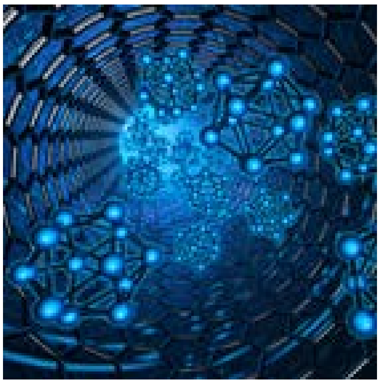
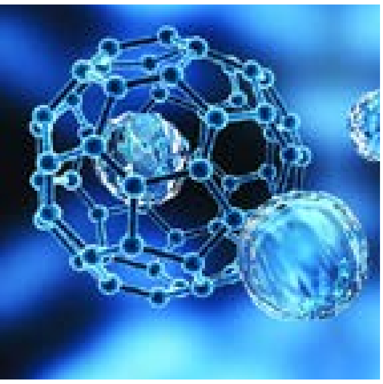
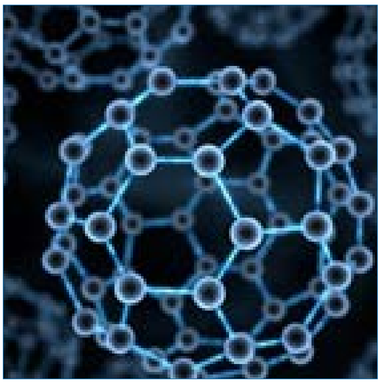
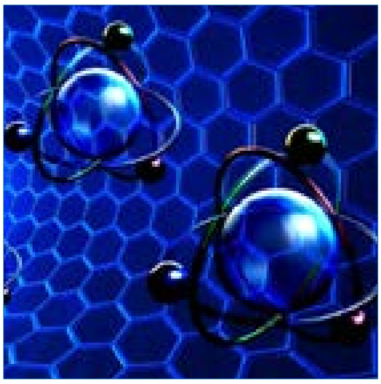
# Keynote Forum
# November 29, 2017

## *Nanochemistry 2017*



International Conference on

# Nanomaterials and Nanochemistry

November 29-30, 2017 | Atlanta, USA


# Charles S Feigerle

*University of Tennessee, USA*


## Nanocrystalline diamond as stripper foils in the spallation neutron source

Since it first became operational in 2007, the spallation neutron source has utilized nanocrystalline diamond foils to strip the electrons from a hydride ions ($H^-$), converting them into protons which collide with a mercury target to produce the neutrons used in the facility. The nanocrystalline diamond foils are grown on lithographically patterned silicon wafers and the lower 2/3$^{rd's}$ of the silicon is chemically removed to produce a single edge supported foil (typically 17 mm x 30 mm x 1µm) with a silicon handle for mounting. These foils have greater than 99% stripping efficiency, as required by SNS, and have exceeded expectations in durability, typically lasting over one month with exposure to a>1 MW beam at 1 GeV energy. Results on the development and use of nanocrystalline diamond stripper foils at SNS will be presented, as well as laboratory studies of the transformations that occur in crystalline structure, emissivity and carbon state of the foils from deposition of beam energy into the foil.

### Speaker Biography

Dr. Charles Feigerle received a B.S. in Chemistry from the University of Illinois at Chicago in 1977 and a Ph.D in Chemical Physics from the University of Colorado in 1983. Before joining the faculty of the University of Tennessee in 1985, he was a National Research Council Postdoctoral Fellow and staff scientist at the National Bureau of Standards (NBS). He has been the head of the Department of Chemistry at the University of Tennessee since 2011. His research interests lie within the broad umbrella of experimental physical chemistry, with emphasis on laser spectroscopy and surface analysis for discovery and characterization of advanced and emerging materials, including chemical vapor deposition of diamond and boron phosphide.

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# Yung Chun Lee

*National Cheng Kung University, Taiwan*


## Nano-contact printing lithography for preparing large-area nano-structures with industrial applications

Nano-fabrication plays a key role in the development of nano-science and nano-technologies and their applications. Photolithography is still now the dominant method for patterning nano-structures with a feature size down to few nm on a large wafer or substrate. However, there are some serious limitations and restrictions in this method which make it not so available to many researchers. Alternative nano-fabrication technologies have been developed in the past two decades. Among them, nano-imprinting and nano-contacting lithography have shown great potentials for fabricating various kinds of nano-structures over a large pattern area with a relatively simple and cost-effective approach. This presentation will address several innovative methods based on nano-imprinting and contact printing lithography. First of all, a soft photomask lithography method is developed which can improve the patterning resolution of conventional contact-type photolithography from µm to sub-µm or even nm scale. As an example, this method has been used for fabricating conical-shape surface structures on sapphire substrate of a light-emitting diode to enhance light extraction efficiency. Secondly, a metal contact printing lithography has been developed for patterning metallic nano-structures on both hard and soft substrates. Following by thermal annealing, one can achieve various kinds of metallic nano-particles which are highly uniform in particle size and deployed precisely and regularly on a substrate. Localized surface plasma resonance (LSPR) can be excited for many biomedical and optoelectronic applications. Finally, a curved surface lithography will be addresses which can directly pattern nano-structures not only on a planar substrate but also on a convex or concave surface of a substrate. Metallic, polymer, or dielectric nano-structures or a combination of them can be created by combining these lithography methods along with other standard material processing methods. The common features shared by all these proposed lithography methods are small line width, large patterning area, using simple equipment readily available in laboratories, and cost-effective.

### Speaker Biography

Dr. Yung Chun Lee received his B.S. degree in Mechanical Engineering (1985) and M.S. degree in Applied Mechanics (1989) both from National Taiwan University, Taipei, Taiwan, and Ph.D degree in Theoretical and Applied Mechanics (1994) from Northwestern University, IL, USA. He was a post-doc. researcher (1994-1996) in the Department of Engineering and Applied Physics, Cornell University, NY, USA, and a project engineer (1996-1997) in Hon-Hai Precision Industry Inc., Taipei, Taiwan. He joined the Department of Mechanical Engineering, National Cheng Kung University (NCKU), Tainan, Taiwan in 1997 and is now a Distinguished Professor there.

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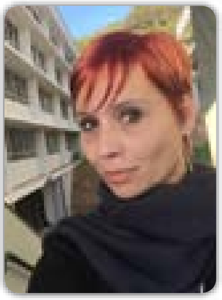


# Ljubica Tasic

*University of Campinas, Brazil*


## Tailor-made nanomaterials for human benefit

Tailor-made nanomaterials designed for human benefit are going to be presented and discussed, such as, antiseptic fabrics loaded with nanosilver particles; hesperidin or nano-hesperidin loaded nanoparticles or formulations for anti-cancer and anti-aging therapies; and inert magnetic nanoparticles for sucrose removal. Many efforts to develop powerful antimicrobial agents or formulations that could be used in clinical treatments against pathogenic and resistant microorganisms have been made still, resistant pathogens are frequently present in hospital areas, complicating the treatment and cure of infections caused by them. In this respect, nanosilver particles show very interesting antimicrobial properties and have been applied in a wide range of products such as those for preventing hospital infections. These particles can be produced by chemical or biological methods. Our research is partly focused on bio-based synthesis of silver nanoparticles, their thorough characterization and application, for example, in cotton fibers impregnation that might be used in medical environment and clothing as to avoid microbial spreading. Nature keeps surprising us with incredible and simple solutions to many health problems. For example, hesperidin is an abundant citrus fruit flavanone that has many interesting properties regarding biological activity. These include anticancer pro-drug effects against different cancer-cell lines and powerful antioxidant effects. Chemo protective roles in carcinogenesis and antioxidant activities of different formulations of hesperidin in some designed drug delivery systems are going to be presented. Finally, I shall finish this keynote lecture with tailored-made nanomagnets designed to benefit population that suffers from diabetes. As a chronical metabolic disease that leads to high glucose levels in the blood, diabetes has grave consequences to human health. Our research idea was to obtain a tailor-made nanomagnet, iron oxide-based, covered with an inert shell and enzyme-linked, as to capture and remove sucrose from a solution. These specially designed nanomagnets are stable, inert, easy to deal with, and reduce the time and cost of the process for obtaining low-sugar beverages.

### Speaker Biography

Ljubica Tasic has obtained her Bachelor's and Master's in Chemistry from the Faculty of Chemistry, Belgrade University (Belgrade, Serbia). After a four-year experience as an Assistant Professor in the Applied Chemistry Department (Faculty of Chemistry, Belgrade), she continued her graduated studies at the Chemistry Institute of the University of Campinas (Unicamp, Campinas, Brazil), where she has obtained Ph.D in May 02. Post-doctorate research, from August to May 04, she has carried out at the National Synchrotron Light Laboratory (Brazil). Since October 04, as Professor at the Organic Chemistry Department of the Chemistry Institute (Unicamp, Brazil), she lectures courses on General, Organic Chemistry and Biochemistry. Her research projects are related to Biological Chemistry, Biochemistry, Nanochemistry and Metabolomics. Currently she is an Associate Professor and Head of the Organic Chemistry Department (Unicamp, Brazil).

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# Kazuaki Sanada

*Toyama Prefectural University, Japan*


## Microstructural design and evaluation of thermally conductive polymer composites containing nano and micro fillers

Thermally conductive polymer composites offer new possibilities for the thermal management in electronic devices. An approach of current interest to improve the thermal conductivity of polymer composites is the addition of hybrid nano and micro fillers with high thermal conductivity. The objective of this paper is to study the effective thermal conductivity of the composites with nano and micro fillers. The nano fillers used were carbon nanotubes and alumina nanowires, and the alumina and boron nitride particles with different shape and size were selected as the micro fillers. The random close-packed structures of micro fillers were obtained using packing simulations, and finite element analyses were performed to predict the composite thermal conductivity. In addition, experimental measurements of the thermal conductivity of the manufactured polymer composites were carried out by using a steady-state method. The microstructure of the composites was also examined using a scanning electron microscope. The results showed that the addition of nano fillers to the matrix significantly increased the thermal conductivity of the composites with close-packed structure of micro fillers.

### Speaker Biography

Dr. Kazuaki Sanada received his Doctor of Engineering from Tohoku University in 1999. From 1999 until 2003 he worked as a researcher at Hitachi, Ltd. He is currently a professor in the Department of Mechanical Systems Engineering at Toyama Prefectural University, which he joined in 2003. Dr. Sanada is primarily interested in the fabrication and evaluation of carbon nanotube/polymer composites, the microstructural design and characterization of thermally conductive polymer composites, and the development of self-healing composites.

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## Soma Dhakal

*Virginia Commonwealth University, USA*

# From material to biotechnology applications of structural DNA nanotechnology

In recent years, DNA has been used as an ideal substrate for the engineering of versatile nanostructures and nanomachines due to its well characterized conformation and predictable self-assembly. Using non-overlapping sticky-end cohesion, DNA nanostructures can be modified in a number of ways for the site-directed spatial arrangement of functional guest components such as proteins, metal nanoparticles, and small molecules with high accuracy. This talk will review the state of DNA nanotechnology including DNA-based sensors, DNA-actuated enzyme nanoreactors, fluorescence-force measurements of motor proteins on DNA origami platforms, and other emerging biotechnological applications of one-, two- and three-dimensional DNA nanostructures.

## Speaker Biography

Soma Dhakal has completed his Ph.D from Kent State University, USA in 2013. After three years of postdoctoral research at the University of Michigan, he joined Virginia Common Wealth University (VCU), USA as an Assistant Professor in the Department of Chemistry where he started his state-of-the art DNA nanotechnology lab. His research is highly interdisciplinary which spans from DNA nanotechnology to single-molecule DNA/protein biophysics and aptamer-based single-molecule sensing. The main research theme of his group is to exploit the programmability of DNA nanostructures for both material as well as biological applications. He is co-author of a book chapter and several publications in high-impact scientific journals. His work has been featured in news outlets such as Nature News and Views, C&EN News, and Phys.Org. He has served as a peer reviewer for several reputed journals and funding agencies.

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# Arup Kumar Raychaudhuri

*S N Bose National Centre for Basic Sciences, India*


## Novel green synthesis of gold and silver nanocolloids, and structured nanofluid and enhanced thermal transport in them

We report synthesis of Au and Ag nanocolliods and structured Au nanofluids that have been synthesized by simple, green and one step methods. Both the methods# one using a natural fibre like Jute, and other using an excimer laser give rise to stable colloids with nanoparticles diameters less than few tens of nanometers. In both the methods no reducing agent and stabilizing agentor any hazardous chemicals need be added or used and water is the dispersing medium. The stability of the nanocolloids and structured nanofluids has been tested for over a year using absorbance by the metal plasmonic bands in the dispersing medium as a monitoring tool. In case of the Jute based synthesis of Ag nanocolliods, the surface of the natural fibre jute that has nanosized pores, acts as a reaction “vessel” on which the Ag nanoparticles are produced *in-situ.* It utilizes α–cellulose present in the jute fibre as a reducing agent of Ag salt and no extra chemicals need be added. The resulting Ag nanoparticles have size dispersion within the range 12-15nm. In case of laser based synthesis of Au nanofluids, laser ablation of a gold coin by an excimer laser (248 nm) created Au nanoparticles dispersed directly into the liquid medium. No reducing agent/chemical is needed for making the nanoparticles of average diameter ≈ 8-10 nm. Interestingly, the resulting nanofluid can be made structured (like a connected network of Au nanoparticles that make a Au necklace) using ethylene glycol as the dispersing medium instead of water. The method can also be used for making Ag nanocolliods where an Ag target is used in place of Au target. For application, we tested both the Ag and Au nanocolloids as heat transport medium where they were used as nanofluids. Both the nanofluids show enhanced thermal conduction over that of the dispersing medium. This was tested using a dynamic technique where the frequency dependence of the thermal effusively can be tested and the enhancement of the thermal conduction can be evaluated.

### Speaker Biography

Prof. Raychaudhuri obtained his M.Sc from IIT, Kanpur (1975) and Ph.D from Cornell University (1980). He had post-doctoral experience at the Max Planck Institute (FKF), Stuttgart as an Alexander von Humboldt Fellow (1980-1982). He served as the Director and Distinguished Professor of S.N.Bose National Centre for Basic Sciences from March 2006 to September 2014. Prior to joining the Centre in 2004 as a Senior Professor , he worked as a Professor of Physics in Indian Institute Science (IISc), Bangalore from 1982 and as Director, National Physical Laboratory (NPL), New Delhi from 1997-2000.

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# Hirofumi Sakuma

*The Center for Better Living, Japan*

## Novel challenge to understand off-shell dressed photons: An initiative taken at newly established institute RODREP

As the outcomes of our intensive research efforts, multitudes of remarkable accomplishments have been made in the field of nanophotonics. We can say, however, that almost all of such researches have a feature of application in the sense that we no longer inquire a fundamental question of what is light during the course of such researches, but we just use or apply to our problem conventional knowledge on electromagnetism (either classical or quantum mechanical) which seems to be firmly established in such a degree that there is no room to improve it. But, is it actually true that the conventional electromagnetic (EM) theory is versatile in doing application researches? The main issue we address here is on the above question from the viewpoint of our ongoing cutting-edge research of off-shell dressed photon (DP) to be explained in my talk. My answer to this basic question is negative, because we now know that experimentally-verified DP serves as a concrete example of an EM phenomenon which defies the interpretation based on the conventional theory. I think that the significance of issue on DP is two-fold: the one is on application studies in which several innovative accomplishments, including the latest high-power silicon laser, have become available now, which is expected to open up an important new realm of nanophotonics, and the other is on its conceptual impact upon the applicability range of off-shell phenomena. So far, we think that off-shell phenomena free from Einstein causality become important only in a sub-atomic quantum world. But a closer inspection derived from a general result of mathematical formulation of quantum field shows that off-shell phenomena are ubiquitous for quantum field interactions at large and they are not restricted to sub-atomic scales.

### Speaker Biography

Mr. Hirofumi Sakuma is currently working at the Center for Better Living (CBL), Japan. His research interests are Nanophotonics, conventional theory, quantum world etc.

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International Conference on

# Nanomaterials and Nanochemistry

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## Erick R Bandala

*Desert Research Institute, USA*

### Nanotechnology applications for water decontamination and disinfection: Current achievements and further research avenues

Zero-Valent Iron (Fe0) has been shown to detoxify water by creating hydroxyl radicals through Fenton-like reactions combined with hydrogen peroxide ($H_2O_2$) to get rid of organic contaminants. Nano-sized zero-valent iron (n/ZVI) in combination with oxidants and UV radiation, has been reported can increase the Fenton reaction rate and make water detoxification more effective. In this work, the production of reactive oxygen species, particularly hydroxyl radicals, was assessed for the heterogeneous photo-assisted Fenton-like reaction using nZVI embedded in a mesoporous silica matrix, hydrogen peroxide, and UV-A radiation. The experiments consisted of preparing a 10 µM solution of N, N-dimethyl-p-nitroaniline (pNDA, used as HO• radical probe) in 100 mL of water and adding the silica-embedded nZVI at three different loads (please include loads of Zvi in the SBA-15) with or without $H_2O_2$, and/or UV-A radiation (λmax=365 nm). The absorbance of the pNDA was measured and compared to that of clear, deionized water. The trials consisted of using immobilized nZVI alone, immobilized nZVI/$H_20_2$, and immobilized nZVI/$H_20_2$/UV. From the experimental results, we have seen that the best conditions for hydroxyl radicals production measured as pNDA bleaching are by the combination of immobilized nZVI/$H_2O_2$/UV despite nZVI, UV-A radiation and hydrogen peroxide alone were capable of bleaching pNDA to a certain extent. The use of the $H_2O_2$/UV system reached a plateau in hydroxyl radical production after 20 min of reaction. Two kinetic models are proposed to fit experimental data for the different reaction conditions tested and the obtained results were capable of fitting experimental data fairly good meaning that the proposed reaction mechanisms may occur within the reaction mixture to some extent. This novel material found was with interesting capabilities to produce reactive oxygen species, particularly hydroxyl radicals, under photo assisted conditions and high potential for further photocatalytic applications in water treatment.

### Speaker Biography

Erick R. Bandala is currently working as, Assistant Research Professor for Advanced Water Technologies at the Desert Research Institute in Las Vegas, NV. Dr. Bandala holds Ph.D degree in Engineering, a Master degree in Organic Chemistry and a B.S. degree in Chemical Engineering. He has been faculty member of the department of Civil and Environmental Engineering (2007-2013) and the Department of Chemical, Food and Environmental Engineering (2013-2015) at Universidad de Las Americas Puebla, Mexico and titular researcher (1993-2007) at the Mexican Institute of Water Technology (belonging to the Ministry of Environment Mexico) in Morelos, Mexico. He has research interests in several different topics related with Environmental Engineering including A) Mechanistic aspects of the use and application of solar driven advanced oxidation processes (AOPs) for environmental restoration B) Development of advanced water and soil treatment for site restoration C) Synthesis, characterization and application of nanomaterials for Indoor Farming systems D) Development of Climate Change adaptation methodologies for water security. As result of his research activities, Dr. Bandala is author or co-author of over 100 international publication including 80 peer-reviewed papers in international journals with high impact index (average impact factor 2.9, >1790 citations, h-index 23); 5 books, 25 book chapters and 65 works published in proceedings of international conferences.

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# Patrick Lemoine

*University of Ulster, UK*


## Protein adsorption on nano-patterned hydrogenated amorphous carbon model surfaces

Predicting how proteins fold and adsorb onto surfaces is a complex problem of strong relevance to the health and environmental sectors. In this work, two nano-patterning techniques, namely focused ion beam (FIB) milling and atomic force microscopy (AFM) nanoindentation were used to develop hydrogenated amorphous carbon (a-C:H) model surfaces with similar nano-topography but different local composition. On the un-patterned surfaces, bovine plasma fibrinogen (BPF) resulted in a thicker and rougher adsorbed film than bovine serum albumin (BSA), although FTIR analysis indicated that, the secondary structure of the proteins changed similarly, with an increase of the β-sheet component (+27% and +34% for BSA and BPF, respectively). AFM analysis on the FIB-patterned surfaces indicates that patterning can modify specific protein adsorption behaviors. Moreover, the patterns were compared by imaging the AFM tip/surface adhesive force for BSA adsorbed on either AFM tips or patterned surfaces. The results show an electrostatic interaction between the implanted Ga+ and BSA surface, modifying the adsorption behavior and the adhesive force. Modeling this interaction gave an estimate of the surface charge per protein, a significantly lower value than in dilute solution (-1.8e instead of -18e). This finding is indicative of protein misfolding, as detected in the FTIR analysis.

### Speaker Biography

Dr. Patrick Lemoine works at the Nano-Integrated Bioengineering center (NIBEC) of the Ulster University (UK). He graduated in 1989 from ENSPG-Grenoble (France), completed his Ph.D in 1992 in Trinity College Dublin (Ireland) and also worked at Turin's Polytechnic Institute (Italy). His research is on ultrathin film analysis, particularly using AFM techniques. He has attracted funding from the Royal Society and the Leverhulme Trust, takes part in both industrial and academic research projects and has been key note speaker and invited speaker at international conferences. He is a contributor to specialist books on carbon materials (CRC Press and Springer Verlag) and has over 61 publications in peer-reviewed journals (h-index=17). He was a Committee member of the IOP in Ireland (2002-2004) and is a member of the UU Research Ethics Committee.

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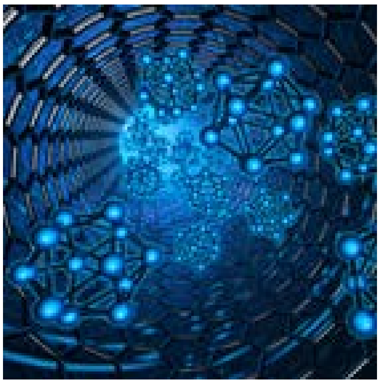
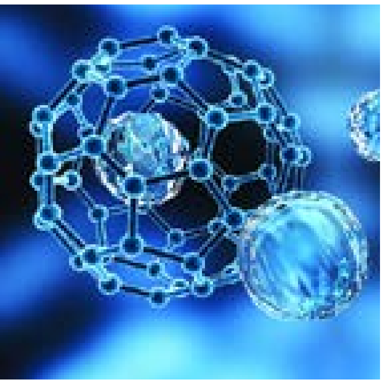
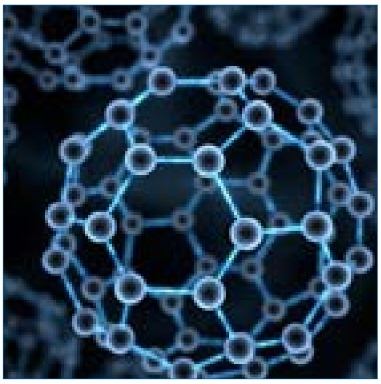
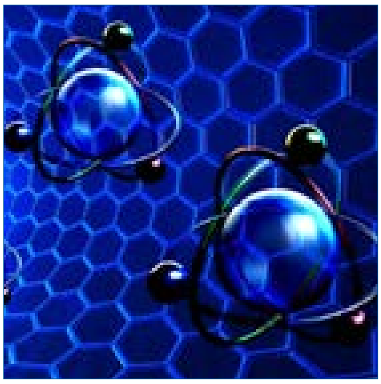
# Keynote Forum
# November 30, 2017

## *Nanochemistry 2017*



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# Nanomaterials and Nanochemistry

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Tetsuya Suzuki

*Keio University, Japan*

## Hard carbon and SiO: CH films synthesized under atmospheric pressure

In this study, we synthesized a-C: H films by filamentary dielectric barrier discharge (FDBD) to improve their characteristics compared to the films synthesized by atmospheric pressure plasma-enhanced chemical vapor deposition. The discharge type was transited from glow DBD (GDBD) to FDBD by increasing the gap between the electrodes from 1 mm to 4 mm. The hydrogen concentration of the a-C:H films synthesized by FDBD was reduced compared to that of the films synthesized by GDBD. The hardness of the films is increased from 3.7 GPa to 11.9 GPa by using FDBD. These results show that the hard a-C:H films can be synthesized at low temperature in a large area by FDBD.

### Speaker Biography

In 1985, Dr. Tetsuya Suzuki is graduated from Inorganic Materials department of Tokyo Institute of Technology and in 1990; he did his Ph.D from Nuclear Engineering Department of same Institute. Currently he is working as a director at Keio Leading-Edge Laboratory, Japan.

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*Kyung Yoon Chung*

*Korea Institute of Science and Technology, Korea*

## High-capacity long-cycle life reduced graphene oxide and it's composite with iron fluoride as cathode materials for Na-ion batteries

High-performance rechargeable batteries are urgently required to meet the rapidly increasing demand for energy storage with cost and availability merits. Recently, sodium-ion batteries (SIBs) have emerged as a potential candidate owing to the need for energy storage in large-scale applications such as stationary grid storage. Sodium possesses the advantages of natural abundances, relatively low cost and due to monovalent; its intercalation chemistry into electrode materials resembles lithium. However, the development of cathode materials in SIBs is quite challenging to compete for the lithium-ion batteries (LIBs) as reduction potential of sodium is lower than lithium (-2.71V compared to -3.04V vs. S.H.E.). Herein, we investigate the electrochemical properties of a nanocomposite of FeF3•0.5H2O and reduced graphene oxide as a cathode material for SIBs. Two different cathodes comprising reduced graphene oxide (RGO) and a composite (of RGO and FeF3•0.5H2O) are characterized for SIBs. The RGO electrode delivers an exceptionally stable discharge capacity of 240 mAh $g^{-1}$ with a stable long cycling up to 1000 cycles. The composite's structure, morphology, and microstructure were studied using XRD, SEM, and TEM, respectively. The nanocomposite cathode exhibits a high capacity of 266 mAh $g^{-1}$ in SIBs. The composite also shows a stable cycle performance with a high capacity retention of >86% after 100 cycles. To understand the electrochemical reaction mechanism in the composite electrode, the cells were disassembled at different charged-discharged potentials for ex situ TEM and X-ray absorption spectroscopy and the results confirm the reversibility of reaction.

### Speaker Biography

Dr. Kyung Yoon Chung is head and principal researcher of the Center for Energy Convergence Research at Korea Institute of Science and Technology (KIST). He got his Ph.D in materials science in 2003 at Yonsei University, South Korea. Then he worked as a Research Associate at Chemistry Department of Brookhaven National Lab., USA. Since 2006, he is working for the KIST. His research focuses on the electrode materials for the secondary batteries. Currently, he is more focusing on the electrode materials for next generation batteries.

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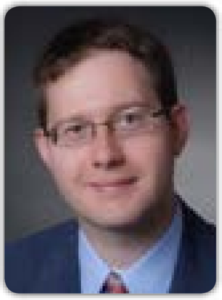


# Daniel S Lambrecht

*University of Pittsburgh, USA*


## First-principles prediction of molecular piezoelectrics for nanoelectromechanical systems

Developing an atomistic understanding of electromechanical responses is a prerequisite for the bottom-up design of nanoelectromechanical systems. This presentation focuses on atomistic simulations of piezoelectric responses in aperiodic systems such as molecules, nanoparticles, or biomolecule agglomerates. More specifically, we develop an analytical approach to predict molecular piezoelectric coefficients from first principles (density functional theory) and introduce a formalism that unifies the description of molecular and mesoscopic responses. Based on this new approach, we develop computational procedures that expedite the first principles calculation of piezoelectric tensors for molecular systems. Numerical benchmarks demonstrate that the results from our analytical theory are fully consistent with numerical computations at drastically reduced computational cost. Most importantly, our approaches (i) reduce the time for developing new candidates from months in the laboratory down to hours and (ii) have the potential to be truly predictive even in the absence of experimental data.

### Speaker Biography

Daniel S Lambrecht has completed his Ph.D from the University of Tuebingen, Germany, and performed his postdoctoral research at the University of California, Berkeley, USA. He is an Assistant Professor of Chemistry at the University of Pittsburgh, USA. He has over 35 publications that have been cited over 2,100 times, and his publication H- and i10-index are 19 and 26, respectively. He has received several national recognitions, including a 2017 Cottrell Scholar Award from the Research Corporation for Science Advancement, USA, and a Kekulé Award from the Association of Chemical Industry (VCI), Germany.

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# Shin Ichi Ohkoshi

*The University of Tokyo, Japan*


## Development of advanced functionalities on metal oxide nanoparticles

Development of functional materials has been extensively studied in the field of materials chemistry. We have reported various unique magnetic functional materials using cyano-bridged bimetallic assemblies, e.g., the photomagnetic functionalities on iron-octacyanoniobate systems, light-induced spin-crossover magnetic phenomenon, and photo reversible light induced spin-crossover phenomenon, spin-crossover-induced second harmonic generation, and photo switching of magnetization-induced second harmonic generation. Based on these knowledge, we developed novel metal oxide nanoparticles with advanced functionalities such as epsilon-iron oxide ($\varepsilon$-$Fe_2O_3$) and lambda-trititanium pentaoxide ($\lambda$-$Ti_3O_5$). This presentation focuses on $\lambda$-$Ti_3O_5$. A unique phase of $Ti_3O_5$, $\lambda$-$Ti_3O_5$, was prepared as nanoparticles. By alternatively irradiating with 532 nm and 410 nm lights, phase transition between $\lambda$-$Ti_3O_5$ (black, metallic conductor) and beta($\beta$)-$Ti_3O_5$ (brown, semiconductor) was repeatedly observed at room temperature. Thermodynamical analysis suggests that $\lambda$-$Ti_3O_5$ is a trapped phase at a local energy minimum. Light irradiation causes the reversible switching between this trapped state ($\lambda$-$Ti_3O_5$) and the other energy minimum state ($\beta$-$Ti_3O_5$). Furthermore, we have recently reported that the reversible switching is also induced by other external stimulation such as pressure, and have found that this material exhibits high performance heat storage properties, which are understood from thermodynamic studies.

### Speaker Biography

Shin Ichi Ohkoshi is currently working as a Vice Dean at School of Science, The University of Tokyo, Japan. He Published 423 papers, having 174 applications for Patent and 173 Invited presentations. His Current research interests are in the areas of inorganic chemistry and physical chemistry, i.e., magnetic materials, phase transition materials, nanomagnetic materials, light-induced phase transition, etc.

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# Asuka Namai

*The University of Tokyo, Japan*


## Large coercive field and high-frequency millimeter wave absorption in metal-substituted ε-iron oxide nanomagnet

Epsilon iron oxide ($\varepsilon$-$Fe_2O_3$) is one of polymorphs of $Fe_2O_3$, which generates as a stable phase in nanometer size region. Our research group has reported the first synthesis of pure $\varepsilon$-$Fe_2O_3$ by using a chemical nanoparticle synthesis method. $\varepsilon$-$Fe_2O_3$ has a strong magnetic anisotropy, and thus exhibits a large magnetic coercive field of 25 kOe at room temperature, which is the largest value among magnetic metal oxides. In this presentation, we report the synthesis of metal subsutituted $\varepsilon$-$Fe_2O_3$ ($\varepsilon$-$M_xFe_2{-}xO_3$), crystallographic orientation of $\varepsilon$-$M_xFe_2{-}xO_3$ nanoparticles, and metal substitution effect on the magnetic properties. Especially, rhodium subsutitution enlarges the magnetic coercive field up to 35 kOe. Due to the large magnetic anisotropy, $\varepsilon$-$Fe_2O_3$ and $\varepsilon$-$M_xFe_2{-}xO_3$ show the electromagnetic wave absorption in a millimeter wave region of 35–222 GHz, which is the highest frequency electromagnetic wave absorption caused by the zero-field ferromagnetic resonance (natural resonance). The present materials are to be useful for recently developed millimeter wave technology such as car radar and high-speed wireless communication.

### Speaker Biography

Asuka Namai is currently an Assistant Professor of Department of Chemistry, School of Science at The University of Tokyo. She received her Ph.D in Science at the University of Tokyo, Japan, in 2013. Her research focuses on the development and physical and chemical characterization of functionalized nanomaterials, with particular interest in iron oxide-based nanomagnets and magnetism.

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# Beata Kalska Szostko

*University of Bialystok, Poland*


## Nanostructures and its stability in the different environment

The main reasons why iron based nanostructures and among them magnetite nanoparticles become a very popular subject for so many studies is huge applicable potential due to their universality, low toxicity to living organisms, and relatively high biodegradability. The fact, that magnetite as compound is considered as a biodegradable it significantly reduces a risk of environmental pollutions caused by nanostructures after the accomplishment of its function. The foreseen drawback is that solubility of magnetite is rather low in most of the solvents. That properties provides new advantages and allows to use it in many medicine related areas or wide range environmental protection. In addition, simple single phase nanoparticles can be modified layer-wise to obtain more advanced core-shell structures, where each part possess new useful properties and that way many multifunctional structures can be obtained. On the other hand, layered morphology helps to prevent the degradation process caused by different factors and related to that pollution or influence on the dissolution process what avoid toxicity of the final waste. Interplay between structural and magnetic properties of the received nanostructures permits to perform modifications by compounds containing free functional groups, where the most universal one are: amine, carboxylic, phosphonic or thiolate one. Such hybrid systems allows in following steps to capture specific compounds (heavy metals, derivatives of medicaments, pesticides, etc.) in rather easy way. Resultant heterostructures can be successfully extracted from the solution by the external magnetic field. Similarly many compounds present in human body can find its counterparts at the specially modified nanostructures surface and be analyzed. However, efficiency of it is related to synergic behavior of reaction environment/solution and inorganic cores/particles body. All these causes that number of studies related to nanostructures behavior in specific condition should be made and discussed in details. Therefore, exploration of the stability of magnetic nanostructures in different artificial and environmental solutions will be reported. The survey was performed in few types of liquids and variable temperatures. Nanostructures before and after tests were measured by: Transmission and Scanning Electron Microscopy, X-ray diffraction, Infrared and Raman spectroscopy, and Mössbauer spectroscopy to monitor changes of physicochemical properties as a result of the environment influence. The amount of Fe (Cu, Ag) atoms transferred into the solutions was estimated by Atomic Absorption Spectrometry. Obtained results allow to conclude that: (i) magnetite nanoparticles are only stable in all water-based solutions, (ii) magnetite nanoparticles has variable durability which is related to particles core-shell structure, (iii) Fe based nanowires are very unstable regardless of their structure in all tested liquides, (iv) temperature influences very significantly on nanostructures composition and therefore its properties.

### Speaker Biography

Beata Kalska Szostko has completed in 2000 her Ph.D in Materials Physics from Uppsala University, Sweden. Her first postdoctoral position (2001-2003) was at Free University Berlin in Experimental Physics group. At the moment she is working at Chemistry Department University of Białystok, Poland. She is the Director of The Center of Synthesis and Analysis BioNanoTechno University of Bialystok, Poland. She has published more than 75 papers in reputed journals and has been serving as a reviewer for many scientific journals. She has more than 90 presentations of the results on National and International Conferences. She was and still is involved in an activity of few COST Actions.

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Ajay Kumar P
University of Wisconsin-Milwaukee, USA

## A novel *in-situ* polymer derived nano ceramic mmc by friction stir processing

Friction stir processing (FSP) is a solid-state technique used for material processing. Tool wear and the agglomeration of ceramic particles have been serious issues in FSP of metal matrix composites. In the present research, FSP has been employed to disperse the nanoscale particles of a polymer-derived silicon carbonitride (SiCN) ceramic phase into copper by an *in-situ* process. SiCN cross linked polymer particles were incorporated using multi-pass FSP into pure copper to form bulk particulate metal matrix composites. The polymer was then converted into ceramic through an *in-situ* pyrolysis process and dispersed by FSP. Multi-pass processing was carried out to remove porosity from the samples and also for the uniform dispersion of polymer derived ceramic particles. Microstructural observations carried out using Field Emission Scanning Electron Microscopy (FE-SEM) and Transmission Electron Microscopy (TEM) of the composite indicated a uniform distribution of ~100 nm size particles of the ceramic phase in the copper matrix after FSP. The microstructure during FSP evolved by discontinuous dynamic recrystallization. In the composite, fine ceramic particles pinned the grain boundaries, preventing grain growth resulting in a fine grain (2 µm) structure being retained. FSPed Cu (processed with the same process parameters as that of the composite) exhibited a grain size of 100 µm compared to 400 µm in the base Cu. The composite microstructure was characterized by equiaxed grains with narrow grain size distribution and a high fraction (>80%) of high angle grain boundaries. The nanocomposite exhibits a five-fold increase in microhardness (260HV100) which is attributed to the nano scale dispersion of ceramic particles. A mechanism of shear has been proposed for the fracturing of PDC particles during multi-pass FSP. The combined effect of grain refinement and nano polymer derived ceramic particle incorporation lead to a two-fold improvement in the proof stress of the composite (201 MPa compared to 98 MPa of base copper). The ultimate tensile strength improved by 33% and there was negligible drop in the ductility of the composite when compared to base Cu. Kocks-Mecking plot of the nano composite showed stage III of work hardening.

### Speaker Biography

Dr. Ajay Kumar P is currently working as a Post-Doctoral Researcher (Research Associate) at the College of Engineering and Applied Science, University of Wisconsin-Milwaukee (UWM) USA working in the area of developing metal matrix composite program. Mainly he is working in the area of Advanced Surface Alloying of Plain Carbon Steel to Stainless Steel Compositions during Manufacturing to improve Corrosion Resistance of Components used in the Water Industry, Novel Surface Microstructure and Low-Cost Surface treatments to reduce drag, Energy Consumption, and Corrosion in Water Transport Systems, Waste Materials Reinforced Metal Matrix Composites for Reducing Embodied Energy and Emissions, Graphene Based MMCs.

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# Marie Yoshikiyo

*The University of Tokyo, Japan*



## Theoretical calculations of the electronic structure and phonon modes of ε-$Fe_2O_3$ nanomagnets

ε-$Fe_2O_3$ nanomagnet, one of the four polymorphs of iron oxide $Fe_2O_3$, was first discovered by our group as a pure phase via a chemical nanoparticle synthesis, a combination of reverse-micelle and sol-gel methods. This material exhibits a large coercive field over 20 kOe at room temperature and the magnetic properties could be widely controlled by metal substitution. In this work, we report the theoretical calculations of the electronic structure and phonon modes of ε-$Fe_2O_3$.

Using the crystal structure determined by powder X-ray diffraction, we calculated the electronic structure of ε-$Fe_2O_3$ using first-principles calculations and molecular orbital calculations, and the origin of the huge coercive field was investigated. Furthermore, we calculated the phonon modes of ε-$Fe_2O_3$ using the Phonon code. The lowest vibration mode was calculated to be 2.51 THz due to the Fe atom vibration along the crystallographic a-axis with A1 symmetry. The phonon modes were experimentally observed by Far-IR spectroscopy, which showed good agreement with the calculation results. Phonon modes of metal-substituted ε-$Fe_2O_3$ are also introduced.

### Speaker Biography

Marie Yoshikiyo received her M.Sc in Chemistry from the University of Tokyo in 2013, and pursuing her Ph.D under the supervision of Prof. Shin Ichi Ohkoshi. She is currently a Project Assistant Professor of Department of Chemistry, School of Science at the University of Tokyo. Her research interests focuses on the development of functional materials, especially magnetic nanomaterials based on iron oxides.

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## *Omar Mounkachi*

*Moroccan Foundation for Advanced Science, Morocco*

### First-principle vs experimental design of diluted magnetic semiconductor

Semiconductors that exhibit room-temperature ferromagnetism are central to find ways to manipulate and use electronic spin to the same degree that electronic charge is used in silicon-based electronics. Diluted magnetic semiconductors (DMS) are a promising class of such materials to the development of semiconductor spintronics, but their success will depend on our ability to understand and optimize their behavior. The interface between first principle and experimental materials design could provide a way to achieve these goals. The purpose of talk is to propose some ideas to answer the most important question in material science for semiconductor spintronics, namely, how we can realize room-temperature ferromagnetism in DMS? And I will discuss the correlation between first principle and experimental design to see how we can predict the properties of yet-to-be-synthesized materials. Based on experimental design I will discuss structural and magnetic properties of same DMS materials. Based on first-principles spin-density functional calculations, the half-metallic ferromagnetic properties of same DMS materials with magnetic impurity have been investigated. New magnetic behaviors will be discussed in DMSs recently observed as spin glass, super paramagnetic, this creates new opportunities for development and construction a new spintronics devises.

### Speaker Biography

Dr. Omar Mounkachi is a researcher and project leader in the Moroccan Foundation for Advanced Science, Innovation and Research (MAScIR). He has obtained his Ph.D at University Mohammed V in collaboration with NEEL Institute (CNRS, Grenoble) in 2009. Dr. Mounkachi has more than 8 years' experience in performing and managing research within several international academic collaboration (France (CEA Grenoble (2008/2009), laue langevin institute (2010/2012)) , university of Strasbourg (2015/2016) , and the jean lamour institute (2014/2016), Poland (Polish Academy of Sciences ( 2009)), Belgium (University of Liège (2015/2016), USA (university of central florida, wake forest university (2009/2016)) and industrials cooperation (MANAGEM,OCP,PEPS,ECOMAG, SOLVAY, McPhy ) . He has published 100 publications in highly recognised scientific journals in several fields of condensed matter, spintronics, energy, and magnetic nanomaterials, and 16 patents. He is co-organizer of several national and international conferences. Dr. Mounkachi has been invited to give seminars in many congresses and to act as a reviewer for many scientific manuscripts from prestigious journals.

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## Simone Mancin

*University of Padova, Italy*

# Nanoparticles for advanced two-phase heat transfer solutions

Innovative strategies for high heat flux dissipation are strongly needed to overcome the intrinsic limitations of the traditional cooling schemes. Passive cooling represents an interesting way to dissipate the heat rejected by electronic devices and when it is associated to a phase change, it can be very effective. The most common phase change process used in the electronics cooling is the liquid–vapor one (i.e. boiling), since it can be found in the heat pipes and vapor chambers largely used to cool electronics devices. On the other hand, the solid-liquid phase change process (as in the case of a phase change material, PCM) is another interesting possibility to reject even high heat loads, especially when they are intermittent as in the case of most electronics cooling. In the last decades, nanotechnologies have been demonstrated to open new interesting opportunities for the two-phase heat transfer enhancement on both liquid-vapor and solid-liquid processes. In particular, the use of nanoparticles to improve the heat transfer properties of fluids has been largely studied and implemented since the concept of nanofluid was firstly advanced by S Choi in 1995. Despite of the large research efforts on nanofluids, the results are still contradicting, especially in two-phase heat transfer, where the nanoparticles-fluid interaction is added to the already very complex phase change phenomenon. This lecture covers the most advanced research activities carried out the Nano Heat Transfer Lab (NHT-Lab) of the University of Padova; in particular, the results on surface functionalization via nanoparticles deposition during nanofluid boiling and the development of nano-PCM by seeding different carbon black and allumina nanoparticles in common paraffin waxes are presented and critically discussed to explore the possible use of these enabling technologies for the next generation of cooling strategies.

### Speaker Biography

Simone Mancin is an Associate Professor at the Dept. of Management and Engineering of the University of Padova, where he teaches three courses: Applied Physics, Thermo-Fluid-dynamics, and Thermal Management of Electronics Devices. He set up an independent laboratory on Nano Heat Transfer (NHT-lab) where he has focused his research activities on Nanotechnologies applied to advanced single and two-phase heat transfer. In particular, his current research projects involve the use of nanoparticles to improve the heat transfer performance of phase change materials for enhanced thermal energy storage and to obtain specific surface functionalization via nanofluid pool boiling. Moreover, other research projects regard the experimental and numerical analyses of single and two-phase (both condensation and evaporation) heat transfer inside microgeometries and nanostructured materials aiming at developing innovative solutions for smart, efficient, and compact heat exchangers for refrigeration and air conditioning, and electronics cooling applications. He is author and co-author of more than 80 scientific papers published in several peer-review international journals and in proceeding of national and international congresses; he acts as reviewer of several scientific international journals. He is member of IIR B1 scientific commission and fellow of ASME.

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