Scientific Tracks & Abstracts (Day 1)
Track 1: Materials Science and Engineering
Track 2: Informatics in Various Fields of Materials

Session Chair
Urs Meier
Swiss Federal Laboratories, Switzerland

Session Co-chair
Jijeesh R Nair
Polytechnic University of Turin, Italy

Session Introduction

Title: Molecular magnetic switches
Marat M Khusniyarov, Friedrich-Alexander-University of Erlangen-Nuremberg, Germany

Title: The role of polymer electrolyte in constructing an aging resistant high energy lithium battery for wide temperature application
Jijeesh R Nair, Polytechnic University of Turin, Italy

Title: The prediction of long-term creep data of fibrous polymer composites based on short term experiments
Urs Meier, Swiss Federal Laboratories for Materials Science and Technology, Switzerland

Title: Group III-Nitride semiconductor nanostructures for novel photonic applications
Yong-Hoon Cho, Korea Advanced Institute of Science and Technology (KAIST), Republic of Korea

Title: Polymer derived boron nitride ceramics for energy applications
Philippe Miele, University of Montpellier, France

Title: Teaching from practice to theory
Mario Pablo Spector, National Technological University, Argentina

Title: Novel biological method for iron rust removal
S Rajendran, Madurai Kamaraj University, India

Title: Towards more efficient upconverting materials based on NaYF₄ nanoparticles: Phase and size controlled synthesis and optical evaluation
Fabrizio Guzzetta, Universitat Jaume I, Spain

Title: High efficiency for photo-polymerizable VCP ester-amide resins: A universal concept providing low volume shrinkage, high reactivity and selectivity
Paul Pineda, University of Bayreuth, Germany

Title: Non-ionic UCST-type polymers: Synthesis and analysis of new thermoresponsive properties in aqueous media
Beatriz A Pineda-Contreras, University of Bayreuth, Germany

Title: Expanding the NMR palette: Insights on artificial charge separators
Brijith Thomas, Leiden Institute of Chemistry, Netherlands
Continuous miniaturization of devices as demanded by modern society requires construction of smaller and smaller device components approaching the limits of the conventional “top-down” approach. An alternative “bottom-up” approach flourishing in widespread nanotechnologies allows overcoming these limits. One step in miniaturization beyond the nanoscale is the development of true molecule-based devices in which single molecules are the active components in the ultimate case. In this regard, molecular switches are the key components for prospective molecular electronics and spintronics. Our research group develops unique molecular switches, molecular coordination compounds, whose magnetic properties can be reversibly changed at room temperature. To accomplish this goal, photoisomerizable ligands were introduced into bistable molecules of two families: Spin-crossover metal complexes and valence tautomeric metal complexes. The efficient and reversible photo switching in spin-crossover species was achieved using the Ligand-Driven Light-Induced Spin Change (LD-LISC) effect and proceeds in solution and in the solid state. The switching of valence-tautomeric cobalt complexes was accomplished by two novel effects: Coordination-Induced Valence Tautomerism (CIVT) and Ligand-Driven Light-Induced Valence Tautomerism (LD-LIVT) both developed in our group. To this end, we demonstrated that magnetic properties of isolated molecules can be conveniently switched at room temperature. Modulation of magnetic properties at molecular level at ambient conditions may open new horizons in development of ultra-high-density memory units and molecular sensors.

Biography
Marat M Khusniyarov has graduated from Novosibirsk State University, Russia in 2002. He has obtained his PhD from Philipp University of Marburg, Germany in 2006, later he has spent 2.5 years as a Post-doctorate at Max Planck Institute for Bioinorganic Chemistry, Germany. In 2009, he has been supported by a prestigious Liebig Fellowship and then he started his independent carrier by establishing a Junior Research Group at Friedrich-Alexander University of Erlangen-Nuremberg, Germany. His research field includes magnetic and photomagnetic materials, molecular switches and sensors, applied spectroscopy and theoretical calculations. He is the author of 31 research publications in high rated journals and one review article.

marat.khusniyarov@fau.de
The role of polymer electrolyte in constructing an aging resistant high energy lithium battery for wide temperature application

Jijeesh R Nair
Polytechnic University of Turin, Italy

Polymer electrolytes (PEs) exhibit unique advantages such as mechanical integrity, wide variety of fabrication methods in desirable size and shape, possibility to fabricate an intimate electrode/electrolyte interface and adapt to a lightweight, leak proof construction, safety and economic packaging structure. Free radical photo-polymerization (UV-curing) can be an interesting alternative process to produce polymer electrolytes for Li-ion batteries. It takes place at ambient temperature: A liquid polyfunctional monomer, containing a proper photo-initiator, forms a cross-linked film upon UV irradiation. It appears highly advantageous, due to its easiness and rapidity in processing, very short time with high efficiency and eco-friendliness as the use of solvent is avoided. In the present work, profoundly ion conducting, self-standing and tack-free ethylene oxide based PEs encompassing a room temperature ionic liquid (RTIL)/Tetraglyme with specific amounts of lithium salt are successfully prepared via UV curing process. All the prepared materials are thoroughly characterized in terms of their physical, chemical and morphological properties, and eventually galvanostatically cycled in lab-scale lithium batteries (LIBs). The Polymer Electrolytes exhibited excellent ionic conductivity, electrochemical stability (>5V vs. Li+/Li), and stable interfacial resistance. At 20°C the conductivity value is equal to $4 \times 10^{-4}$ Scm$^{-1}$ and it exceeds $10^{-3}$ Scm$^{-1}$ at 50°C. The lab-scale Li-polymer cell assembled demonstrated stable charge/discharge characteristics without any capacity (150 mAh g$^{-1}$) fading. The overall performance of the SPEs postulates the possibility of effective implementation in the next generation of safe, durable and high energy density secondary all-solid Li-metal polymer batteries working at ambient and/or sub-ambient temperatures.

Biography

Jijeesh R Nair obtained his European Doctorate degree (2010) in Materials Science & Technology from Politecnico di Torino, Italy. He is a Co-author of 50 publications published in peer reviewed ISI journals. He has attended 30+ conferences in Italy and abroad. In 2010, he won the Oronzio and Niccolo' De Nora Foundation Prize of the Italian Chemical Society. In 2012, he won the most prestigious ENI AWARD 2012 – Debut in research category from the Italian President Giorgio Napolitano. He has been serving as an Editorial Board Member as well as reviewer of several reputed international journals.

jijeesh.nair@polito.it
The prediction of long-term creep data of fibrous polymer composites based on short term experiments

Urs Meier
Swiss Federal Laboratories for Materials Science and Technology, Switzerland

After a short review of the historical development of the time-temperature superposition principle, its application for the extrapolation of creep modulus curves will be discussed with the help of two examples. Conditions for the applicability of the principle for fibrous polymer composites will be pointed out. The normalization of the measured data will be revealed. The construction of the master creep modulus curve will be demonstrated in detail. The extrapolated values resulting from the superposition of short-term creep data of an unsaturated polyester-glass fiber composite are going to be compared with the results of long-term creep experiments. Based on this outcome, it can be concluded that the time-temperature superposition principle is for the prediction of long-term creep behavior a suitable tool for R&D-laboratories to get a good impression about the tendency of the long-term creep behavior of fibrous composites.

Biography

Urs Meier has held various positions at the Swiss Federal Laboratories for Materials Science and Technology (Empa). In 1983, he rose to the rank of the Managing Director of Empa in Dubendorf, a position that he held until his recent retirement. In addition, he has also been Professor at the Swiss Federal Institute of Technology (ETH) in Zurich. Over the years, his accomplishments in the application of fibrous polymer based composites in civil engineering have had a tremendous impact on the field. Especially noteworthy is his work on the post-strengthening of civil structures with carbon-fiber-reinforced polymer strips, which has been successfully implemented at a growing rate worldwide and the application of CFRP stay-and post-tensioning cables.

urs.meier@empa.ch
Group III-nitride semiconductor nanostructures for novel photonic applications

Yong-Hoon Cho
Korea Advanced Institute of Science and Technology, Republic of Korea

Group III-nitride semiconductor nanostructures have attracted much attention due to their rich and unique optical properties and their versatile applications. Here, we present various nitride-based quantum nanostructures grown on pyramidal, annular, columnar, and tapered structures by using metal-organic chemical vapor deposition (MOCVD). First, we demonstrated multi-color and broadband visible light emitting diodes based on GaN hexagonal nano-pyramid and annular structures. Second, GaN-based rod structures were directly fabricated on Si substrates and then InGaN/GaN multiple quantum wells (QWs) were deposited on the surface of GaN rods. By using tapered GaN/InGaN core–shell QW semiconductor rods having a large gradient in their bandgap energy along their growth direction, highly asymmetric photonic diode behavior was observed. Finally, we demonstrate a novel approach of the self-aligned deterministic coupling of single quantum dots (QDs) to nanofocused plasmonic modes. Using this approach, we achieved strong spontaneous emission enhancement of QDs over a wide spectral range of ~150 meV.

Biography

Yong-Hoon Cho received his PhD degree in Solid State Physics from Seoul National University, Korea in 1997. He is currently the KAIST-Chair Professor, the Head of Department of Physics, the Director of KAIST Center for LED Research, and the Chief of Educational Program for LED. He has more than 229 refereed international publications and 310 international conferences presentations. He has served as a Editorial Board Member of Scientific Reports, Associate Editor of IEEE Transactions on Nanotechnology, and Associate Editor of AAPPS Bulletin.

yhc@kaist.ac.kr
Polymer derived boron nitride ceramics for energy applications

Philippe Miele$^{1,2}$
$^1$Institut Européen des Membranes, France
$^2$Université de Montpellier, France

The development of new materials, with the goal to meet the needs of near-future technological challenges in energy or environment issues particularly, is strongly dependent on the elaboration of ceramics with suitable morphologies, shapes and enhanced properties. This ambitious goal can be achieved by both the utilization of non-conventional chemical methods and the related preparation of tailored precursors. In the case of non-oxide ceramics, the so-called Polymer Derived Ceramics route is a suitable and useful process for preparing various inorganic materials with a controlled chemical composition and in complex shapes, exploiting the potential of numerous shaping processes. The general strategy to produce such materials can be described as a molecule-to-ceramic conversion, involving a complex sequence of physical and chemical modifications. This process can be divided into two sub-processes both starting from a single-source molecular precursor. The first route lies on the creation of polymeric intermediates, allowing a subsequent shaping step whereas the second method is related to a one-step access to specific shapes. In this contribution, several examples of shaped-polymer derived nano-ceramics will illustrate this elegant method as well as their use in energy applications, particularly for hydrogen storage. We will focus on boron- and silicon-based PDCs displaying various forms and sizes, including monolith-type foams with hierarchical porosity, nanostructures including nanopowders and nanopolyhedrons, nanocomposites. Micro, meso-materials and other types of materials will be also described.

Biography

Philippe Miele received his PhD in Inorganic Chemistry in 1993 at the University of Montpellier (France) and completed Post-doctoral study at Georgia Institute of Technology (Atlanta, GA, USA). He is the Director of the European Institute of Membranes in Montpellier. He has co-authored around 200 papers in international journals, 10 patents and has given 35 invited talks in international congresses. He has been elected in 2011 at the “World Academy of Ceramics” as Professional Member (Academician) and is affiliated with the class “Science”.

philippe.miele@univ-montp2.fr
Teaching from practice to theory

Mario Pablo Spector, Liliana Ferrari and Graciela Yudgar
Universidad Tecnológica Nacional, Argentina

Cognitive processes seem to be highly activated when curiosity intervenes as motivational energy in the classroom. This conclusion is reached after a teaching experience in a metallurgy class, with students from a technical school with low interest in learning and studying. Unlike the traditional sequence of teaching materials in which crystalline and atomic models are studied from the literature to later arrive at a phase diagram; this experience begins directly in the laboratory with students doing cooling curves for the alloy of two metals. After this, students make metallographic specimens with the solidification obtained. This experience results in a research activity by which students observe a phenomenon, measure values, verify changes and transform two metals in a number of phases before they study the theory. In this way, students understand the theoretical explanation as a necessary element to further delve into the scientific activity as opposed to pre-established knowledge that is imposed on them.

Biography

Mario Pablo Spector is Director of the Materials Laboratory at National Technological University in the City of Parana (Argentina) and teaches Metallurgy at a secondary technical school. His main field of research interest is implantable metallic prostheses. The Laboratory he leads performs work for companies and hospitals, especially in connection with the quality of the material, machining, and finish of metal prostheses, and prepares university students in the Metallurgy field. "Applied research" is also an important aspect in his work, focusing on the area of Micro-Bio-Metallurgy, in terms of the relationship between metals and bacteria.

Notes:
Novel biological method for iron rust removal

S Rajendran
Madurai Kamaraj University, India

Rust is the reddish brown oxide of iron formed by the action of moisture and oxygen on the metal. It is an electrochemical corrosion which weakening the iron structures. It was estimated that the corrosion alone causing a loss of over $5000 bn USD to global economy every year. According to a recent report of NACE the corrosion cost in any developing countries predicated by 5% of the GDP for India the cost of corrosion is estimated to be Rs 1.52 lakh crores per year. All available methods for rust removal and corrosion prevention are having their own limitations. Therefore, it is an urgent need to find out suitable method to check the corrosion. A fungal based biological derustification process was observed and reported by us already. This present investigation deals with our further experiments and experiences on the fungal based technology for iron rust removal. The derustification process was repeated once again to conform the reproducibility of the technology in polybag fermenters. Rusty iron mesh which were rolled in the form of cylinders were placed in the fermenters to expose them to the aerosol particles generated by the fungus. The rate of derustification was noted. Attempts were also made to enhance the aerosol generation from the substrate (straw) by coconut water supplementation. It was observed that the rusty metals placed in the supplemented substrate where derusted quickly then the raw substrate. Various level of supplementation was also correlated with rate of derustification. Further works on rust removal process are under progress.

Biography

S Rajendran holds MSc, MPhil, PhD degrees and is an Associate Professor at Saraswathi Narayanan College and a Coordinator of Unit of Rural Biotechnology at Saraswathi Narayanan College, India. He has over 50 scientific papers and projects either presented or published. He is an internationally recognized expert in many areas of Environmental biology including solid waste management, waste water treatment, anaerobic digestion, biofuel, bioenergy production and formulator of bio-pesticide and herbicide. He has delivered key note speech in various international conferences and also given invited lectures in various educational institutions and universities. He is one of the leading Scientific Writers in Tamil Dailies. He has conducted more than 30 scientific workshops for the upliftment of rural people and women self help groups. He also had given training to municipalities employees about garbage disposal. Because of his excellence in environmental science, he was awarded with Patron of Environment by Tamil Nadu Government in 2006. His research group is actively working in the following aspects: MSW management, mushroom culture, biofuel generation, waste water treatment and bio-pesticide and herbicide development. His work in biological derustification is a novel pioneer technique and growing area in the environmental biotechnology.

s.rajendrann@yahoo.co.in

Notes:
Towards more efficient upconverting materials based on NaYF4 nanoparticles: Phase and size controlled synthesis and optical evaluation

Fabrizio Guzzetta and Beatriz Julian-López
Universitat Jaume I, Spain

U pconverting nanomaterials are of vast technological and bio-medical interest, both from the pure scientific research and industrial point of view. Their interest lies on their ability to convert two or more low energy infrared photons into one higher energy photon in the UV-VIS range that can be used for less invasive teranostics and bioassays, more efficient solar cells, IR-activated photocatalytic systems, and so on. The biggest challenge that the scientific community faces for their commercial deployment is to synthesize bright-emitting, phase-consistant and small-sized nanocrystals. Normally these materials are formed of a crystal host in which Lanthanide ions act as substitutional doping within the lattice. To date, the Er3+-Yb3+ codoped β-NaYF4 is the most efficient material known. However, the upconversion phenomenon is a highly complex non-linear optical process and the efficiency depends on several factors such as the nature and crystal structure of the host lattice, the nature and local dispersion of the lanthanides, the synthetic conditions (reagents, solvent, reaction, time and temperature, pH, etc.), and so on. In this context, our study deals with the synthesis and evaluation of up-converting nanoparticles (UCNPs) with formulae Lnx-Yb0.2:NaY0.80-xF4, where x=0.5% for blue-emitting Ln:Tm3+ and x=2% for red and green-emitting Ln: Er3+ and Ho3+ systems. Here we report an account of some fundamental research performed in our group that tries to address some of these challenges to afford highly efficient tuneable UCNPs. In particular, we are focusing on the crystalline phase and size, and on the photoluminescent properties of solvo thermal- and microwave-assisted NaYF4 based-nanomaterials.

Biography

Fabrizio Guzzetta has completed his Bachelor in Science at the University of Palermo (Italy) in 2005, and his Master’s degree from University of Florida in 2013. Currently, he is pursuing his PhD at the Universitat Jaume I (Spain) under the supervision of Dr. Beatriz Julian-López.

guzzetta@uji.es
High efficiency for photo-polymerizable VCP ester-amide resins: A universal concept providing low volume shrinkage, high reactivity and selectivity

Paul Pineda Contreras and Seema Agarwal
University of Bayreuth, Germany

Cyclic monomer systems that can undergo a radical-ring opening polymerization (RROP), such as vinylcyclopropane (VCP) derivatives are highly interesting monomer resins, providing lower-volume shrinkage on polymerization than other vinyl monomers, like methacrylates. Especially among electronics, coatings, lithography, dental applications and 3D microstructures highly specified resins with low volume shrinkage are fundamental to match the precise specifications adapted for the final end-use. Thereby, cross-linkable VCP resins are currently accessing a variety of precise specifications within a wide spectrum of applications, in industry as well as in research. Thus we developed a universal concept based on selective intermolecular interactions, applying VCP resins as fast curable, low-shrinking, high-performance resin. Herein we focused on the monomer synthesis as well as on the development and characterization of a modular construction kit based on VCPs. To provide a powerful illustration, diversified resins were prepared and analyzed. Hereby, we could show an excellent control of high reactivity, nearly regardless of the chosen spacer-unit. With an appropriate variation of spacer-unit selective characteristics, like e.g. mechanical strength, thermal stability and optical refraction could be adjusted in a simple and suitable way, making the system adaptable to any use. These results are highlighted in this presentation and offer the system an outstanding prospective within various applications.

Biography

Paul Pineda Contreras is currently working on his PhD at the University of Bayreuth (Germany) under the supervision of Prof. Seema Agarwal, focusing on the photo-polymerization of novel low-shrinking resins. He received his BSc and MSc degree from the University of Marburg in 2010 and 2012, respectively. During his undergraduate studies, he made a research internship in Prof. Susanta Banerjee’s group at the Indian Institute of Technology (IIT) Kharagpur on PPX modified poly(arylether)s. After that he received his research initiative a scholarship of the Bayer-Science Foundation. His research interests are photo-polymerization techniques, materials characterization, composites and coatings.

paul.pineda@uni-bayreuth.de

Notes:
Non-ionic UCST-type polymers: Synthesis and analysis of new thermoresponsive properties in aqueous media

Beatriz A Pineda-Contreras and Seema Agarwal
University of Bayreuth, Germany

Thermoresponsive polymers are one of the most intensively studied “smart” materials. Polymers with UCST (Upper Critical Solution Temperature) behavior can be synthesized via free radical polymerization or via controlled polymerization methods like Reversible addition-fragmentation chain transfer (RAFT). Controlled radical polymerization methods offer several advantages in the synthesis of this type of polymers, such as sharp phase transition temperature and low hysteresis. Herein, we focused on the synthesis and characterization of copolymers of acrylamide (AAm) and hydrophobic comonomers e.g. acrylonitrile (AN) and styrene (St). The phase transition temperatures of polymer samples of poly(AAm-co-AN) could be easily tuned, showing an effective phase transition temperature. Further, we studied the chemical and thermoresponsive stability under different conditions, which increased the understanding of non-ionic UCST-type polymers for possible applications under aqueous conditions over long periods of storage. In the case of copolymers of poly(AAm-co-St), the observation of thermoresponsivity was highly dependent upon copolymer composition. Therefore, we provided controlled polymerization reactions of AAm and St up to high conversions via RAFT technique, to induce sharp phase transition temperatures in a range between 50 – 62 °C. However, the same copolymers prepared by conventional free radical polymerization were not UCST responsive, even after synthesis of different St compositions. Thus the controlled polymerization of AAm with hydrophobic non-hydrolysable comonomers offers a clear highlight in the field of thermoresponsive polymers and defines new possible applications.

Biography

Beatriz A Pineda-Contreras received as DAAD fellow her MSc degree in Chemistry with specialization in macromolecular chemistry from the Marburg University (2012), with a thesis on water-soluble thermoresponsive polymers with UCST behavior. She obtained her Diploma in Chemistry with focus on electrodeposition of Chitosan/ Hydroxyapatite composites onto Ti6Al4V. She is working on her PhD since 2013 at the University of Bayreuth under the guidance of Prof. Seema Agarwal on synthesis and application of “smart” materials as polymeric carriers. Her research interests are “smart” polymers, water-soluble thermoresponsive polymers, their synthesis and possible applications.

beatriz.pineda-contreras@uni-bayreuth.de

Notes:
Expanding the NMR palette: Insights on artificial charge separators

Brijith Thomas¹, Jeroen Rombouts², Rajeev K Dubey³, Karthick Babu Sai Sankar Gupta⁴, Gert T Oostergetel¹, Max Clabbers¹, Ute Baumeister⁵, Wolter F Jager⁴, Francesco Buda¹, Romano Orru², Jan Pieter Abrahams¹, and Huub J M de Groot¹

¹ Leiden Institute of Chemistry, The Netherlands
² Vrije University Amsterdam, The Netherlands
³ Martin-Luther-Universitat Halle-Wittenberg, Germany
⁴ Delft University of Technology, The Netherlands

Spurred by worries over climate change, there is increasing interest in mimicking natural photosynthesis for the conversion of solar energy into fuel. The molecular structure and packing of self-assembled Zinc Salphen/NDI dyad and Perylene-based molecules, which are potential, charge separators were studied in detail in the solid state. While dynamic scattering, availability of diffraction grade crystal, destruction of crystal due to electron beam were the drawback of TEM, difficulty to index the bragg peaks due to overlap is the limitation of the powder XRD. The combination of MAS NMR, TEM, Powder XRD and molecular modeling provide a powerful methodology that can be of use to investigate molecular geometry (and properties) of larger unlabeled - aggregated supramolecular systems. DFT calculations were performed using the CASTEP module in the material studio with GIPAW wave function. Quantum mechanical calculations allow experimental 1H and 13C solid-state NMR spectra to be assigned in a quantitative manner to a specific molecular packing arrangement, starting from the chemical structure of a moderately sized molecule. The incompleteness of SSNMR data is supplemented by data from TEM and powder XRD. Here we simulated the distance constraints obtained from the LGCP build up curve using Simpson/Spinevolution for the selected carbon atoms. An electron density map of the proposed structure is generated and its projected down in the right orientation followed by fourier transform using EMAN2 software is employed to simulate the electron diffraction pattern. To confirm the model we simulated the powder XRD pattern using Reflex module in the material studio. We described a methodology in which the computational integration of MicroED, Powder XRD and SSNMR to propose a model for a molecule with high molecular mass, with less ambiguity. One of the biggest challenges with smarter crystallography is that it is limited to small molecules but here we proposed structures for molecules with higher atomic weight, which is around 1000 gm/mol. This methodology could be extended to understand the mechanism of battery in the near future.

Biography

Brijith Thomas is a graduate student in Leiden University. His area of interest include NMR crystallography, solar fuel cell, charge separators, battery.

b.thomas@chem.leidenuniv.nl

Notes:
Track 3: Role of Materials Chemistry in Pharmacy
Track 4: Design and Synthesis of Materials

Session Chair
Wlodzimierz Stanczyk
Polish Academy of Sciences, Poland

Session Co-chair
Bruno Bureau
Institut Universitaire de France, France

Session Introduction

Title: Synthesis of the first POSS cage - anthracycline nano-conjugates
  Wlodzimierz Stanczyk, Polish Academy of Sciences, Poland

Title: Synthesis of fine-controlled subano-metal particles using a dendrimer reactor
  Kimihisa Yamamoto, Tokyo Institute of Technology, Japan

Title: Tellurium based glasses for far infrared and thermoelectric applications
  Bruno Bureau, Institut Universitaire de France, France

Title: Game-based materials to teaching and learning the periodic table
  Antonio Joaquin Franco-Mariscal, University of Malaga, Spain

Title: Polymers with tunable properties via variable cross-linking conditions
  Lee D. Wilson, University of Saskatchewan, Canada

Title: Fibre Structures for energy harvesting in wearables
  Elias Siores, Bolton University, UK

Title: Advanced functional organic-inorganic nano-composite membranes: Application of membrane technology for removal of contaminants of drinking water
  Urfi Ishrat, Taibah University, Saudi Arabia

Title: Microstructure evolution at different cooling rates of a low carbon microalloyed steel
  Elena Brandaleze, National Technological University, Argentina

Title: Mechanical response of Ti,SiC to He/H irradiation: Elaboration from first-principles calculation
  Yuexia Wang, Fudan University, China
Synthesis of the first POSS cage - Anthracycline nano-conjugates

Włodzimierz Stanczyk, K Gradzinska, J Kurjata, K Rozga-Wijas, M Florczak and E Wielgus
Polish Academy of Sciences, Poland

The antitumor drugs Doxorubicin (DOX) and daunorubicin (DAU) are important anthracycline antibiotics of a broad spectrum of action, widely used in therapy. Unfortunately they can cause also serious cardiovascular side effects leading to heart failure. Thus, currently a focus is being made on synthesis of nanoparticles bearing DOX and DAU that should limit exposure of drugs to normal cells. Pathways, including encapsulation e.g. in poly(lactide-co-glycolide, poly(trimethylene carbonate-co-glutamic acid) and solid lipid nanoparticles were studied. On the other hand a number of carriers was applied for chemical bonding of doxorubicin that include polymeric and dendrimer nanoparticles or fatty acids. Polyhedral oligomeric silsesquioxanes (POSS) have been surprisingly missing from the above list of anthracycline nanocarriers, although octameric POSS is considered a next generation material in biological fields. Herein we present the synthesis of the first two, according to our knowledge, T8-POSS-doxorubicin (Scheme 1) and daunorubicin conjugates. T8-POSS cage can be easily functionalized and its small size (~1.5 nm) makes it an unique carrier, compared to the ones studied till now in binding anthracyclines. It is also well known to facilitate cell penetration, the important feature in drug delivery processes, while on decay forms only a harmless silicic acid - Si(OH)4.

Biography
Włodzimierz Stanczyk has completed his PhD and DSc at Lodz University of Technology and Post-doctoral studies from University of Sussex. He is the Head of Inorganic-Organic Composites Research Group at CMMS. He has published more than 100 papers in reputed journals in the area of organometallic and polymer chemistry.

was@cbmm.lodz.pl
Synthesis of fine controlled sub nanometal particles using a dendrimer reactor

Kimihisa Yamamoto
Tokyo Institute of Technology, Japan

We show that tin chlorides, SnCl2 and FeCl3 complexes to the imines groups of a spherical polyphenyl-azomethine dendrimer in a stepwise fashion according to an electron gradient with complexation in a more peripheral generation proceeding only after complexation in generations closer to the core has been completed. The metal assembly in a discrete molecule can be converted to a size regulated metal cluster with a size smaller than 1 nm as a molecular reactor. Due to the well defined number of metal clusters in the subnanometer size region, its property is much different from that of bulk or general metal nanoparticles. Dendrimers are highly branched organic macromolecules with successive layers or “generations” of branch units surrounding a central core. Organic inorganic hybrid versions have also been produced by trapping metal ions or metal clusters within the voids of the dendrimers. Their unusual, tree like topology endows these nanometer sized macromolecules with a gradient in branch density from the interior to the exterior which can be exploited to direct the transfer of charge and energy from the dendrimer periphery to its core. Here we show that tin ions, Sn2+, complex to the imines groups of a spherical polyphenylazo-methine dendrimer in a stepwise fashion according to an electron gradient with complexation in a more peripheral generation proceeding only after complexation in generations closer to the core has been completed. By attaching an electron withdrawing group to the dendrimer core, we are able to change the complexation pattern, so that the core imines are complexed last. By further extending this strategy, it should be possible to control the number and location of metal ions incorporated into dendrimer structures, which might and uses as tailored catalysts, building blocks or fine controlled clusters for advanced materials.

Biography

Kimihisa Yamamoto has received his PhD degrees from Waseda University in Polymer Chemistry in 1990. He joined the Department of Chemistry at Keio University from 1997 as a Professor. Currently, he is a Professor in the Chemical Resources Laboratory, Tokyo Institute of Technology since 2010. His present research interests are in developing supra metallomolecules for nanosynthesizers involving nanoparticles, subnanoparticles and super atoms.

Notes:
Tellurium based glasses for far infrared and thermoelectric applications

Bruno Bureau¹, Catherine Boussard-Pledel¹ and Pierre Lucas²
¹Université de Rennes, France
²University of Arizona, USA

The glass-forming ability of chalcogen elements has been known for several decades but compared to classical oxide glasses, this class of vitreous materials is just emerging in particular in order to shape optical lenses or fibers. Indeed, they look like metallic alloys rather than classical glasses, and their main interest relies on their large optical window extending in the mid-infrared. This exceptional transparency, associated with suitable viscosity/temperature dependence is a favorable context to seize the opportunity to develop innovative optical fibers for mid-infrared sensing in biology and medicine for example. Recently, some new families of glasses, based on tellurium, have been developed to extend the working domain of these sensing devices. In particular, they give access to the CO₂ absorption band in the mid-infrared which is useful for the Darwin mission of the ESA on one hand, and in the context of the strike against the global warning on the other hand. Also, due to their unusual high electrical conductivity, some tellurium based glass compositions appeared as nice candidate for thermoelectric application as soon as they are doped with metallic elements such as copper. The talk will be devoted to the description of this atypical family of glass and their applications for the mid-infrared sensing as well as for thermoelectricity.

Biography
Bruno Bureau is Professor in Material Sciences and works on the glass formation processes by synthetizing special materials based on selenium and tellurium. His group develops optical devices for mid and far-infrared sensing for medical applications or space optics for example. He is the author of about 150 papers and about 25 invited talks in the field of non-oxide glasses, infrared sensing, optical fibers, material and glass science. He received the Yvan Peychès award from the French Academy of Sciences in 2009. He has co-founded the DIAFIR Company in 2011 and is currently appointed to the “Institut Universitaire de France”.

bruno.bureau@univ-rennes1.fr
Game-based materials to teaching and learning the periodic table

Antonio Joaquín Franco-Mariscal
University of Málaga, Spain

Periodic Table is a cornerstone of the Chemistry that should be learnt by all the students in the school. However, it is a boring and tedious task because pupils do not find a connection between the chemical elements and their daily life. The use of educational games can make the learning process of this topic more creative and enjoyable for students. Motivation, emotion, attention, concentration, implication or co-operation are the main keys of the games that can contribute to learning. Different game-based materials that can help students learning the names and symbols of the elements, their uses and properties or understanding the Periodic Table are presented in this communication. Playing forming words with chemical symbols can become more familiar the names and chemical symbols. Drawing everyday life contexts as objects of a house, a class or a car is other alternative to learn the uses of the chemical elements. Playing with the chemical elements in a card game can help pupils learn the different families of elements and their properties. Playing with the pieces of a puzzle can help them understand how the different elements can combine forming chemical compounds. Finally, designing a chemical soccer team with the symbols of the elements and competing with them in the stages of the Soccer World Cup can help students understand the Periodic Table.

Biography
Antonio Joaquín Franco-Mariscal obtained his PhD in Chemistry from the University of Cádiz (Spain) in 2011. Now, he is a Lecturer at the University of Málaga (Málaga, Spain) and teaches Chemistry at Juan Ramón Jiménez School in Málaga (Spain). He is a Research Chemist with interests in didactic of chemistry and educational games for secondary school students (12–16 years old). He has published more than 70 papers in reputed journals and serves as an Editorial Board Member in Revista Eureka sobre Enseñanza y Divulgación de las Ciencias. He has received 2 Educational Innovation Awards in Spain (2004 and 2006) and 11 Research Awards.

antoniojoaquin.franco@uca.es
Fibre structures for energy harvesting in wearables

Elias Siores
Bolton University, UK

The piezoelectric effect in Poly (vinylidene fluoride), PVDF, has been utilised in the development of fibres and their integration into fabric structures for energy harvesting. A “3D spacer” technology based all-fibre piezoelectric fabrics as power generators and energy harvesters are presented. The knitted single-structure piezoelectric generator consists of high β-phase (~80%) piezoelectric PVDF monofilaments as the spacer yarn interconnected between silver (Ag) coated polyamide 66 multifilament yarn layers acting as electrodes. The novel and unique textile structure provides an output power density in the range of 1.10 - 5.10 μWcm-2 at applied impact pressures in the range of 0.02 - 0.10 MPa, providing significantly higher power outputs and efficiencies over the existing 2D woven and nonwoven piezoelectric structures. The method of producing high quality piezoelectric yarn and piezoelectric fabric provides an effective option for the development of high performance energy-harvesting textile structures for electronic devices that could be charged from ambient environment or by human movement. Furthermore, via the creation of hybrid photovoltaic films and fibres, energy can be captured from solar radiation and used where the mechanical impetus is absent. The high energy efficiency, mechanical durability and comfort of the soft, flexible and all-fibre based power generator is highly attractive for a variety of potential applications such as wearable electronic systems and energy harvesters charged from ambient environment or by human movement.

Biography
Elias Siores has completed his PhD from Brunel University, UK and MBA from Wollongong University, Australia. He is the Provost, Research and Development, Bolton University, UK. He is researching in the area of smart materials for renewable energy and biomedical devices applications and has published more than 300 papers in international journals, holder of 5 international patents and recipient of 15 international awards.

E.Siores@bolton.ac.uk
Microstructure evolution at different cooling rates of a low carbon microalloyed steel

Elena Brandaleze, E Benavidez and M Melia
Universidad Tecnológica Nacional, Argentina

Rust is the reddish brown oxide of iron formed by the action of moisture and oxygen on the metal. It is an electrochemical corrosion which weakens the iron structures. It was estimated that the corrosion alone causing a loss of over $5000 bn USD to global economy every year. According to a recent report of NACE the corrosion cost in any developing countries predicated by 5% of the GDP for India the cost of corrosion is estimated to be Rs 1.52 lakh crores per year. All available methods for rust removal and corrosion prevention are having their own limitations. Therefore, it is an urgent need to find out suitable method to check the corrosion. A fungal based biological derustification process was observed and reported by us already. This present investigation deals with our further experiments and experiences on the fungal based technology for iron rust removal. The derustification process was repeated once again to conform the reproducibility of the technology in polybag fermenters. Rusty iron mesh which were rolled in the form of cylinders were placed in the fermenters to expose them to the aerosol particles generated by the fungus. The rate of derustification was noted. Attempts were also made to enhance the aerosol generation from the substrate (straw) by coconut water supplementation. It was observed that the rusty metals placed in the supplemented substrate where derusted quickly then the raw substrate. Various level of supplementation was also correlated with rate of derustification. Further works on rust removal process are under progress.

Biography

Elena Brandaleze has completed her PhD in National University of Rosario. She is the Head of the Metallurgy Department of the Tecnological National University from Argentina. She also is the vice-Director of DEYTEMA Center at the same university. She has published more than 40 papers in reputed journals and has been serving as an Editorial Board Member of repute.

Notes:
Scientific Tracks & Abstracts (Day 2)
## Session Introduction

**Title:** Photoprocesses in science education  
Michael W Tausch, University of Wuppertal, Germany

**Title:** Hybrid organic-inorganic materials for thin-film lighting technologies  
Ruben D Costa, Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany

**Title:** Novel polymer-peptide conjugates and polymer-based peptidomimetics  
Marc Devocelle, Royal College of Surgeons in Ireland (RCSI), Ireland

**Title:** Conjugated copolymers and their optimization for ambipolar field effect transistors  
Martin Baumgarten, Max Planck Institute for Polymer Research, Germany

**Title:** Spectroscopic tools to study and interpret macromolecular dynamics at a molecular scale  
Jorge Teno Diaz, Carlos III University of Madrid, Spain

**Title:** Ultrasonic fabrication of microfluidic polymer chips  
Werner Karl Schomburg, RWTH Aachen University, Germany

**Title:** Synthetic polymers from easily available monossacharides  
M Gracia García-Martín, University of Seville, Spain
Photoprocesses in science education

Michael W Tausch
University of Wuppertal, Germany

A fundamental demand on science education today is to communicate core principles of chemistry, physics, biology and informatics in close combination with everyday life experiences of students as well as with convincing applications from modern science and technology. Photochemical and photophysical processes are par excellence suitable to fulfill this requirement. Therefore research in science education is challenged to develop experiments, concepts and teaching materials which help to interpret and communicate photoprocesses in a manner, that it is both, exciting and understandable. Adequate teaching concepts, experiments and materials have bridge the gap between the state of the art in science and technology and the everyday educational activities in high schools, colleges and universities. Starting from N. J. Turro’s paradigm of the excited states of molecules as “the heart of all photoprocesses” and their interpretation as “an electronic isomer of the ground state”, a set of variations of this big idea, related models and further teaching materials have been developed in order to introduce and investigate different types of photoprocesses without and with chemical transformation. In this lecture a series of experiments leading to the concepts of photo-, chemo- and electroluminescence, energy and electron transfer, photoisomerization and photosteady will be presented and discussed together with actual applications of these phenomena. Using selected classes of photoprocesses, a gradual theoretical approach based on experimental observations will be proposed. As an example the fluorescence will be exemplified and discussed from the simple case of a luminescent dye in solution until the luminescence depletion or amplification in aggregated systems.

Biography

Michael W Tausch studied chemistry at the Polytechnic Institute of Bucharest, Romania, from 1967 to 1972. He subsequently studied mathematics and educational sciences in Bremen and Oldenburg, both Germany, and received his PhD from the University of Bremen in 1981. He was a teacher for chemistry and mathematics from 1976–1996. In 1996, he completed his habilitation at the University of Duisburg-Essen, Germany and became Professor for Chemistry and Chemical Education there. In 2005, he moved to the Department for Chemistry Didactics at Bergische Universität Wuppertal, Germany. He has published more than 222 papers and textbooks.

mtausch@uni-wuppertal.de
Hybrid organic-inorganic materials for thin-film lighting technologies

Ruben D Costa
Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany

Hybrid organic-inorganic materials are heralded to head into the next generation of lighting technologies. In this context, our efforts encompass three main actions, namely the development of suitable third-generation of electroluminescent materials for ionic-based lighting devices, the application of nanocarbon-based hybrids in lighting devices and the development of bio-inspired components for lighting, energy conversion and diagnostic applications. Herein, the implementation of the third generation of materials i.e., lighting perovskite nanoparticles, small molecules and copper (I) complexes for light-emitting electrochemical cells (LECs) will be presented as new approaches to develop deep-red, blue and white lighting sources. Finally, a new strategy to stabilize any type of bio-components like enzymes, fluorescent proteins, etc in a rubber-like material will be described. As an example, the latter was applied to fabricate the first bio-inspired hybrid light-emitting diodes featuring a bottom-up energy transfer protein-based cascade coatings. The synergy between the excellent features of fluorescent proteins and the easily processed rubber produces bio-HLEDs with less than 10% loss in luminous efficiency over 100 hours.

Biography
Ruben D Costa has obtained his PhD on the design of ionic transition-metal complexes for thin-film lighting sources at the Institute of Molecular Science in 2010. From 2011 to 2013, he was a Humboldt Post-doctorate at the University of Erlangen-Nuremberg (FAU) working on nanocarbon-based solar cells. Since 2013, he is Junior Group Leader at the FAU. His current research interest concerns the design of new hybrid materials (organic/inorganic) and their utilization in thin-film optoelectronics in which he is considered as a well-established researcher.

ruben.costa@fau.de

Notes:
Novel polymer-peptide conjugates and polymer-based peptidomimetics

Marc Devocelle
Royal College of Surgeons in Ireland, Ireland

Peptides are essential biomolecules with widespread applications, including pharmaceutical, biotechnological and in biomaterials. They are in particular an emerging class of new therapeutic candidates, but their clinical development can be limited by a number of shortcomings. Conjugation to polymers and peptidomimetic conversion are among the main technologies which have been successfully implemented to improve the pharmacokinetic and pharmacodynamic properties of peptides and proteins. In this research, both novel functionalised linear poly(ethylene glycol)s for peptide conjugation and polymer-based peptidomimetics are presented. In the former case, modified PEG backbones with high peptide loading capacities were synthesised and different conjugation chemistries investigated for their functionalization. The candidates produced can be used as peptide-based targeted drug delivery vehicles, nanomedicines or polymeric prodrugs. In the latter case, 2 classes of biologically active peptides were subjected to the novel peptidomimetic conversion. The candidates generated by this approach can reproduce or surpass the biological activity of their parent peptides, while displaying no toxicity (determined by epithelial cell viability, mitochondrial membrane potential, plasma membrane permeability and nuclear morphology). The performances of some of these candidates are close to those of reference commercial reagents.

Biography
Marc Devocelle has completed his PhD at the University of Lille (France) under contract with a pharmaceutical company. He subsequently joined RCSI in 1999 as a Post-doctoral researcher and became Manager of the Peptide Synthesis Laboratory in 2000. He has since been appointed as a Lecturer in 2004, a Senior Lecturer in 2008 and an Associate Professor of Chemistry in 2014. His laboratory is involved in over 25 collaborations with 14 academic groups across 8 HEIs in Ireland, 2 SMEs and 1 MNC.

Notes:
Conjugated copolymers and their optimization for ambipolar field effect transistors

Martin Baumgarten
Max Planck Institute for Polymer Research, Germany

Starting from cyclopentadithiophene-benzothisdiazoles, we varied the side chains from hexadecyl to branched decyl-tetradecylo ones and further included linear cis and trans-alkenes which had a major influence on the backbone packing. We further concluded to strengthen the acceptor part upon introducing thiadiazoloquinoxalines leading to a lowering of the LUMO levels and more suited ambipolar character. Upon condensation of the diamino benzothiadiazoles with benzodithiophene-dione phenthrene-dione and phenanthroline-dione the acceptor part could be further strengthened and open a variety of new copolymers and small molecule acceptor structures.

Biography

Martin Baumgarten has completed his PhD in 1988 from the Free University of Berlin and went for Post-doctoral studies to Princeton University. Since 1990 he is a Project Head at the Max Planck Institute for Polymer Research and habilitated later and became Professor at the Johannes Gutenberg-University in Mainz. He has co-authored more than 250 papers in reputed journals.

Notes:
Spectroscopic tools to study and interpret macromolecular dynamics at a molecular scale

Jorge Teno Diaz, Javier González-Benito and Dania Olmos
Carlos III University of Madrid, Spain

In Polymer Science, knowing macromolecular chains dynamics (i.e. how and why they move) is one of the most important issues to understand properties of polymers. In this sense, a good starting point might be to know if certain motions of a group or groups of atoms is the main driving force of the polymer dynamics. Therefore, instruments capable of extracting information at a local scale are essential to carry out these studies. However, the most conventional techniques used to give information about polymers dynamics are based on signals coming from changes occurring in the sample as a whole. This is the case of the differential scanning calorimetry, DSC, which measures changes in the heat capacity or the dynamic mechanical analysis, DMA, which monitors the change in the modulus of a material. Although in both cases results can be interpreted from changes in the local dynamics, the direct information from those molecular sites are not actually obtained. In fact, the deductive thought starts from a macroscopic information given by the experiments whose molecular origin will be speculations the most of times. Therefore, the way of avoiding this kind of speculations would be to achieve information at a molecular scale sensitive to the polymers relaxations or to the motions of polymers chains. Infrared spectroscopy and fluorimetry by using fluorescent labels seem to be the answer since they are very easy handling and low cost techniques. In polymers spectroscopy the study of band shapes and widths is a common practice since they are related to the distribution of different local environments experienced by the absorbing or emitting groups. In this communication, by using some examples, useful basics about infrared spectroscopy and fluorescence will be given in order to study and interpret macromolecular dynamics in polymers and polymer composites.

Biography

Jorge Teno Diaz received his degree in Materials Engineering in 2013 from the University Rey Juan Carlos (Spain). He received his master degree also in Structural Materials for New Technologies in 2014 from the University Rey Juan Carlos and University Carlos III of Madrid. Since 2015 Jorge Teno Diaz is doing his Ph.D. in Materials Science and Engineering Department from University Carlos III of Madrid in the research group of Professor González-Benito. His current research activities focus on characterization of nanocomposite materials produced by Solution Blow Spinning technique, using a variety of microscopic imaging methods, FT-IR spectroscopy and fluorescence based methods.

Notes:

jteno@ing.uc3m.es
Ultrasonic fabrication of microfluidic polymer chips

Werner Karl Schomburg
RWTH Aachen University, Germany

Ultrasonic fabrication is a new way to generate microfluidic chips. Micro channels are produced by ultrasonic hot embossing with a commercially available ultrasonic welding machine in a few seconds. A stack of polymer films is placed onto a tool with protruding micro structures. The stack is pressed onto the tool and ultrasonic vibrations generate friction heat and melt the polymer. The polymer adapts to the shape of the micro structures on the tool and hardens again by cooling down after the ultrasound is switched off. Then a single micro patterned piece of polymer is removed from the tool. A new tool can be fabricated by milling of an aluminum plate within a few hours. Therefore, this process requires both investment costs of a few 10,000 € and cycle times of a few seconds. Besides this, the fabrication can be changed to a new design or a new polymer in a few hours or a few minutes, respectively. Nearly every thermoplastic polymer can be processed this way.

By ultrasonic welding, micro channels generated by ultrasonic hot embossing are closed with a lid or another micro patterned layer. This way, chemical micro reactors, micro systems for biological investigations and analysis chips for disease diagnosis have been fabricated. Consider a polymer chip including micro structures for intercepting bubbles, a mixer and a cuvette. A cut is seen through the micro nozzle on a chemical micro reactor. The nozzle has a circular cross-section and was made of two ultrasonically hot embossed polymer layers welded on top of each other. Also there is a heat exchanger with three layers of micro channels on top of each other.

Biography

Werner Karl Schomburg obtained his Diploma in Theoretical Physics at the University of Kiel in 1983. In 1987 at the University of Munich he obtained his PhD in Experimental Nuclear Physics. He then was working for the LIGA process at Karlsruhe and became leader of a group developing low-cost micro fluidic devices from polymers. Since 2004 he has been the Head of a research group at RWTH Aachen University. His research interests are ultrasonic fabrication of micro devices from thermoplastic polymers. From 2006 to 2009 he teaching for 3 weeks every year at Tsinghua University at Beijing. Recently, the 2nd edition of his book "Introduction to Microsystem Design" has been issued. He has published more than 220 scientific papers.

schomburg@KEmikro.RWTH-Aachen.de
Synthetic polymers from easily available monosaccharides

M Gracia García-Martín
University of Seville, Spain

The development of biocompatible synthetic polymers is an emergent research field because they are specially demanded for pharmaceutical and biomedical applications. Materials of this kind are scarcely obtained from natural resources. Being petroleum the main source, the low biocompatibility and biodegradability of synthetic petroleum-based polymers have focused the interest in natural renewing resources for the chemical synthesis of polymers. Some biobased materials are being prepared from biobased monomers to increase biocontent, while other systems provide total biorenewable materials for the chemical synthesis of polymers. Since biocompatibility and biodegradability are inherent features of carbohydrates, which are the most representative example of readily available natural renewable resources, synthetic carbohydrate-based polymers generate great expectations. They can be obtained from readily available monosaccharides such as glucose, galactose, xilose, arabinose, among others. However, the synthesis of the monosaccharide-based monomers implies, for instance, previous protection of hydroxyl groups or activation of unreactive carboxylic acid groups. In addition to their multiple functionalities, they present wide stereochemical diversity, thus these synthetic polymers would be able to mimic functional biological polymers. On the other hand, the hydrophilic nature of the resulting materials affords enhanced hydrolytic degradability. Carbohydrate-based polymers such as polyamides, polyesters, polyesteramides, polycarbonates, polyureas, polyurethanes and polytriazoles have been prepared, as well as chemical modifications of commercial petroleum-based polymers like PET.

Biography

M Gracia García-Martín received her PhD degree in Pharmacy from the University of Seville (Spain) in 1985, in the carbohydrate chemistry field. She got a Fulbright Post-doctoral Fellowship to move to Ohio State University (USA, 1986-88). She was appointed Tenure Professor at the Department of Organic and Pharmaceutical Chemistry of the University of Seville in 1990, and accredited to Full Professor in 2014. She has published about 40 scientific papers in reputed journals. Her current research interest focuses on the preparation of sugar-based monomers for the synthesis and characterization of biodegradable polymers for biomedical applications.

Notes:
Session Introduction

Title: **Solute effect on grain boundary migration in ultrafine/nanostructured materials**
Yan Huang, Brunel University London Institute of Materials and Manufacturing, UK

Title: **Application of ultra-thin flexible glass sheets to microfluidic devices**
Yo Tanaka, RIKEN, Japan

Title: **Nanoscale strategies towards development of advanced Mn-based permanent magnets**
Felix Jimenez-Villacorta, Materials Science Institute of Madrid (ICMM-CSIC), Spain

Title: **Sialon nano-composites matrix reinforced by cubic boron nitride prepared by using spark plasma sintering**
Abbas Saeed Hakeem, King Fahd University of Petroleum & Minerals, Saudi Arabia

Title: **Segregation of ions in deliquesced droplets of alkali halide nano-crystals on SiO₂**
Kenta Arima, Osaka University, Japan

Title: **Nanomechanics with nanotubes and fullerene-like-WS₂(MoS₂)**
Reshef Tenne, Weizmann Institute, Israel

Title: **One-pot waterborne superhydrophobic pigment coatings at high solids with improved scratch and water resistance**
Agne Swerin, SP Technical Research Institute of Sweden – Chemistry, Sweden

Title: **Fuel briquettes from municipal solid waste through solid state fermentation**
S.Rajendran, Saraswathi Narayanan College, India

Title: **Microreactors based on nanostructured monolithic materials for electrochromatography separation and catalysis applications**
Seydina Ibrahima KEBE, University Paris-East, France

Title: **Heterogeneous kinetic uptake studies of conventional and nanomaterials in solution**
Lee D. Wilson, University of Saskatchewan, Canada
Solute effect on grain boundary migration in ultrafine/nanostructured materials

Yan Huang
Brunel University London, UK

Interactions between solute atoms and grain boundaries have strong impact on the kinetics of grain boundary migration (GBM). It has been shown that GBM rate is dependent on boundary misorientation angle, rotation axis and geometry of boundary plane because solute boundary interactions are largely determined by these boundary features. Grain size also affects GBM kinetics but the effect has been mainly related to the change in boundary curvature. The present work was conducted to investigate the effect of solute atoms on GBM in ultrafine/nanostructured materials, focusing on features of solute segregation and consequently GBM kinetics. GBM kinetics during deformation and annealing in high purity Al-Mg and Al-Cu aluminium alloys was examined and analyzed. For alloys with small amount of solute additions, boundary segregation is found heterogenous in ultrafine/nanostructured materials due to the presence of excessive grain boundaries that can accommodate solute atoms. Grain boundaries with less or without solute segregation gain extra driving pressure for migration, leading to abnormal local grain growth. This contributes to the thermal instability of ultrafine/nanostructured materials. For alloys with saturated solute additions, boundary assisted precipitation takes place and Zener pinning dominates GBM behavior. The thermal stability of the grain structure depends on the kinetics of precipitate growth. The driving pressure for GBM is inversely proportional to grain size and the influence of ultrafine/nanostructure on the thermodynamics of GBM is also discussed.

Biography
Yan Huang is currently a Lecturer in the Institute of Materials and Manufacturing, Brunel University London. He has previously worked as a Technical Director at Confae Technology Ltd. (UK) from 2004 to 2010 and as a Senior Research Fellow at the University of Manchester from 1996 to 2004. He has extensive experience in physical metallurgy of light alloys and published over 70 peer reviewed journal papers.

Yan.Huang@brunel.ac.uk

Notes:
Application of ultra-thin flexible glass sheets to microfluidic devices

Yo Tanaka
RIKEN, Japan

Ultra thin glass is a glass sheet with a minimum thickness of a few micrometers fabricated using an overflow fusion downdraw process. In this lecture, application of this very flexible glass sheet to microfluidic devices is presented. Microfluidic technology is a major research field aiming to realize sophistication of analytical experiments. The most popular material in this field is Polydimethylsiloxane (PDMS) due to its low cost, self-sealing, and elastomeric property. However, chemical and physical instability is not enough. By contrast, glass is stable. In analytical field, optical transparency and durability against laser or acoustic wave is significant. But, glass is hard. So, it is difficult to make valves or pumps into a glass microchip. Here, ultra thin glass is used to make such fluidic devices exploiting the flexibility. Microchips were fabricated by wet-etching and thermal fusion to guarantee 100% glass. The valve function in a 100-µm width, 50-µm depth linear channel was then demonstrated. The durable pressure and the response time were comparable to similar PDMS-based valves. Peristaltic pump principle using 4-sequential valves was also demonstrated, and the flow rate was also comparable to conventional PDMS peristaltic pumps. This valve and pump system can be applied to wide range of fields using glass.

Biography
Yo Tanaka received his PhD degree in Engineering at the University of Tokyo in 2007. He worked as an Assistant Professor at the Department of Applied Chemistry, School of Engineering, the University of Tokyo, Japan from 2008 to 2011. He has been working as a Unit Leader at Quantitative Biology Center, RIKEN, Japan, since 2011.

yo.tanaka@riken.jp

Notes:
Nanoscale strategies towards development of advanced Mn-based permanent magnets

Felix Jimenez-Villacorta
CSIC-Materials Science Institute of Madrid, Spain

The so-called “rare-earth crisis” in the 2010’s re-ignited investigation in the search for new concepts in permanent magnetic materials design. The key factor that determines this new joint global effort is that advanced fabrication and analysis methods with precision down to the nanoscale that combine composition and crystal structure control and optimization of the microstructure to manipulate the intrinsic magnetic properties of magnets (magnetization, exchange and magnetocrystalline anisotropy) or to enhance extrinsic magnetic features (remanence and coercivity) are now accessible. In this presentation, different strategies will be described in which nanostructuring and control of crystal structure and composition to the nanoscale through metallurgical non-equilibrium processing techniques convey optimization of the magnetic properties or advantageous modification of the fabrication process of new magnets. Two examples will be introduced. On one hand, a proof-of-concept of an exchange-biased magnet is presented, reproducing the special microstructure of anisotropic Alnico magnets in phase separated Fe-Co-Mn nanostructured alloys, as an alternative pathway for realization of novel rare-earth-free exchange-coupled magnets. Also, processing methods for nanostructured MnAl alloys are envisioned to promote formation of the intermetallic L10-type MnAl phase from a precursor ε-MnAl phase (exhibiting micromagnetic character) with lowered phase transformation temperatures, providing an attractive low energy route for the fabrication of permanent magnets.

Biography
Felix Jimenez-Villacorta is a Researcher at the Materials Science Institute of Madrid (ICMM-CSIC). After completion of his PhD in 2007, he worked for 3 years at the European Synchrotron Radiation Facility (ESRF), in the characterization of magnetic nanostructured materials by X-ray absorption spectroscopy techniques. After that, he made a Post-doctoral stay at Northeastern University, conducting research on the development of rare-earth-free nanostructured permanent magnetic materials. He has published 64 papers (+3 under review) in reputed journals, including a review article, and 2 book chapters.

fjv2003@gmail.com

Notes:
Sialon nano-composites matrix reinforced by cubic boron nitride prepared by using spark plasma sintering

Abbas Saeed Hakeem \textsuperscript{1a*}, Bilal Anjum Ahmed \textsuperscript{2b}, Akolade Idris Bakare \textsuperscript{1c}, Ibrahim Ahmed Ibrahim Ali \textsuperscript{1d}, Tahar Laoui \textsuperscript{1e}

\textsuperscript{1}Center of Excellence in Nanotechnology, King Fahd University of Petroleum & Minerals, Dhahran, 31261, Saudi Arabia

\textsuperscript{2}Mechanical Engineering Department, King Fahd University of Petroleum & Minerals, Dhahran, 31261, Saudi Arabia

A luminosilicate oxynitride and cubic Boron Nitride (cBN) composites having excellent mechanical properties and chemical stability in room temperature to high temperature applications. In the present study, cubic Boron Nitride (cBN) reinforced alpha-Sialon nano-composites were prepared using Spark Plasma Sintering (SPS) technique. The starting powders including Sialon precursors and various particles size of cBN (10, 20 and 30 wt.%) were homogeneously mixed by probe sonication before sintering. The effect of SPS processing parameters on the densification and mechanical behavior of these nano-composites were investigated. These cBN enabled in the densification sialon composite samples were analyzed for phase identification by X-ray diffraction. As well as, composite samples were evaluated to find cBN to hBN transformation in the Sialon matrix sintered at 1500 $^\circ$C. Field emission scanning electron microscopy (FESEM) used for morphology and hardness and fracture toughness were measured.

Biography
Abbas Saeed Hakeem has completed his PhD from Stockholm University. He is a Research Scientist at Center of Excellence in Nanotechnology, King Fahd University of Petroleum and Minerals. He has published more than 25 papers in reputed journals.

ashakeem@kfupm.edu.sa
g201410060@kfupm.edu.sa aibakare@kfupm.edu.sa
g201102610@kfupm.edu.sa tlaoui@kfupm.edu.sa
Segregation of ions in deliquesced droplets of alkali halide nano-crystals on SiO₂

Kenta Arima
Osaka University, Japan

Anion concentrations at the air/water interface of saline droplets are important in atmospheric and environmental chemistry, because gaseous halogens emitted from the droplet surface mediate various key tropospheric chemical processes. The purpose of this study is to reveal the ion segregation in deliquesced droplets of alkali halide nano-crystals on SiO₂; noted that SiO₂ was chosen as a model substrate for dust particles. First, the adsorption of water on alkali halide nano-crystals (KBr, KCl, KF, NaCl) on SiO₂ was in-situ investigated by noncontact atomic force microscopy (AFM) in an amplitude-modulation mode with electrostatic forces. For KBr, KCl and NaCl, deliquesced droplets show negative surface potentials relative to the surrounding region, indicating the preferential segregation of Br− and Cl− anions to the air/solution interface, even in the presence of a liquid/solid interface located a few nanometers away. This trend is more drastic for larger anions, meaning that heterogeneous reactions of gas-phase molecules with saline droplets to emit gaseous halogens can be more significant with larger anions. Secondly, I used ambient-pressure X-ray photoelectron spectroscopy (XPS). In-situ XPS spectra of a deliquesced droplet of KBr on SiO₂ demonstrate that Br− ions are segregated at the air/droplet interface, which agrees with the AFM results. Thirdly, I introduce our recent challenge to fabricate a transistor with a gate insulator of SiO₂. The point of this transistor is a water droplet acting as a gate material instead of metals. After showing its design and device process, I present some results of electrical characteristics of the water-droplet/SiO₂/Si transistor.

Biography
Kenta Arima is an Associate Professor in the Department of Precision Science and Technology in the Graduate School of Engineering in Osaka University, Japan. In 2000, he received his PhD in Precision Science and Technology from Osaka University. In 1997-2000, he was a Junior Research Associate at RIKEN. He became an Assistant Professor in 2000 and has been an Associate Professor since 2009 at Osaka University. In 2007-2008, he was a visiting scholar in Materials Sciences Division in Lawrence Berkeley National Laboratory (USA). He is a member of four academic societies including Materials Research Society.

arima@prec.eng.osaka-u.ac.jp

Notes:
Nanomechanics with nanotubes and fullerene-like-WS₂ (MoS₂)

Reshef Tenne
Weizmann Institute, Israel

Some new aspects of nanomechanics and nanotribology with fullerene-like (IF) and nanotubes (INT) of WS2 (MoS2) will be discussed. New experimental work on the mechanical behavior of individual nanoparticles will be presented and discussed. These experiments were established in order to address specific questions, like the mechanical strength of such nanoparticle under compression. In the next series of slides, the mechanical and tribological properties of nanocomposites based on such nanoparticles will be shown and discussed. Finally, the wetting of individual WS₂ nanotubes by liquids will be discussed.

Biography

Reshef Tenne earned his Ph.D. in 1976 in the Hebrew University. He joined the Weizmann Institute in 1979, where he was promoted to a professor in 1995. He headed the Department of Materials and Interfaces and was the director of the G. Schmidt Minerva Center for Supramolecular Chemistry (2000-2007) and the Helen and Martin Kimmel Center for Nanoscale Science (2003-2014). He held the Drake Family Chair in Nanotechnology (2003-2014) until his retirement. Among his recognitions were the Materials Research Society Medal (2005); The Koltzoff Prize in Chemistry of the Technion, Israel (2005); The Israel Vacuum Society Excellence in Science Prize (2006); The Landau Prize of the Israeli Lottery in Nanotechnology (2005); was nominated MRS Fellow in 2008; received the Israel Chemical Society Prize (2008) and the European Research Society (ERC) Advanced Research Grant (2008). He became Fellow of the Royal Society of Chemistry, elected to the Israel Academy of Sciences and Academia Europaea in 2015 and was chosen to deliver the CNR Rao Award Lecture (Indian Chemical Res. Soc.) in 2012. He received the Gold Medal of the Israel Chemical Society (2015) and the Rothschild Prize for Physical and Chemical Sciences (2016).

Notes:

reshef.tenne@weizmann.ac.il
A pigment coating was developed to achieve superhydrophobicity in one step from a waterborne formulation containing aragonite calcium carbonate, hydrophobized using sodium oleate, latex binder and cross-linker. Coatings formulated ≤50 mass% and applied to polyethylene coated paperboard substrates displayed typical superhydrophobic features: water contact angles ≥150°, low roll-off angle and low stain sizes, but poor scratch and water resistance as well as foaming issues during preparation. Reformulation at higher solids content significantly improved scratch and water resistance properties. Water rinsing of the dried coatings further increased the water barrier capacity due to reduced surfactant-assisted wetting; findings were corroborated by detailed surface chemistry analyses showing the removal of surface-active components after water rinsing of the dried coatings. A plausible cause for the improved durability is the fact that capillary forces increase exponentially with increasing pigment volume fraction (power law exponent of 2.2) leading to efficient binder coverage during the early stage of pigment coating consolidation.

Biography
Agne Swerin is Research Director at SP Technical Research Institute of Sweden – Chemistry, Materials and Surfaces and Troëdsson Professor in Forest-based Surface Chemistry at KTH Royal Institute of Technology, Division of Surface and Corrosion Science.

agne.swerin@sp.se
On the peculiar mechanical and tribological behavior of polymer nanocomposites with nanotubes of WS$_2$ and nanowires of Mo$_6$S$_2$I$_8$

Johann G Meier
ITAINNOVA Instituto Tecnológico de Aragón, Spain

W e report on the preparation and resulting mechanical and tribological properties of polymer nanocomposites (PNC) based on nanotubes of tungsten disulfide (WS$_2$) and nanowires of Mo$_6$S$_2$I$_8$ (MoSI) with both; a semicrystalline apolar and an amorphous polar thermoplastic polymer (i-PP, PC). The PNCs were obtained by melt-mixing of nanoparticles into polymer using a lab-scale conical twin-screw extruder. We present the results of the mechanical and tribological properties of the PNC in function of NP-concentration and processing conditions. Most, interesting is the fact that excellent reinforcement of both polymer matrices is obtained with both types of nanoparticle morphologies (wires and tubes). Up to 1.5 wt% nanoparticle concentration one observes a steady increase of Young's modulus. Higher concentrations mark a plateau, which is ca. 25% higher than the pure polymer matrix. Estimates of the fibre aspect ratio, employing the reinforcement model of Halpin and Tsai, give very high values that are apparently beyond any physical sense, marking the limits of the Halpin-Tsai model. We point out that the extremely high reinforcing effect cannot be attributed to the induction of crystallinity nor changes in the crystalline morphology, because the effect occurs in the amorphous matrix as well. Studies of the tribological properties of the i-PP composites revealed a reduction of the friction coefficient by ca. 25% at a concentration of 1.5wt%. Composites with WS$_2$-nanotubes performed better than nanowires of Mo$_6$S$_2$I$_8$. Likewise wear rate was reduced by ca. 25%, although here the nanowires of Mo$_6$S$_2$I$_8$ showed better results.

Biography

Johann G Meier studied Chemistry from 1991-1996 at Humboldt-University Berlin. He graduated with a Master thesis on photo-orientation of liquid crystal side chain polymer films. He then went to Chalmers University of Technology, Gothenburg, working on chiral and polar effects in liquid crystals in the group of S. T. Lagerwall, receiving his Doctorate for the discovery, characterization and description of an anti-ferroelectric twist grain boundary liquid crystalline phase in 2002. From 2002-2006, he was Post-Doc at Deutsches Institut für Kautschuktechnologie (DIK); Hanover, focusing there on reinforcement of elastomers, polymer-nanoparticle interactions and filler network structures. Since October 2006 he has been at the Instituto Tecnológico de Aragón, Zaragoza were he has built-up the research line on polymer nanocomposites. He has authored more than 30 papers.

jmeier@itainnova.es

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