50 **Coffee break**

16:50-17:10 **Control of Infrared Thermal Emission in VO2 based nanoantenna arrays**

M. Centini

Sapienza, Università di Roma, Dipartimento di Scienze di Base e Applicate per l'Ingegneria (SBAI) (Rome, Italy)

ONS17_paper_04

We numerically show the control of spatial and spectral features of the far field thermal emission pattern of finite nanoantenna arrays, composed of alternating Gold and VO2 rods, as a function of the temperature. The control mechanism is achieved by taking advantage of the metal-insulator phase transition of VO2 at its critical temperature. The changes of the VO2 refractive index produce strong differences in the behavior of the overall system by creating or destroying evanescent wave coupling between different rods of the nanoantenna.

17:10-17:30 **Optical response control of all-dielectric metamaterials by means of thin phase change material layers**

E. Petronijevic[1], V. Di Meo[2,3], A. Crescitelli[3], P. Dardano[3], G.Coppola[3], E.Esposito[3], I. Rendina[3], G. Leahu[1], M. Miritello[4]
, M.G. Grimaldi[4], and C. Sibilia[1]
[1]*Department S.B.A.I., La Sapienza University of Rome (Rome,Italy)*
[2]*Departement D.I.M.E.S, University of Calabria (Rende, Italy)*
[3]*Institute for Microelectronics and Microsystems – CNR (Naples, Italy)*
[4]*Institute for Microelectronics and Microsystems – CNR Catania (Catania, Italy)*

ONS17_paper_05

We investigate the hybridization of all-dielectric metasurfaces based on Si nanoresonators with thin layers of phase change materials (PCM) for all-optical switching applications in telecom range. We propose structures by numerical simulations, we then fabricate SOI-based metamaterial covered by a thin layer of PCM GeTe, and we perform initial characterization of the device. All materials used have low losses in the telecom range, therefore they can be combined and optimized for high-Q responses, offering new perspectives in all-optical light control.

Monday, 11 September 2017 | Terahertz optics | Sala Marconi

17:30-17:50 **Spectroscopy of MoSe2 and WSe2 thin films for THz optics**

G.P. Papari[1,2], C. Koral[1], T. Hallam[3,4] , G. S. Duesberg[3,5] and A. Andreone[1,2]
[1] *Dipartimento di Fisica, Università di Napoli "Federico II," (Naples, Italy)*

[2] *CNR-SPIN, UOS Napoli (Naples, Italy)*
[3] *CRANN & AMEBR Center, School of Chemistry, Trinity College Dublin (Dublin,Ireland)*
[4] *School of Physics, Newcastle University (Newcastel, United Kingdom)*
[5] *Universität der Bundeswehr München (Neubiberg, Germany)*
ONS17_paper_06

THz spectroscopy is used to investigate the electrodynamics of layered transition metal dichalcogenides (TMDs). The samples were 20 nm thick polycrystalline MoSe2 and WSe2 films, grown by conversion of metal film (TAC). We provide the dielectric function of both thin films to characterize the THz response of two TMDs for the possible development of a new generation of optoelectronic devices.

17:50-18:10 **Coding THz Metasurfaces with Sub-Optimal Design for Diffuse Scattering**

M. Moccia[1], G. Castaldi[1], V. Galdi[1], S. Liu[2], R. Y. Wu[2], T. J. Cui[2], C. Koral[3], G. P.Papari[3,4], A. Andreone[3,4]
[1]*Department of Engineering, University of Sannio, I-82100 Benevento, Italy*
[2]*State Key Lab. of Millimeter Waves, Southeast University, Nanjing 210096, China*
[3] *Physics Department "E. Pancini", University of Naples "Federico II", I-80125 Naples, Italy*
[4]*CNR-SPIN, UoS Napoli, I-80126, Naples, Italy*
ONS17_paper_07

Recently many studies on coding metasurfaces, based on two basic unit cells with out-of-phase responses, have shown
the possibility of achieving diffuse scattering. Here, the physical mechanism underlying the scattering-signature reduction is elucidated via a theoretical study and the relevant scaling-laws validated by THz measurements.

18:10-18:30 **Narrow and broad band terahertz transmission filters**

Antonio Ferraro, [1] Dimitrios C. Zografopoulos,[1] Roberto Caputo, [2] and Romeo Beccherelli[1]
[1]*Consiglio Nazionale delle Ricerche, Istituto per la Microelettronica e Microsistemi (Rome, Italy)*
[2]*Department of Physics, University of Calabria (Rende, Italy)*
ONS17_paper_08

Frequency-selective surface filters (FSS) for terahertz (THz) applications are investigated numerically and experimentally. A periodic FSS array of cross-shaped apertures is patterned on aluminium, deposited on thin foils of a low-loss polymer. We observe the filtering response of the FSS elements and very narrow-linewidth peaks with high transmittance, associated with guided-mode resonances in the substrate.

18:30-20:00 Welcome cocktail

Tuesday, 12 September 2017 | Plasmonics II | Sala Marconi

09:00-09:30 **Helix-Shaped nanostructures for tailored chiro-optical properties in the Visible range**

A. Passaseo[1], M. Esposito[1,2], V. Tasco[1]
1CNR - Institute of Nanotechnology, c/o campus Ecotekne (Lecce, Italy)
2Dipartimento Mat-Fis Ennio De Giorgi, Università del Salento (Lecce, Italy)

Invited speakers

ONS17_paper_09

Chiral metamaterials, allowing the manipulation of circular polarization states of light could represent a disruptive breakthrough for advanced optical devices.
In this work, helix-shaped nanostructures are presented, underlying the possibility to effectively modulate their optical performances in the linear regime at optical frequencies. This result is accomplished by exploiting different 3D spatial architecture and material choice (metal or dielectrics). Advanced designs for improved functionality, envisaged to match practical applications, will be discussed.

09:30-09:50 **SERS substrates on optical fiber tips: toward the optrode configuration**

G. Quero[1], S. Managò[2], M. Pisco[1], F. Galeotti[3], G. Zito[2], A. C. De Luca[2], A. Cutolo[1], A. Cusano[1]
[1]Optoelectronic Division - Engineering Dept., University of Sannio (Benevento, Italy)
[2] National Research Council, Institute of Protein Biochemistry (IPB-CNR) (Napoli, Italy)
[3] National Research Council, Institute for Macromolecular Studies (ISMAC-CNR)(Milano, Italy)

ONS17_paper_10

This paper presents an investigation regarding the capability to use the Optical Fiber Tip (OFTs) as surface-enhanced Raman spectroscopy (SERS) nanoprobes in optrode configuration, based on the integration of nanostructures, realized via nanolithography technique, onto OFTs.

09:50-10:10 **Integrated polymeric platforms for biosensing applications**

Gianluca Persichetti, Genni Testa and Romeo Bernini
IREA-CNR, Istituto per il rilevamento Elettromagnetico dell'ambiente (Naples, Italy)

ONS17_paper_11

Two integrated polymeric platforms based on polymeric optical resonators are proposed for biosensing applications. The first one is based on self-assembled bottle microresonator integrated with a SU-8 exciting waveguide in a fully planar optical configuration demonstrating high Q factors and easiness in integration without performances degradation. The second platform is based on SU-8 polymeric ring resonator with an innovative flow-through microfluidic configuration demonstrating a response time reduction of a factor 4.9 compared to the conventional flow-over approach.

10:10-10:30 **Experimental Identification of Unique Angular Dependent Scattering Behavior of Nanoparticles**

G. Yin,[1] M. Song,[1,2] W. Raja,[1] P. Andrae, [1,2] M.Schmid[1, 3]
[1] Nanooptische Konzepte für die PV, Helmholtz Zentrum Berlin für Materialien und Energie (Berlin, Germany)
[2] Freie Universität Berlin, Department of Physics (Berlin, Germany)
[3] Universität Duisburg-Essen & CENIDE, Department of Physics (Duisburg, Germany)

ONS17_paper_12

Angular resolved scattering measurements enable experimentally revealing the particular scattering properties of different nanostructures. Applying this characterization method we investigate both metallic and dielectric nanoparticles. The random Ag nanoparticles are able to scatter light into large angles. In contrast, both Ag and PS periodic nanoparticles are characterized by a strong scattering zone where scattering angles are increasing as the wavelength increases.

10:30-10:50 **Mechanisms of Perfect Absorption in Nano-Composite Systems**

S. Mader, [1] O.J.F. Martin[1]
1Swiss Federal Institute of Technology Lausanne (EPFL), Nanophotonics and Metrology Laboratory (Lausanne, Switzerland)
ONS17_paper_13

Near-perfect absorption across the entire VIS based on metallic nano-composite materials was realized experimentally by Hedayati et.al. in 2011 and optimized based on simulations by Etrich et.al. in 2014. However, both works did not reveal the mechanisms that lead to broadband light absorption by a typically highly-reflective metal. Here we investigate the microscopic location of absorption and the origin of the strong resonance broadening compared to that of individual metal nano particles.

10:50-11:20 **Coffee break**

Tuesday, 12 September 2017 | Light manipulation | Sala Marconi

11:20-11:50 **Design and Engineering of Complex Aperiodic Metamaterials**

Luca Dal Negro
Boston University (Boston, USA)
Invited speaker

The ability to manipulate light-matter interactions using complex, aperiodic electromagnetic media is at the heart of current nanoplasmonics and metamaterials technologies. Efficient approaches for multiscale electromagnetic field enhancement, concentration and manipulation of fields with designed spatial-frequency spectra in complex media enable the control of propagating and non-propagating electromagnetic modes in optical nanostructures with broadband/multi-band enhanced responses. Besides its fundamental interest, photonic-plasmonic coupling in complex electromagnetic environments is also of great importance for device applications such as nano-antennas, ultrafast optical switchers, nanoscale energy concentrators, laser nano-cavities, and optical biochemical sensors. In this talk, I will discuss our recent work on the design and engineering of field localization, resonant scattering phenomena, and light transport in metal-dielectric deterministic aperiodic nanostructures. In particular, I will introduce our activities on the design and engineering of plasmonic antennas with fractal geometry for near-infrared and mid-infrared surface enhanced spectroscopy. I will then introduce the distinctive light scattering and localization properties of a new class of aperiodic media generated from prime numbers in complex quadratic fields, and discuss their potential for active plasmonics and metamaterials devices.

11:50-12:10 **Observation of fluorescence enhancement at a Bound State in the Continuum of a photonic crystal membrane**

Silvia Romano[1], Gianluigi Zito[2], Stefano Managò[2], E. Penzo[3], S. Sassolini[3], S. Dhuey[3], Stefano Cabrini[3], Anna Chiara De Luca[2], Vito Mocella[1]
[1]Institute for Microelectronics and Microsystems, National Research Council, CNR-IMM (Naples, Italy)
[2]Institute of Protein Biochemistry, National Research Council, CNR-IBP(Naples, Italy)
[3]Molecular Foundry, Lawrence Berkeley National Laboratory (Berkeley, USA)

ONS17_paper_14

A photonic crystal membrane can support bound states in the continuum of radiation modes, i.e. resonant states with theoretical infinite lifetime. Here, we show that the enhanced field confined in proximity to the surface of a silicon nitride photonic crystal membrane can be applied to boost fluorescence emission of probe molecules dispersed on the surface. Our results provide new solutions for light manipulation at the nanoscale, especially for sensing and nonlinear optics applications.

12:10-12:30 **Quantum Spin-Hall Effect of Light at Bound States in the Continuum**

Gianluigi Zito[1], Silvia Romano[2], Giuseppe Calafiore[3], Simone Sassolini[3] , Scott Dhuey[3], Stefano Cabrini[3], Anna Chiara De Luca[1], Vito Mocella[2]
[1]Institute of Protein Biochemistry, National Research Council, CNR-IBP(Naples, Italy)
[2]Institute for Microelectronics and Microsystems, National Research Council, CNR-IMM (Naples, Italy)
[3]Molecular Foundry, Lawrence Berkeley National Laboratory (Berkeley, USA)

Herein, we discuss a novel phenomenon based on the combination of quantum spin-Hall transport of light with spin-to-orbital angular momentum conversion. This effect is observed in a dielectric resonator operating near the bound-state-in-continuum (BIC) regime. Our results shed new light on fundamental mechanisms of light-spin manipulation at the nanoscale, with strong impact on emerging quantum technologies.

12:30-12:50 **Controlling Photons with Plamons in Core-shell Nanowires**

Kiana Montazeri, Zhihuan Wang, Bahram Nabet
Department of Electrical and Computer Engineering Drexel University (Philadelphia, USA)
ONS17_paper_15

Surface Plasmon Polaritons (SPPs) are density oscillations of electrons at the surface of a dielectric. Materials such as noble metals including Au and Ag are considered as the most promising plasmonic material candidates because of their high optical conductivity and low ohmic loss. A heterojunction is the interface that occurs between two layers or regions of dissimilar crystalline semiconductors with unequal bandgaps which provides a mature system of extremely high mobility electrons. At the interface of the core-shell nanowires, a heterostructure can be formed which results in 6 sheets of 2D and 6 pillars of 1D charge, forming the plasmonic boundary of the optical cavity. This method can produce better optical cavity quality factor, as well as enhance emission and absorption of radiation. A comparison among this plasmonic medium and noble metallic surfaces is conducted to show that 2DEG at the interface has similar effects as the well-known plasmas. Plasmonic resonant modes in sub-wavelength geometries in CSNWs can be used in THz nanowire laser applications. Additionally, control of charge density leads to design of tunable nanowire cavities.

12:50-14:30 **Lunch**

Tuesday, 12 September 2017 | Materials for photonics | Sala Marconi

14:30-15:00 **Transition metal dichalcogenides: a new material for photonic structures**

Adam Schwartzberg
Lawrence Berkeley National Labs (Berkeley, USA)

Invited speakers

Photonic structures require materials with a high index of refraction that can also be patterned with high resolution without degradation, silicon being the point of reference. In this talk I will present the transition metal dichalcogenide (TMD) tungsten disulfide as a new photonic material with properties surpassing silicon in the near-infrared and a set simple fabrication techniques enabling 3D photonic structures never before possible. Atomic layer deposition of transition metal oxides followed by chalcogen annealing allows for conformal patterning and high-resolution structuring while maintaining material quality. Three exemplar structures and their optical behaviors are demonstrated: 2D patterned, 2D templated, and 3D templated photonic crystals. We have modeled these results and present a theoretical framework which we hope will aid the photonics community in developing new structures that can take advantage of this new material and flexibility of fabrication.

15:00-15:20 **Coherent phonon dynamics and metastable state in misfit layered chalcogenide compound**

M. Lejman[1] , G. Galle[1], J. Faure[1], L. Cario[2], D. Boschetto[1]
[1]LOA, ENSTA ParisTech, CNRS, Ecole Polytechnique, (Palaiseau, France)
[2]Institut des Materiaux Jean Rouxel, CNRS, Universite de Nantes (Nantes, France)
ONS17_paper_16

We show time resolved spectroscopy measurements with femtosecond time resolution in LaVS3 compound. The results show that, by tuning the wavelength of the pump pulse in the near infrared range, it is possible either to excite a coherent optical phonon or to create a metastable state that might indicate a photoinduced phase transition. Moreover, the results also show a competition between the coherent phonon mode and the photoinduced metastable state.

15:20-15:50 **Semiconductor nanowires for photonic integration and miniaturization**

T.V. Hakkarainen
Optoelectronics Research Centre, Tampere University of Technology (Tampere, Finland)
Invited speakers
ONS17_paper_17

III-V semiconductor nanowires (NW) are capturing increased interest as building blocks in future electronic and photonic devices. GaAs NWs can be grown directly on Si by self-catalyzed molecular beam epitaxy using a lithography-free technique for defining the NW nucleation sites, leading to a record high size uniformity. Such NWs exhibit diameter-dependent resonant absorption that can be detected by photo-acoustic technique. When coated asymmetrically by Au, the NWs provide chiral optical response in both absorption and emission.

15:50-16:10 **Long-range exciton diffusion in cesium lead halide perovskite nanocrystals organized in ordered nanoscale assemblies**

Erika Penzo, Stefano Cabrini, Adam Schwartzberg, Alexander Weber-Bargioni, Edward Barnard
Lawrence Berkeley National Laboratory (USA)

Fully inorganic cesium lead halide perovskite nanocrystals (NCs) are a novel colloidal material displaying remarkably bright photoluminescence (PL) characterized by high quantum yield (QY) and narrow emission line widths. Compositional control and quantum-size effects allow for the precise and continuous tuning of bandgap energies over the entire visible spectral region, making it a particularly attractive material for optoelectronics. Under proper synthesis conditions, the perovskite crystal structure results in NCs with cubic

shape, 4-15 nm in side length. Taking advantage of their affinity for hydrophobic surfaces, these NCs can be assembled in highly ordered monolayers in which the cubic NCs are organized in arrays with parallel edges. The close proximity of this arrangement and the high polarizabilty of these NCs allow for efficient exciton migration between adjacent NCs through Förster Resonant Energy Transfer (FRET).

16:10-16:30 **Coffee break**

Tuesday, 12 September 2017 | Nanoscale Phenomena | Sala Marconi

16:30-17:00 **Aspects of ultrafast thermomechanics at the nanoscale**

F. Banfi,[1,2] M. Gandolfi,[1,2,3] S. Peli,[1,2] F. Medeghini,[4] P. Maioli,[4] A. Crut[4] , F. Vallée[4], N. Del Fatti[4], C. Giannetti,[1,2] G. Ferrini,[1,2]
[1]Università Cattolica del Sacro Cuore, Dipartimento di Matematica e Fisica (Brescia, Italy)
[2]Università Cattolica del Sacro Cuore, Interdisciplinary Laboratories for Advanced Materials Physics (I-LAMP), (Brescia, Italy)
[3]Laboratory of Solid State Physics and Magnetism (Leuven, Belgium)
[4]FemtoNanoOptics group, Institut Lumière Matière, Université Lyon, CNRS (Lyon, France)
Invited speaker
ONS17_paper_18

The talk addresses the potentiality of time-resolved optical techniques in accessing the impulsive thermal and mechanical dynamics occurring in paradigmatic nanoscale systems. Hypersonic surface acoustic waves, triggered in Phononic Crystals, will be covered together with their applications in mechanical nanometrology. Scaling from the meta-material to a single nano-object, the thermal boundary resistance, the parameter ruling heat transfer at the interface between two materials, will be addressed at the nanoscale.

17:00-17:20 **Material-Independent Modes for Electromagnetic Scattering from Nanoparticles**

Roberto Tricarico[1], Carlo Forestiere[1], Giovanni Miano[1], Mariano Pascale[1], Antonello Tamburrino[2], Guglielmo Rubinacci[1], Salvatore Ventre[2]
[1]Department of Electrical Engineering and Information Technology, Università degli Studi di Napoli Federico II (Naples, Italy)
[2]Department of Electrical and Information Engineering, Università di Cassino e del Lazio Meridionale (Cassino, Italy)
ONS17_paper_19

We introduce an alternative representation of the electromagnetic field scattered by a homogeneous object in terms of modes independent of its permittivity. Thanks to this spectral technique it is possible to: evaluate the resonance frequencies of the full retarded regime; clarify the role of the modes in the analysis of scattered power spectra; unveil the differences between dielectric and metal spheres in their electromagnetic scattering properties; simplify the NP permittivity design.

17:20-17:50 **Light scattering by periodic rough surfaces - equivalent jump conditions**

A. Maurel[1], J.-J. Marigo[2], B. Gallas[3], A. Ourir[1]
[1]Institut Langevin (Paris, France)
[2]Laboratoire de Mécanique des Solides | LMS - Ecole polytechnique (Palaiseau, France)

[3]IInstitut des NanoSciences de Paris (Paris, France)
Invited speaker
ONS17_paper_20

The scattering of light by a periodic rough air-dielectric interface is analyzed in terms of equivalent jump conditions provided by two scale homogenization. Results are validated using direct numerics and experimental measurements on a Si substrate. In particular, we show the ability of the model to predict, without any adjustable parameter, the shift in the Brewster effect.

17:50-18:10 **Advanced in stimulated Raman scattering in nanostructures**

Luigi Sirleto,[1] *Alessandro Vergara,*[2] *Maria Antonietta Ferrara*[1]
[1]*Consiglio Nazionale delle Ricerche (CNR), Istituto per la Microelettronica e Microsistemi (Naples, Italy)*
[2] *Dipartimento di Scienze Chimiche, Università di Napoli Federico II (Naples, Italy)*

Stimulated Raman scattering is essentially a "light amplification," and some of the most important applications are light amplifiers and laser sources. Important achievements have been obtained in the fields of fiber amplification and integrated photonics. However, photonics components, currently used in optical interconnects, are relatively large and not ideally suited to on-chip integration. A reduction in the size of integrated optical devices, while maintaining a high level of performance, is a key challenge in photonics. On this line of argument, the ability to construct nano-objects is expected to have a significant impact in the future, leading to the development of fully functional nanodevices, such as nanoscale optical sources. The aim of this talk is to review accomplishments in the field of stimulated Raman scattering in nanostructures, to delineate the state of the art, and to identify the emerging trends and remaining challenges.

20: 30 Social dinner at "Da Gelsomina" Restaurant

Wednesday, 13 September 2017 | Nonlinear optics | Sala Marconi

Special Session: COST action MP1403 Nanoscale Quantum Optics Work Group 2 Meeting

09:00-09:30 **Engineering nanoantennas for efficient nonlinear photon conversion at the nanoscale**

M. Celebrano,[1] A. Locatelli,[2] L. Ghirardini,[1] G. Pellegrini,[1] P. Biagioni,[1] X. Wu,[3] S.Grossman,[3] L. Carletti,[2] C. De Angelis[2], L. Duò,1 B. Hecht,3 M. Finazzi1
[1]Politecnico di Milano, Physics Department (Milano, Italy)
[2]University of Brescia, Department of Information Engineering (Brescia, Italy)
[3]University of Würzburg, Nano-Optics & Biophotonics Group - Department of Physics- Experimental Physics (Würzburg, Germany)
Invited speaker
ONS17_paper_21

We have recently devised a plasmonic nanoantenna working in the near infrared region of the electromagnetic spectrum, which allows boosting the second harmonic generation SHG efficiency. This is achieved by optimizing the nanoantenna geometry to feature (i) a double resonant response at both the fundamental and emission wavelengths, (ii) a spatial overlap between the modes involved in the process and (iii) a broken symmetry, to enable dipole-allowed SHG. We found that this nanoantenna concept behaves like a strongly coherent nanoscale light source, featuring extremely low uncoherent photoluminescence in the visible range and a marked third harmonic generation along with an intense SHG.

09:30-09:50 **Coherent Control of Second Harmonic Near-Field Distribution in Nanoantennas**

A. Comin[1], V. Giegold[1], A. Bouhelier[2], A. Hartschuh[1]
[1]Ludwig Maximilian University, Chemistry Department (München, Germany)
[2]Laboratoire Interdisciplinaire Carnot de Bourgogne, CNRS (Dijon, France)
ONS17_paper_22

We show a method to control the spatial distribution of the second harmonic produced by a single L-shaped gold nanoantenna, by means of femtosecond pulse shaping. We employ far field super-resolution microscopy to detect displacements of the second harmonic spot with an accuracy of few nanometers. By iteratively optimizing the spectral amplitude and phase of the excitation laser beam, we can displace of the second harmonic spot imaged on the camera by about 20nm.

09:50-10:10 **Amplification of ultrafast laser harmonics in resonant nanostructures**

Hamed Merdji
Ultrafast Nanophotonics Group LIDYL Laboratory Bat (Gif sur Yvette, France)
ONS17_paper_23

A scheme is proposed for high harmonic generation (HHG) in crystals using nanoscale amplification of a mid-infrared laser. High intensities required for nonlinear processes are reached by local enhancement of the electric field through plasmonic resonances in the sample rather than using large laser amplifier systems.

10:10-10:30 **SHG and SPDC in hybrid nanostructures**

G.Laurent[1], N. Chauvet[1], M. Ethis De Corny[1], S. Huant[1], G. Dantelle[1],T. Gacoin[2], G. Nogues[1], A. Drezet[1], G. Bachelier[1]
[1]Neel Institute – CNRS, Grenoble-Alpes University (Grenoble, France)
[2]LPMC, UMR CNRS – Ecole Polytechnique (Palaiseau, France)
ONS17_paper_24

We present a numerical study of SHG and SPDC in structures that combines plasmonic resonances and intrinsic nonlinearity. If simulations relying on a classical description are sufficient for up conversion processes, a quantum approach is needed for the investigation of entangled photon pair production. We have developed simulation tools mixing quantum formalism and numerical approaches for quantitative evaluation of photons pair correlation measurements in realistic experimental configurations.

10:30-11:00 **Coffee break**

Wednesday, 13 September 2017 | Quantum Phenomena | Sala Marconi

Special Session: COST action MP1403 Nanoscale Quantum Optics Work Group 2 Meeting

11:00-11:30 **Ultrafast electron dynamics in plasmonic nanostructures for quantum active control of nanophotonics**

J. Aizpurua[1], G. Aguirregabiria[1], M. Zapata[1], R. Esteban[1,2], A.K. Kazansky[1,2],D. C. Marinica[3] and A.G. Borisov[3]
[1]Center for Materials Physics (CSIC-UPV/EHU) and DIPC (San Sebastián, Spain)
[2]IKERBASQUE, Basque Foundation for Science (Bilbao, Spain)
[3]Institut des Sciences Moléculaires d'Orsay, CNRS-Université Paris Sud (Paris, France)
Invited speaker
ONS17_paper_25

The optical response of plasmonic nanostructures can be strongly affected by the quantum nature of the conduction electrons in the metal, particularly in small particles and narrow gaps. Effects such as quantum size, nonlocal dynamical screening, atomistic features, electron spill-out, or electron tunneling ultimately determine the optics of subnanometric metallic structures and interconnects. To address these effects, a quantum treatment of the electron gas within time-dependent density functional theory (TDDFT) is able to fully account for the dynamical screening of the electrons confined by the boundaries in a metallic nanostructure. TDDFT in time domain allows to trace the ultrafast evolution of the electronic density as well as to address the linear and nonlinear optical response in metallic nanoantennas, thus showing how to exploit these building blocks in applications of active control in nanophotonics.

11.30-12.00 **On chip intrasystem Quantum Entangled States Generator**

Fabio Antonio Bovino
Leonardo & University of Rome "Sapienza" (Rome, Italy)
Invited speaker
ONS17_paper_26

Quantum technology is a fundamental new way of harnessing Nature and it has potential for a truly revolutionary innovation and promise the next generation of products with exciting and astounding properties that will affect our lives profoundly. They will have a great influence in defence, aerospace, energy and telecommunications sectors. If this process is to continue in the future, new, quantum technology must replace or supplement what we have now. In particular, Quantum Information Technology can support entirely new model of information processing based on so called quantum bits or qbits. Its eventual impact may be as great as greater than that of its classical predecessor. There is almost daily progress in developing promising technologies for realizing quantum information processing with various advantages over its classical counterpart.

12:00-12:20 **Quantum State Engineering for Color q-bits**

M. Artoni[1,2], A. Zavatta[1], G. La Rocca[3], Jin-Hui Wu[4]
[1]Istituto Nazionale di Ottica & European Laboratory for Nonlinear Spectroscopy (Firenze, Italy)
[2]Department of Engineering and Information Technology, Brescia University (Brescia, Italy)
[3]Scuola Normale Superiore and CNISM, (Pisa, Italy)
[4]Center for Quantum Sciences, Northeast Normal University (Changchun, China)
ONS17_paper_27

Entanglement is today the basis for many new potential applications such as quantum communications, quantum metrology and optical computing. We present a general mechanism for the generation of two-colour entangled photons. The mechanism exploits specific multi-level third-order nonlinearities, can be extended to multi-color entanglement and adapted both to miniaturized atomic cells and to solid interfaces. Both interfaces have a potential for new quantum information and communication technology (ICT) architectures.

12:20-12:40 **From plasmon mediated efficient energy transfer to long-range strong coupling of quantum emitters**

Matthias Hensen,[1] Tal Heilpern,[2] Stephen K. Gray,[2] Walter Pfeiffer[3]
[1]Universität Würzburg, Institut für Physikalische und Theoretische Chemie (Würzburg, Germany)
[2]Argonne National Laboratory, Center for Nanoscale Materials (Lemont, USA)
[3]Universität Bielefeld, Fakultät für Physik, (Bielefeld, Germany)
ONS17_paper_28

Establishing strong coupling between spatially separated and thus selectively addressable quantum emitters is a key ingredient to complex quantum optical schemes in future technologies. Plasmonic nanostructures are considered, however, the energy transfer and mutual interaction strength between distant quantum emitters failed so far to provide strong coupling. Here, based on mode hybridization the longevity and waveguide character of an elliptical plasmon cavity is combined with intense and highly localized field modes of suitably designed nanoantennas. Based on FDTD simulations a quantum emitter–plasmon coupling strength of 16.7 meV is reached while simultaneously keeping a small plasmon resonance line width of 33 meV. This facilitates strong coupling and quantum dynamical simulations reveal an oscillatory exchange of excited state population and a notable degree of entanglement between the quantum emitters spatially separated by 1.8 μm, i.e. about twice the operating wavelength.

13:00-14:30 **Lunch**

Wednesday, 13 September 2017|Imaging & Spectroscopy|Sala Marconi

Special Session: COST action MP1403 Nanoscale Quantum Optics Work Group 2 Meeting

14:30-15:00 **Coherent multidimensional spectroscopy of nanomaterials**

K. J. Karki, [1] N. Lenngren,[1] K. Zidek,[1] J. Chen, [1] M. J. Al-Marri,[2] D. Zigmantas,[1] O. Kühn,[3] T. Pullerits[1]
[1]Lund University, Chemical Physics and NanoLund (Lund, Sweden)
[2]Qatar University, Gas Processing Center (Doha, Qatar)
[3]Universität Rostock, Institut für Physik (Rostock, Germany)
Invited speaker
ONS17_paper_29

Coherent 2D spectroscopy is the most complete third order nonlinear optical technique. Together with conventional photon echo-based 2D spectroscopy, we apply incoherent action based 2D spectroscopy in the studies of various nanomaterials as QDs, plasmonic particles and light harvesting pigment proteins.

15:00-15:20 **Advances in photoacoustic spectroscopy for nondestructive characterization of nanomaterials**

R. Li Voti
Sapienza Università di Roma, Dipartimento SBAI (Rome, Italy)
ONS17_paper_30

Photoacoustic Spectroscopy (PAS) is an excellent technique for studying the optical absorption spectra of opaque and highly light-scattering substances such as nanomaterials. In this paper we review recent advances in the methodology of PAS and its novel applications. In particular we discuss the performance of PAS to detect circular dichroism of both extrinsic or pseudo-chiral (meta) surfaces, showing how the selective absorption of circularly polarised light depend on the orientation of the metasurface. We also applied PAS in the VIS/IR range to measure the resonant absorption peaks related to the guided modes of GaAs-based NW on Si. In disordered media we also show how PAS confirms to be the most appropriate technique to determine separately the absorption and the scattering coefficients allowing to determine the size of both metallic (AgNP) or semiconductor nanospheres (ZnO) or clusters of nanospheres bridged by the ligands.

15:20-15:40 **STED nanoscopy assisted by small metal nanoparticles – new advances**

Yonatan Sivan,[1] Matthew R. Foreman,[2] Nicolai T. Urban,[3] Stefan W. Hell [3]
[1]Unit of Electro-Optics engineering, Ben-Gurion University (Be'er Sheva , Israel)
[2]Max Planck Institute for Science of Light (Erlangen, Germany)
[3]Max Planck Institute for Biophysical Chemistry (Gottingen, Germany)
ONS17_paper_31

In this contribution, we report the use of 20nm gold spheres coated with fluorescent silica in aqueous environment, and a much shorter STED wavelength, of 595nm. First, we demonstrate deep super-resolution with the hybrid nanoparticles, down to ~75nm, at up to 2 times lower intensities compared with a standard STED. No boiling of the aqueous environment is observed within this range, indicating the method's applicability to imaging of biological media. Second, we demonstrate up to a 3-fold reduction of the bleaching rate in both confocal and STED modes, thus, providing the first confirmation of the second part of the NP-STED theory.

15:40-16:00 **Selective Coherent anti-Stokes Raman Scattering Microscopy Employing Simultaneously-Nanofocused SPP Pulses at 800 and 400 nm**

Keita Tomita, Yasuhiro Kojima, and Fumihiko Kannari
Department of Electronics and Electrical Engineering, Keio University (Tokyo, Japan)
ONS17_paper_32

Aluminum (Al) is expected to excite surface plasmon polariton (SPP) which strongly localizes and propagates on the metal-dielectric interface in the visible and ultraviolet wavelength region. Thus, to nanofocus SPP pulses simultaneously at 800 and 400 nm, we used an Al tapered tip with a curved grating structures. In this work, we demonstrated selective CARS measurements of a monolayer of graphene employing a spectral focusing scheme with nanofocused SPP pulses simultaneously at 800 and 400 nm using an Al tapered tip.

16:00-16:20 **Label-free imaging of cellular dynamics at 100Hz and 140nm resolution.**

Alexander Rohrbach
Lab for Bio- and Nano-Photonics Department of Microsystems Engineering (IMTEK) and Department of Physics
University of Freiburg (Freiburg, Germany)

Many new, exciting imaging techniques have emerged during the last decade, providing significantly improved spatial resolution and contrast. However, this extra information comes at the cost of more photons required to illuminate the cell, which requires more time and energy and often damages biological structures. The smaller the structures to be investigated, the faster they usually move inside living cells, because of both Brownian motion and coordinated work of molecular motors. Therefore, alternative imaging approaches are necessary. In this talk I will present a novel technique called rotating coherent scattering (ROCS) microscopy. This imaging method is characterized by label-free, coherent imaging through scattering of a rotating laser beam, which reveals a variety of unexpectedly fast processes inside/of living cells. The technique operates at up to 100 Hz with a spatial resolution of currently 140nm, it can acquire thousands of images without loss in image quality and does not require postprocessing, such that the cells can be observed online.

16:20-16:50 **Coffee break**

Wednesday, 13 September 2017|Plasmonics III|Sala Marconi

Special Session: COST action MP1403 Nanoscale Quantum Optics Work Group 2 Meeting

16:50-17:20 **Control of optical emitters quantum efficiency by near-field coupling with plasmonic and pre-plasmonic nanostructures**

T. Cesca, B. Kalinic, N. Michieli, C. Scian, G. Mattei
1University of Padova, Dept. of Physics and Astronomy, NanoStructures Group (Padova)
Invited speaker
ONS17_paper_33

The capability to control and enhance the emission efficiency of optical emitters by near-field coupling with plasmonic and pre-plasmonic nanostructures is reported. An intense boost of the photoluminescence of Er3+ ions in silica is obtained with ultra-small sub-nanometric metal clusters. Moreover, it was demonstrated that extended plasmonic nanostructures, in the form of gold nanohole arrays, can be efficiently used to control their energy relaxation rates.

17:20-17:40 **Local field enhancement and thermoplasmonics in multimodal Aluminum structures**

P. R. Wiecha[1], M.-M. Mennemanteuil[2] , D. Khlopin[3] , J. Martin[3] , A. Arbouet[1] , D. Gérard[3] , A. Bouhelier[2] , J. Plain[3] , A. Cuche[1]
[1]CEMES, University of Toulouse and CNRS(Toulouse, France)
[2]ICB, University of Bourgogne and CNRS (Dijon, France)
[3]LNIO, Institut Charles Delaunay, UMR CNRS, Université de Technologie de Troyes (France)
ONS17_paper_34

In this work, we reveal a new facet of this metal relevant for both plasmonics purpose and photo-thermal conversion. The field distribution of high order plasmonic resonances existing in two-dimensional Al structures (200 nm – 2 µm) is studied by nonlinear photoluminescence (nPL) microscopy in a spectral region where electronic interband transitions occur (around 800 nm). The polarization sensitivity of the field intensity maps shows that the electric field concentration can be addressed and controlled on-demand. We use a numerical tool based on the Green dyadic method to analyze our results and to simulate the absorbed energy that is locally converted into heat. A comparison with similar gold structures demonstrates the higher efficiency of the mechanism in these Al cavities in the red and near infrared part of the electromagnetic spectrum. Finally, the polarization-dependent temperature increase of the Al structures is experimentally measured. The recorded temperature maps are in excellent agreement with theoretical predictions, demonstrating the potential of high order plasmonic resonances in Al.

17:40-18:00 **Near Field Hyperspectral Quantum Probing of Multimodal Plasmonic Resonators**

A. Cuche[1], M. Berthel[2], U. Kumar[1], G. Colas des Francs[3], S. Huant[2], E. Dujardin[1], C. Girard[1] and A. Drezet[2]
[1]CEMES, University of Toulouse and CNRS (Toulouse, France)
[2]Néel Institute, University Joseph Fourier and CNRS (Grenoble, France)
[3]ICB, University of Bourgogne and CNRS (Dijon, France)
ONS17_paper_35

When interacting with metallic nanostructures, two-level quantum systems see their emission properties strongly modified by the local photonic and plasmonic landscape since the emitter dynamics is ruled by a subtle balance between radiative or non-radiative energy channels.
We present here an experimental configuration based on a single nanodiamond attached at the apex of an optical tip that applies and generalizes this concept to achieve a genuine quantum probing of multimodal plasmonic resonators by collecting and filtering the broad emission spectra generated by a nanodiamond (from 637 nm to 800 nm). The small number of color centers with random orientation hosted by the particle makes the system acting as a scalar probe while quantum features of the emission statistics are preserved. We therefore attribute the name of HQ-NSOM (Hyperspectral-Quantum Nearfield Scanning Optical Microscopy) to this new modal imaging technique. With this active probe, we monitored at different energies the evolution of the fluorescence signal from 10 NV- centers hosted by a 80 nm nanodiamond driven into the nearfield of 2D multimodal mesoscopic plasmonic cavities. These structures, made of silver, sustain high-order delocalized SP modes in the visible range that are mainly confined along the edges.

18:00-18:20 **Nonlinear plasmonics at high temperatures & Thermooptic metamaterials**

Yonatan Sivan,[1] Shi-Wei Chu,[2]
[1]Unit of Electro-Optics engineering, Ben-Gurion University (Be'er Sheva , Israel)
[2]Department of Physics, National Taiwan University (Taiwan)
ONS17_paper_36

Based on newly measured permittivity data of Au under increasing temperatures, we show that the initial decrease of the scattering can be explained by the thermal nonlinear optical response of the metal to CW light. In contrast to the multitude of studies of the ultrafast regime and the electron temperature contribution, we provide an elaborate solid state model that explains for the first time, the dependence of the metal permittivity on the lattice temperature. We also show that the consequent growth of the

scattering is related with a decrease of the metal permittivity, which can be associated with the electron non-thermal distribution.

18:20 COST action MP1403 Nanoscale Quantum Optics Work Group 2 Meeting| Sala Marconi

Thursday, 14 September 2017 Ultrafast phenomena |Sala Marconi

Special Session: COST action MP1403 Nanoscale Quantum Optics Work Group 2 Meeting

09:00-09:30 **Femtosecond and attosecond dynamics in carbon-based structures studied with ultrashort XUV pulses**

Franck Lepine
Université Claude Bernard Lyon 1, LASIM (Lyon , France)
Invited speaker

9.30-9.50 **(The Road to) Understanding Localization of Light in Nanosponges**

F. Schwarz,[1] G. Hergert,[2] J. Vogelsang,[2] D. Wang,[3] P. Schaaf,[3] C. Lienau,[2] E. Runge[1]
[1]TU Ilmenau, Fakultät für Mathematik und Naturwissenschaften (Ilmenau, Germany)
[2]Carl von Ossietzky Universität, Institut für Physik (Oldenburg, Germany)
[3]TU Ilmenau, Fakultät für Elektrotechnik und Informationstechnik (Ilmenau, Germany)

Disorder can induce light-localization. Porous gold nanosponges are particularly fascinating examples where light trapping results in high local plasmonic fields and strong non-linear effects. Long-lived excitations are confirmed using photo-electron emission. FDTD simulations reproduce the experiments quiet well and, thus, allow to study localization quantitatively. Here, we focus on the question, which disorder parameters have to be tailored in order to optimize field enhancement.

9.50-10.10 **A Quantum Opto-plasmonic Capacitor for Low-power High-speed Information Processing**

Pouya Dianat and Bahram Nabet
Department of Electrical and Computer Engineering, Drexel University (Philadelphia USA)
ONS17_paper_37

Low-power logic operations with ~9aJ/bit energy integrated with fast photodetection based on "plasmorons" are realized in a quantum capacitor with embedded plasmons. Such operation is unbounded by transport limitations and

10:10-10:40 **Free-electron quantum state tomography for the characterization of attosecond electron pulse trains**

K.E. Priebe,[1] C. Rathje,[1] S.V. Yalunin,[1] T. Hohage,[2] A. Feist,[1] S. Schäfer,[1] C. Ropers[1]
[1]University of Göttingen, 4th Physical Insitute – Solids and Nanostructures (Göttingen, Germany)
[2]University, of Göttingen, Institute for Numerical and Applied Mathematics (Göttingen, Germany)
Invited speaker
ONS17_paper_39

Coherent electron-light scattering in tailored optical near-fields allows for the manipulation and reconstruction of free-electron Wigner functions. We developed a quantum state reconstruction scheme for free electrons – "SQUIRRELS" – which we apply to experimentally demonstrate attosecond electron pulse trains in an ultrafast transmission electron microscope.

10:40-11:00 **Method of single expression – an alternative approach for boundary problems solution in intensity-dependent nano-optics and quantum mechanics**

H.V. Baghdasaryan,[1] T.M. Knyazyan,[1] T.T. Hovhannisyan,[1] M. Marciniak[2]
[1]National Polytechnic University of Armenia (Yerevan, Armenia)
[2]National Institute of Telecommunications (Warsaw,Poland)
ONS17_paper_40

For boundary problems' solution in optics and quantum mechanics the same mathematical methods are in use. With the increase of light intensity in nano-optics and energy of micro-particles in quantum mechanics nonlinear phenomena are appeared. Existing computational methods are valid only for modest nonlinearity. Non-traditional method of single expression (MSE) is an alternative approach permitting to obtain a steady-state solution of boundary problems at any value of intensity-dependent nonlinearity. An application of the MSE in nano-optics and quantum mechanics is considered.

11:00-11:20 **Ultrafast pulse generation using transient Bragg gratings via spectral inheritance in optical waveguides**

Yonatan Sivan, Shai Rozenberg, Aviran Halstuch, Amiel A. Ishaaya
Faculty of Engineering Sciences, Ben-Gurion University of the Negev (Be'er Sheva, Israel)
ONS17_paper_41

We introduce and demonstrate theoretically a flexible yet simple, compact and CMOS compatible scheme to generate ultrashort pulses at arbitrary wavelength and duration via spectral inheritance, whereby a spectrally-narrow pulse "inherits" the wide spectrum of a pump pulse centered at a different wavelength. Moreover, our scheme provides a new route for spatio-temporal pulse shaping and further practical advantages such as pulse-to-pulse control. The suggested scheme enables such spectral "inheritance" by introducing a transient Bragg grating (TBG) in a waveguide/fiber. The TBG can be induced via Cross-phase modulation in Kerr media, or more efficiently using free-carrier or even thermal nonlinearities. Various parameters such as: spatial profile, temporal profile, intensity and wavelength, of the induced TBG affect the duration and intensity of the reflected pulse generated.

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