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Advanced Nanotechnology

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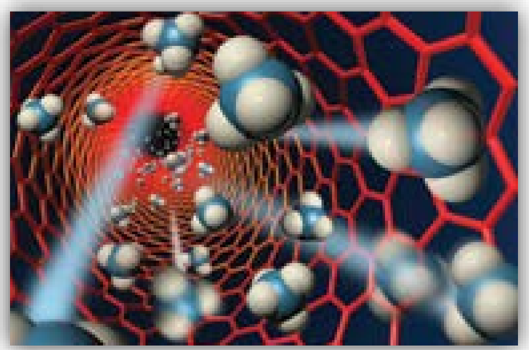

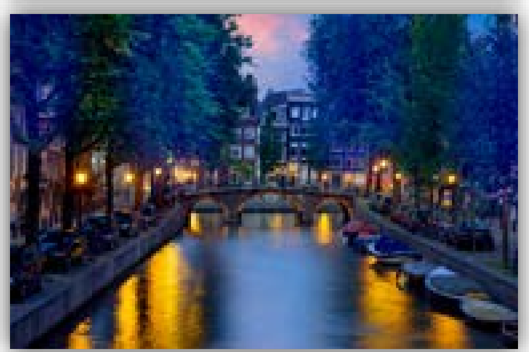

Keynote Forum

Day 1

Advanced Nano 2017

Claire Deeb, Nano Res Appl 2017, 3:3
DOI: 10.21767/2471-9838-C1-001

Claire Deeb
Université Paris-Saclay, France

Light emission based on electrically-fed nanogap optical antennas

Gaps formed between metal surfaces control the coupling of localized plasmons, thus allowing gap-tuning targeted to exploit the enhanced optical fields for different applications. Classical electrodynamics fails to describe this coupling across sub-nm gaps, where quantum effects become important owing to non-local screening and spill-out of electrons. The advantages of narrow gap antennas have mostly been demonstrated for processes like SERS that are excited optically, but promising new phenomena appear when such antennas are fed by electric generators. However, the extreme difficulty of engineering and probing an electrically driven optical nanogap antenna has limited experimental investigations of physical concepts at stake in these conditions. The feasibility of structuring electron-fed antennas as nano-light sources has been recently demonstrated; however, this configuration remains very limited, too much power was lost as heat when operating the optical antenna, and the antenna operation time was limited by the structure lifetime to sustain a bias voltage for a few hours. The innovative structure that we suggest here will cope with all these limitations: ALD dielectric materials substitute the air gap to improve the antenna stability; a quantum efficiency of 10-1 is targeted owing to a significantly efficient antenna (2 orders of magnitude higher field enhancement). The resulting source will operate at room temperature and have a tunable spectral response (ranging from visible frequencies to THz regime) defined by the antenna geometry and the applied bias. Also, this source will be compact, Si-compatible, and will not request specific emitting materials (e.g. III-V semi-conductors) to operate.

Biography

Claire Deeb has completed her PhD from University of Technology of Troyes, France and Post-doctoral research from Argonne National Laboratory, USA and Northwestern University, USA. She is currently a Research Scientist at C2N - CNRS where she conducts research in the field of optics, active plasmonics, and nano-photonics. She is collaborating with leading groups at UIUC (IL, USA) and LMU-Munich and has led many international projects. She has given 11 invited talks and has published over 13 papers and one book chapter. Additionally, she has received two PhD awards and has been serving as an Editorial Board Member of PNN.

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Menglin Chen, Nano Res Appl 2017, 3:3
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Menglin Chen

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Nanofiber Technology for 3D Nano-Biointerface Fabrication and Cellular Engineering

The significance of the overall fibrillar and porous nanoscale topography of the extracellular matrix (ECM) in promoting essential cellular processes has led to consideration of biomaterials with nanofibrous features. Of the many methods for fabricating fibers with micrometer and nanometer diameters, electrospinning is simplest, most straightforward and cost-effective. Fibers are produced by forcing a polymer melt or solution through a spinneret in the presence of a high electric field. This approach becomes intriguingly powerful when remarkable morphological features such as very large surface area to volume ratio and porosity are combined with unique chemical, physical, or mechanical functionalisation by adding desired components with ease and control. Our current research focuses on exploring new possibilities to fabricate three-dimensional Nano-biointerfaces that recapitulate the in vivo environment. The developed biocompatible, therapeutics-incorporated nanofibers synergise the nanostructural induction and the bioactives signalling to affect cellular behaviours, such as gene knockdown, cell adhesion and migration, proliferation and stem cell differentiation. The biomimetic nanofibers that are responsive to different stimuli, such as temperature, pH, light, and electric/magnetic field were also developed for on-demand therapeutic delivery and intervention.

Biography

Dr Chen has completed her PhD in 2008 from Aarhus University and is currently an Assistant Professor at Department of Engineering, Interdisciplinary Nanoscience Center (iNANO), Aarhus University in Denmark, and visiting assistant professor at Stanford University School of Medicine. She leads the research group of Nanofiber Technology and Cellular Engineering, and has published more than 50 peer-reviewed papers in reputed journals.

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Notes:

Jean-Luc Pelouard, Nano Res Appl 2017, 3:3
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Jean-Luc Pelouard
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Improved SWIR photo-detection in the context of sub-wavelength structuration

The extreme light confinement provided by sub-wavelength metal-dielectric structures pushes towards revisiting the design rules of the photo-detectors. Furthermore, introducing absorbing layers in optical nano-resonators demands a dedicated electromagnetic design. Developing together semiconducting heterostructures and optical nano-antennas opens the way for performance improvements and new functionalities, introducing very promising features such as ultra-thin absorbing layers and device area much smaller than its optical cross-section. High responsivity, high-speed behavior, and carved optical response are among the expected properties of this new generation of photo-detectors. In this talk, I present a GMR InGaAs photo-detector dedicated for FPA applications as an illustration of this global design. I discuss the cross-linked properties of the optical and semiconductor structures. Experimental results show at λ=1.55 μm an EQE of 75% and a specific detectivity of 1013 cm√Hz.W-1.

Biography

Jean-Luc Pelouard is a French Physicist and Researcher. His achievements include research of feasibility of InP-based heterojunction bipolar transistors and; development of first InAPGaAs/InGaAs heterojunction bipolar transistor.

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Mato Knez, Nano Res Appl 2017, 3:3
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Mato Knez
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Hybrid materials by ALD-derived methods: opportunities for novel material design

Atomic layer deposition (ALD) has become the method-of-choice for solving many technical issues that occurred on the way towards designing current and future electronics. Serious effort has been invested in order to optimize the materials, processes and processing instrumentation, which eventually resulted in the success story of this processing technique. The ALD process allows controlled deposition of thin films on a variety of substrates and in this way enables a modification of a given functionality of a surface or even introduction of a new functionality. It may be seen as a chemical reactor that allows precise dosing of a chemical, allowing for chemical interaction and modification of the substrate. Considering both points of view, the process opens large variation possibilities for a design of novel functional materials for emerging applications and devices. Among those functional materials hybrid materials play an increasingly important role. By bridging the worlds of polymers and ceramics the most desirable properties can be united within a singular material. Furthermore, in a well performing hybrid material the individual components will add value to their counterpart in a synergistic way. In this talk, some approaches will be discussed that show great promise for establishing ALD as the method-of-choice for innovation in technological fields beyond the microelectronics industry. In an adapted processing mode, the ALD processing technology allows infusing metals into polymeric substrates, which leads to novel material blends that cannot easily be obtained in other ways. The chemical or physical properties of the initial substrate are improved or new functionalities added. With some showcases, this talk will discuss approaches towards non-traditional application of ALD to fabricate novel materials with great promise in various applications.

Biography

Mato Knez studied Chemistry and completed his Doctoral degree in Physical Chemistry at Max-Planck Institute of solid-state research in Stuttgart (Germany). In 2003, he moved for Post-doctorate studies to Max-Planck Institute of Microstructure Physics in Halle (Germany), where in 2006 he received the Nanofuture award of the German Ministry of Education and Research (BMBF) with a grant to establish a junior research group. Since 2012, he is Ikerbasque Research Professor in San Sebastian (Spain) and Group Leader of Nanomaterials at research institute CIC nanoGUNE. In 2012, he received the prestigious Gaede prize of the German Vacuum Society.

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Vasily Temnov, Nano Res Appl 2017, 3:3
DOI: 10.21767/2471-9838-C1-001

Vasily Temnov
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Acousto-magneto-plasmonics for future applications in nano photonics

Acousto-magneto-plasmonics deals with experimental and theoretical investigations of interactions between the acoustic, magnetic and plasmonic transients in hybrid metal ferromagnet multilayer structures excited by ultra-short laser pulses. The main focus is on understanding the novel aspects of acoustic dynamics in materials as well as the peculiarities in the nonlinear optical and magneto-optical response in nano-scaled structures. For example, the nonlinear optical detection is illustrated in details by probing the static magneto-optical second harmonic generation in gold-cobalt-silver tri-layer structures in Kretschmann geometry. Furthermore, we show experimentally how the nonlinear reshaping of giant ultra-short acoustic pulses propagating in gold can be quantified by time-resolved plasmonic interferometry and how these ultra-short optical pulses dynamically modulate the optical nonlinearities. An effective medium approximation for the optical properties of hybrid multilayers enables the understanding of novel optical detection techniques. Exploring acousto-magneto-plasmonic functionalities at the nano-scale provide the experimental platform for designing the next-generation ultrafast nano photonic devices. As the next step, functionalizing hybrid metal-ferromagnet multilayer structures with solid-state nano-scale light emitters will allow for detailed quantum-optical studies of magneto-plasmonic interactions at the nano-scale using nonlinear optical and quantum-optical techniques. From an even more fundamental perspective, combining graphene-based plasmonic nanostructures with optical metamaterials may shade light on the mysteries of topological plasmonics.

Biography

Vasily Temnov has obtained his PhD from University Duisburg-Essen in 2004. After Post-doctoral studies at Dortmund Technical University and Massachusetts Institute of Technology, he became a CNRS Researcher at Institute des Molécules et Matériaux du Mans in Le Mans in 2011, where he also obtained a Habilitation degree in 2012. Being the recipient of numerous academic awards by the CNRS, DAAD and the Humboldt Foundation, he served as a Coordinator of an international network on the nonlinear nano photonics “NNN-Telecom” as well as several French-German ANR-DFG and French-Russian CNRS-RFBR collaborative research projects.

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Liqiu Rick Wang, Nano Res Appl 2017, 3:3
DOI: 10.21767/2471-9838-C1-001

Liqiu Rick Wang
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Small is big: magic microfluidic droplets

Droplets of nanoliter and subnanoliter are useful in a wide range of applications, particularly when their size is uniform and controllable. Examples include biochemistry, biomedical engineering, food industry, pharmaceuticals, and material sciences. One example of their many fundamental medical applications is the therapeutic delivery system for delivering site-specific therapy to targeted organs in the body and as the carriers for newer therapeutic options. The size, the size distribution, the generation rate and the effective manipulation of droplets at a scale of nano, pico, femto and even atto liters are critical in all these applications. We make an overview of microfluidic droplet generation of either passive or active means and report a glass capillary microfluidic system for synthesizing precisely controlled monodisperse multiple emulsions and their applications in engineering materials, nanofluids, microfibers, embolic particles and colloidosome systems. Our review of passive approaches focuses on the characteristics and mechanisms of breakup modes of droplet generation occurring in microfluidic cross-flow, co-flow, flow-focusing, and step emulsification configurations. The review of active approaches covers the state-of-the-art techniques employing either external forces from electrical, magnetic and centrifugal fields or methods of modifying intrinsic properties of flows or fluids such as velocity, viscosity, interfacial tension, channel wettability, and fluid density, with a focus on their implementations and actuation mechanisms. Also included is the contrast among different approaches of either passive or active nature.

Biography

Liqiu Rick Wang received his PhD from University of Alberta, Canada and is currently a Full Professor in the Department of Mechanical Engineering, University of Hong Kong. He is also the Qianren Scholar (Zhejiang) and serves as Director and Chief Scientist for the Laboratory for Nanofluids and Thermal Engineering, Zhejiang Institute of Research and Innovation (HKU-ZIRI), University of Hong Kong. He was Visiting Professor at Harvard University (2008) and Duke University (2003). He has given over 45 invited plenary/keynote lectures at international conferences, and serves/served as the Editor-in-chief for the *Advances in Transport Phenomena*, the Editor for the *Scientific Reports*, the Associate Editor for the *Current Nanoscience* and the Guest Editor for the *Journal of Heat Transfer*.

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Yoon-Bong Hahn, Nano Res Appl 2017, 3:3
DOI: 10.21767/2471-9838-C1-001

Yoon-Bong Hahn
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Selective detection of glucose, cholesterol and urea with metal-oxide nanostructures based field-effect transistors array biosensors

Nanotechnology revolution has led to the nanofabrication of sensor devices for rapid and specific identification of chemical/biological species. However, the development of multiplexed nanoscale biosensor for simultaneous detection of different analytes still remains a major challenge at the nanotechnology frontier. It is well recognized that diabetes mellitus is a metabolic disorder resulting in an abnormal blood glucose level and activation of several metabolic pathways related to inflammation and apoptosis events. Heart disease and stroke due to excess cholesterol in blood is the leading cause of death and disability, and kidney failure due to excess urea is caused by urea cycle disorders. We have developed metal-oxide nanostructures based, integrated field-effect transistors (FETs) array biosensor with simultaneously immobilizing GOx, ChOx and Ur enzymes on three separated FET arrays. In this lecture, we report a novel straight forward approach for simultaneous and highly selective detection of multi-alanytes (i.e., glucose, cholesterol and urea) with the FETs array biosensor without interference in each sensor response. Compared to analytically measured data, performance of the FETs array biosensor is found to be highly reliable for rapid detection of multi-analytes in mice blood, serum and blood samples of diabetic dogs. The development of an integrated, low-cost FETs array biosensor will produce quick detection under critical patient conditions, early identification of disease/disorder, and also have an enormous impact on the future generations.

Biography

Yoon-Bong Hahn is Fellow of Korea Academy of Science and Technology, Director of BK21 Center for future energy materials and devices, Director of National Leading Research Lab for hybrid green energy, and Head of School of Semiconductor and Chemical Engineering, Chonbuk National University (CBNU). He joined CBNU in 1991, prior to which he worked for LG Metals Research Center from 1988 to 1991 after he received his PhD in Metallurgical Engineering from University of Utah in 1988. His main research interest is the synthesis of metal and metal oxide nanostructures and their applications for optoelectronic devices and chemical and biological sensors, resulting in over 270 peer-reviewed SCI papers and 14 patents. He co-authored six books including *Metal Oxide Nanostructures and Their Applications* (five volume sets) published in March 2010 by American Scientific Publishers. He also has 11 registered and nine applied patents.

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Notes:

Yongmei Zheng, Nano Res Appl 2017, 3:3
DOI: 10.21767/2471-9838-C1-001

Yongmei Zheng
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Bioinspired gradient micro- and nanostructured surfaces with controlling of dynamic wettability

Biological surfaces create the enigmatical reality to be contributed to learning of human beings. They cooperate between endlessly arranged various-style gradient micro- and nanostructures (MN) that greatly provide with excellent functions via natural evolvement. Such biological surfaces with multi-gradient micro- and nanostructures display unique wetting functions in nature for water collection and water repellency, which have inspired researchers to design originality of materials for promising future. In nature, a combination of multiple gradients in a periodic spindle-knot structure take on surface of spider silk after wet-rebuilding process in mist. This structure drives tiny water droplets directionally toward the spindle-knots for highly efficient water collection. Inspired by the roles of gradient MNs in the water collecting ability of spider silk, a series of functional fibers with unique wettability has been designed by various improved techniques such as dip-coating, fluid-coating, tilt-angle coating, electro-spun and self-assembly, to combine the Rayleigh instability theory. The geometrically-engineered thin fibers display a strong water capturing ability than previously thought. The bead-on-string hetero structured fibers are capable of intelligently responding to environmental changes in humidity. Also a long-range gradient-step spindle-knotted fiber can be driven droplet directionally in a long range. An electro spun fiber at micro-level can be fabricated by the self-assembly wet-rebuilt process, thus the fiber displays strong hanging-droplet ability. The temperature or photo or roughness-responsive fibers can achieve a controlling on droplet driving in directions, which contribute to water collection in efficiency. Besides, inspired by gradient effects on butterfly wing and lotus leaves, the surfaces with ratchet MN, flexible lotus-like MN are fabricated successfully by improved methods, which demonstrate that the gradient MN effect rises up distinctly anti-icing, ice-phobic and de-ice abilities. These multifunctional materials can be designed and fabricated for promising applications such as water-collecting, anti-icing, anti-frosting, or anti-fogging properties for practical applications in aerospace, industry and so on.

Biography

Yongmei Zheng is a Professor at School of Chemistry, Beihang University. Her research interests include "Bioinspired surfaces with gradient micro- and nanostructures to control dynamic wettability, and develop the surfaces with characteristics of water repellency, anti-icing, and anti-frosting, or fog-harvesting, tiny droplet transport, water collection, fog-harvesting and so on". Her research work was highlighted as Scientist on News of Royal Society of Chemistry, Chemistry World in 2014. She is a senior member of Chinese Composite Materials Society (CSCM), member of Chinese Chemistry Society (CCS) and American Chemistry Society (ACS).

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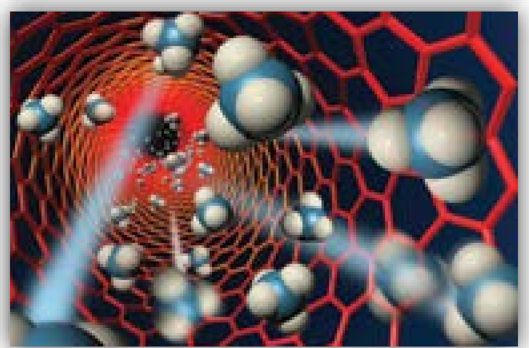
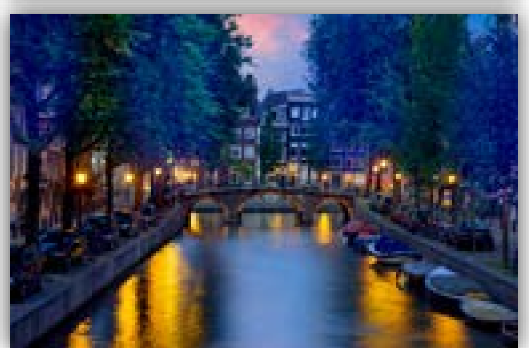
Keynote Forum
Day 2





Daniel Bonn, Nano Res Appl 2017, 3:3
DOI: 10.21767/2471-9838-C1-001

Daniel Bonn
University of Amsterdam, Netherlands

Wetting of water on graphene

In contemporary literature, the wetting properties of graphene have proven to be controversial and difficult to assess; especially, whether the presence of a thin molecular layer such as graphene influences the adhesion of a solid phase. In this work, we directly measure the water adsorption in graphene nano-powder flakes of different thicknesses in a novel experimental approach, which shows that the thinnest of graphene flakes do not adsorb water. Thicker flakes of graphene nano-powder, on the other hand, do adsorb water. Calculation of the van der Waals interactions in this system confirms that the adhesive interactions between graphene and water are very weak, which makes graphene super hydrophobic. Subsequent 'liquid marble' tests with graphene nano-powder flakes establish this super hydrophobicity. Our work affirms the much debated 'wetting transparency' property of graphene, implying that a single graphene layer on top of a substrate does not affect the adhesion between a wetting phase and the substrate.

Biography

Daniel Bonn completed his PhD in University of Amsterdam, Dept. of Chemistry in 1993 and MSc at University of Amsterdam, Dept. of Chemistry, and MSc in Physical Chemistry in 1990. Since 2003, he has worked as a Professor of Physics (part-time) at the van der Waals-Zeeman Institute, University of Amsterdam. His current research interests include "Complex fluids, rheology, glasses, surface phase transitions, instabilities, and turbulence". He has over 90 publications in refereed journals.

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Uri Nir, Nano Res Appl 2017, 3:3
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Uri Nir
Bar-Ilan University, Israel

Targeting the reprogrammed energy generation system of cancer cells

The aspiration to achieve efficacious cancer targeted therapy involves intense global R&D efforts. Blockage of fundamental processes like the unique reprogramed energy generation system of malignant cells, combined with a nano-technology approach, should offer new tools for efficient interference with cancer progression. While deciphering the energy generation systems of cancer cells, we found that two related enzymes (kinases), termed Fer and FerT, which normally reside in the cell energy power-station-mitochondria of sperm cells, are harnessed to the reprogrammed mitochondria of cancer cells. Both enzymes potentiate the generation of energy by mitochondria in cancer cells subjected to stress conditions like nutrient and oxygen deprivation. This enabled the survival of cancer cells under harsh conditions which are prevalent in solid tumors. To translate these findings into a novel anti-cancer therapy we have combined, synthetic-chemistry, robotic, and high throughput screening approaches, for the development of a synthetic low molecular weight compounds which binds and inhibit the kinase activity of both Fer and FerT. Such a compound termed E260 was then formulated and incorporated into nano-micelles to selectively target Fer and FerT in the mitochondria of malignant cells. Notably, the formulated E260 compound selectively perturbs mitochondrial functioning in malignant cells thereby imposing energy crisis and consequent necrotic death in cancer but not in normal cells. The anti-cancer potency of the E260 formulation is also manifested using human tumors derived-xenografts models in mice, thus portraying it as a new potential anti-cancer drug.

Biography

Uri Nir leads the cancer and inflammatory diseases research lab in the Faculty of Life- Sciences at Bar-Ilan University, Israel. He completed his PhD degree from Weizmann Institute of Sciences in Israel. He then went for a Post-doctoral training at Hormone-Research Institute, University of California San-Francisco, USA. Since 1988, he is a faculty member at Bar-Ilan University.

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Fang Xie, Nano Res Appl 2017, 3:3
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Fang Xie
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Nanoscale engineering of plasmonic materials for biosensing

Early diagnosis plays an increasingly significant role in current clinical drive. Detection, identification, and quantification of low abundance biomarker proteins form a promising basis for early clinical diagnosis and offer a range of important medical benefits. Amplification of light from NIR fluorophores by coupling to metal nanostructures, i.e. Metal Induced Fluorescence Enhancement (MIFE), represents a promising strategy for dramatically improving the detection and quantification of low abundance biomarker proteins, and potentially increase already sensitive fluorescence based detection by up to three orders of magnitude. The amplification of the fluorescence system is based on interaction of the excited fluorophores with the surface plasmon resonance in metallic nanostructures. The enhanced fluorescence intensity due to the existence of metal nanostructures makes it possible to detect much lower levels of biomarkers tagged with fluorescence molecules either in sensing format or for tissue imaging. The first part of my talk will focus on some recent developments of plasmonic metal nanostructures by both top-down and bottom up methods. I will then discuss the prepared plasmonic nanostructures in the applications of biosensing.

Biography

Fang Xie is a Senior Lecturer in Department of Materials, Imperial College London. She is also Deputy Director. She has expertise in functional nanomaterials including metal, semiconducting, and oxide nanomaterials synthesis, as well as the applications of the functional materials in energy and life sciences. Her current research interests include plasmonic nanostructures for efficient light harvesting for solar cells and solar fuels, as well as in ultrasensitive biosensing and bio-imaging applications. She has over 50 publications including five patents.

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J L Weyher, Nano Res Appl 2017, 3:3
DOI: 10.21767/2471-9838-C1-001

J L Weyher

Institute of High Pressure Physics - Polish Academy of Sciences, Poland

Technology of nano-structuring of GaN for surface enhanced Raman spectroscopy measurements

It is commonly accepted that the presence of so-called hot-spots is necessary for obtaining high enhancement factor (EF) of Raman signal from individual molecules attached to the plasmonic metal particles. It was experimentally confirmed that organic (biological, chemical) molecules located at hot-spots contribute most significantly to the overall surface enhanced Raman spectroscopy measurements (SERS) intensity. Two approaches are usually used in order to deliver SERS platforms, namely planar and nano-structured substrates, both with plasmonic metal particles on the top surface. It has been shown experimentally that 3D SERS substrates are more efficient for SERS measurements compared with planar substrates. The aim of this presentation is to demonstrate the technology of nano-structuring of hetero-epitaxial GaN substrates using different (photo)-etching methods as well as tailoring of plasmonic metal surfaces for increased SERS efficiency. Highly rough and stable GaN surface are formed by defect-selective photo-etching of GaN layers containing dislocations. The resultant nano-pillars contribute to the formation of hot-spots and high EF. It will be shown that orthodox etching yielding well developed pits also leads to the formation of hot-spots and EF up to 10E6 for the examined test molecules of para-mercaptobenzoic acid (pMBA). The efficiency of SERS platforms can also be tailored by chemical treatment (dealloying) of sputtered alloyed metal layer of Au-Ag and Au-Cu and by thermal treatment leading to recrystallization of metal clusters. The novel SERS platforms based on etched GaN show very good mechanical and chemical stability and high EF up to 10E7. This feature enabled time-lapse measurements of various biological systems such as Hepatitis B virus antigen and DNA and recently of different bacteria (BC, BT, and BS).

Biography

J L Weyher has completed his PhD at Military Academy of Technology in Warsaw, Poland and received Habilitation at University of Montpellier in France in 1995. He is an Associate Professor at Institute of High Pressure Physics in Warsaw. He has published more than 200 papers in reputed journals.

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