Plenary Lectures

Wednesday 06.12.2017	**11:00-11:30 Plenary (1)**	**Prof. Toshiaki Enoki**	**Energy & Nano. Elect._363-ICN3I** Molecular science of Nanographenes – Interplay between edge geometry and Chemistry in their Electronic Structures
Wednesday 06.12.2017	**11:30-12:00 Plenary (2)**	**Prof. Peter Skabara**	**Syn. & Char._23-ICN3I** Investigating twisted and other non-conventional molecular architectures for application in organic electronics
Wednesday 06.12.2017	**12:00-12:30 Plenary (3)**	**Prof. Uwe Boveispien**	**Energy & Nano. Elect._1039-ICN3I** Ultrafast spin current induced magnetization dynamics in epitaxial metallic heterostructures
Wednesday 06.12.2017	**14:00-14:30 Plenary (4)**	**Prof. Y. Shacham-Diamand**	**Sens. & Act._1105-ICN3I** Printed Nano-Particles Based Bio Sensors
Wednesday 06.12.2017	**14:00-14:30 Plenary (5)**	**Prof. Shigeyuki Toki**	**Syn. & Char._31-ICN3I** Strain-induced crystallization and mechanical properties of rubber and thermo-plastic elastomer
Thursday 07.12.2017	**09:00-09:30 Plenary (6)**	**Prof. Chan Kiat Hwa**	**Syn. & Char._665-ICN3I** Complexity In The Relationship Between Peptide Structure And Their Self-Assembly Tendencies
Thursday 07.12.2017	**09:00-09:30 Plenary (7)**	**Prof. S. K. Mishra**	**Energy & Nano. Elect._148-ICN3I** A review of EPR studies on magnetization of nanoparticles of dilute magnetic semiconductors doped by transition-metal ions
Thursday 07.12.2017	**09:30-10:00 Plenary (8)**	**Prof. Ajay K. Dalai**	**Energy & Nano. Elect._205-ICN3I** Development of Advanced Nanomaterials for Transportation Fuels from Biomass
Thursday 07.12.2017	**09:30-10:00 Plenary (9)**	**Prof. Ani Idris**	**Bio NT_92-ICN3I** Superparamagnetic iron oxide nanoparticles (SPIONs) for tissue engineering

Thursday 07.12.2017	**10:00-10:30 Plenary (10)**	**Dr. Wolfgang Betz, (Director, Sales)**	**Syn. & Char._1154-ICN3I** Applications of 2- and 3-dimensional Analysis on Nanostructured Materials using XPS, Auger and Time-of-Flight SIMS with MS/MS
Thursday 07.12.2017	**10:00-10:30 Plenary (11)**	**Prof. Felicia Iacomi**	**Syn. & Char._1153-ICN3I** Functional hybrid nanocomposites
Thursday 07.12.2017	**14:00-14:30 Plenary (12)**	**Prof. Toyoko Imae**	**Syn. & Char._302-ICN3I** Fabrication and application of carbon-based composites
Thursday 07.12.2017	**14:00-14:30 Plenary (13)**	**Prof. Tamoghna Mitra**	**Sens. & Act._1114-ICN3I** Porous Organic Molecular Solid for Separations

Plenary Speakers 1

Date and Time : 06.12.2017, 11:00-11:30
Room : Convocation Hall
Name : Prof. Toshiaki Enoki
Affiliations : Department of Chemistry, Tokyo Institute of Technology,
Ookayama, Meguro-ku, Tokyo 152-8551 Japan

Molecular science of Nanographenes – Interplay between edge geometry and Chemistry in their Electronic Structures

Graphene is a two–dimensional one-atom-thick carbon sheet created by fusing infinite number of benzene rings. When an infinite graphene sheet is cut into nanofragments, a variety of graphene nanostructures having different sizes and geometries are created. Here their electronic structures depend crucially on the edge geometry. Indeed, armchair-edged nanostructure is subjected to the formation of standing wave (aromatic stability) together with the opening of an energy gap, whereas a nonbonding edge state, which is the origin of electronic, magnetic and chemical activities, is created in the vicinity of the edges in zigzag-edged nanostructures. In addition, the electronic structures depend on how the edge carbon atoms are bonded to foreign chemical species. Accordingly, the interplay between edge geometry and chemistry gives rise to a wide variety of electronic structures.

We investigated the electronic structures of graphene nanostructures, such as linear edges, defects with one and two missing carbon atoms, and corner edges, with edge carbon atoms terminated with hydrogen or oxygen atoms, using microprobe (STM/STS, AFM) experiments together with DFT calculations. A mono-hydrogenated zigzag edge shows the presence of edge states, while replacing mono-hydrogenated sites with di-hydrogenated sites in every three edge carbon site in a zigzag edge creates a standing wave of $\sqrt{3}\times\sqrt{3}$ superstructure at the expense of edge state, similar to armchair edges. A complete di-hydrogenation of a zigzag edge gives again edge states, but their feature becomes less localized and the local density of states of the edge states becomes extended to the terminating hydrogen atoms due to hyperconjugation. An edge state in a ketonated zigzag edge penetrates into the oxygen atoms and also into the interior of graphene with a long decay length due to charge transfer from the graphene edges to the electronegative oxygen atoms. An armchair edge can have edge states when their edge carbon atoms are asymmetrically terminated with a combination of mono- and di-hydrogenation. A defect having one missing carbon atom has a variety of electronic structures with or without edge state depending on how the edge carbon atoms are terminated with hydrogen atoms. In defects having two missing carbon atoms with edge carbon atoms being oxidized, we observed an interesting switching phenomenon between edge state and standing wave, induced by the mechanical force of an AFM tip. The corner between two linear zigzag edges with a mutual angle of 60° has no edge state, when one additional carbon atom is incorporated at the corner.

Keywords: Nanographene; Electronic structure; Magnetic structure.

Plenary Speakers 2

Date and Time : **06.12.2017, 11:30-12:00**
Room : **Convocation Hall**
Name : **Prof. Peter Skabara**
Affiliations : **Department of Pure and Applied Chemistry, University of Strathclyde Glasgow, G1 1XL, United Kingdom**

Investigating twisted and other non-conventional molecular architectures for application in organic electronics

We have synthesised a series of well-defined, monodisperse oligothiophenes bearing a bridging, fused tetrathiafulvalene (TTF) unit and the much lesser known tetrathiocin heterocycle. The materials exhibit complex redox chemistry for longer conjugated analogues and they can be oxidised up to the octacation within a relatively narrow potential window. The methodology used to construct the end-capped oligothiophene chains has enabled us to explore a new range of Ge centred cruciform structures, in which the central bridging atom of the molecule provides a tetrahedral geometry. Whilst these materials are candidates for applications requiring good charge transport properties, we have also been investigating oligofluorene star-shaped structures for photonics applications and we report two series of new materials with multifunctional architectures. In this presentation we report on the synthesis, self-assembly and properties of these monodisperse macromolecules.

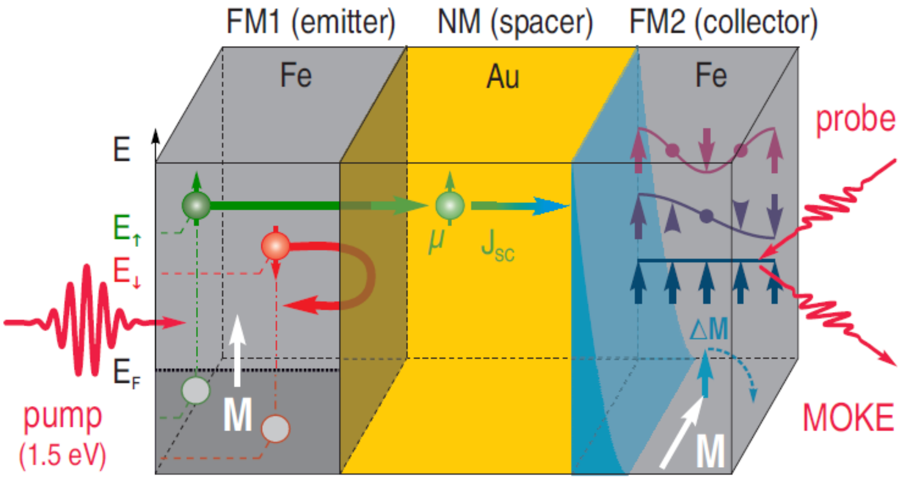
Keywords: Ologothiophenes; Photonics; Charge transport; Tetrathiafulvalene

Plenary Speakers 3

Date and Time : 06.12.2017, 12:00-12:30
Room : Convocation Hall
Name : Prof. Uwe Boveispien
Affiliations : Faculty of Physics and Center for Nanointegration (Cenide),
University of Duisburg-Essen, 47048 Duisburg, Germany

Ultrafast spin current induced magnetization dynamics in epitaxial metallic heterostructures

Optical excitation of ferromagnets results in spin-polarized hot electrons, which relax locally on femtosecond time scales within the ferromagnet and are transferred into adjacent constituents leading to transient spin currents. We analyse such spin currents and the photo-excited magnetization dynamics in epitaxial heterostructures by time-resolved magneto-optics. Pump-probe experiments on Co/Cu (001) detecting the complex, linear magneto-optical Kerr effect (MOKE) and the second harmonic optical response allow to disentangle the magnetization dynamics near the surface and the inner interface. The dynamics of local demagnetization due to spin flip scattering and spin transfer into Cu is distinguished. Back pump – front probe experiments in epitaxial heterostructures Fe/Au/Fe/MgO (001) facilitate the analysis of the currents directly. Employing detection of the second harmonic generation we have identified a non-linear magneto-optical response which represents the symmetry breaking generated by the spin currents. Furthermore, we report up 0.5 THz standing spin waves driven by the spin current induced spin transfer torque in the collector Fe layer, see figure. A spectral analysis of the spin wave frequencies allows to estimate the depth in which the spin transfer torque acts to a few nanometer.



Keywords: Ultrafast dynamics; Spintronics; Spin currents; Spin transfer torque.

Plenary Speakers 4

Date and Time : **06.12.2017, 14:00-14:30**
Room : **LHC 001**
Name : **Prof. Y. Shacham-Diamand**
Affiliations : **School of Electrical Engineering, Faculty of engineering, Tel Aviv University, Ramat Aviv, Israel 69978**

Printed Nano-Particles Based Bio Sensors

Additive patterning of functional electronic materials allows low cost and high throughput fabrication method producing integrated sensors on both rigid and flexible substrates. In this work, we present recent results on nanoparticles printed by inkjet printing, electroplating and by cluster beam deposition. Inkjet direct patterning has advantages of being low cost, low waste and simple; however, the nanoparticles are in an ink media which needs extra care. Electroplating of gold nanoparticles is unique method depositing selectively on polypyrrole high quality nanoparticles with relatively large distribution in size. Cluster beam deposition yields high quality nanoparticles with very narrow size and shape distribution that can be tailored to many substrate; however, it requires high vacuum deposition systems which are typically of cost and lower throughput when compared to Inkjet or laser printing for example. Additionally, we present a way to modify the nanoparticle characteristics using electroless plating of gold and their modification using other electroless and electroplating processes.

We present few sensor types, suitable for flexible substrates, the first is a bio-electrochemical device made by ink-jet printed seed on polyimide substrate followed by two gold plating steps: electroless plating (AuELD) followed by electroplated (AuELP). After a short description of the electrodes we present the electrical properties of the thin film and their bio-electrochemical sensing properties. The second is a device made by gold nanopartoles on polypyrrole. The last one is a family of devices based on conjugate polymers (e.g. polyaniline, polypyrrole) modified with gas phase clusters. Three types of cluster beam sources were utilized; 1. Laser ablated Pt and Pt:Ni clusters deposited on PANI were utilized for dopamine sensing. 2. Au cluster assembled film implanted on PDMS were used for electroless plating and enzyme bio sensing. 3. Au cluster deposited using magnetron source on polypyrrole were used for electroless plating. Finally, we present few results of bio electrochemical sensors. For example, specific gold nanoparticle modified polypyrrole electrode chips were tested for enzymatic sensors, sensing p-aminophenol (pAP) which is a common product in enzymatic reactions in whole cell bio sensor. The electrodes demonstrated sensitivity of 8.3mA/mM and limit of detection of 1.5µM with 91% specificity for the detection of alkaline phosphatase (ALP) enzyme in the presence of the ascorbic acid. Another example is sensor based on inkJet printed silver nanoparticles coated with electroless gold sensing Alkaline Phosphatase enzyme in the presence of its substrate, *p*-Aminophenyl Phosphate. The electrodes demonstrated a sensitivity of 11.8µA/mM and a limit of detection of 0.9mM.

Keywords: Bioelectrochemical sensors; Additive manufacturing; Nano particles.

Plenary Speakers 5

Date and Time : 06.12.2017, 14:00-14:30
Room : LHC 002
Name : Prof. Shigeyuki Toki
Affiliations : Chemistry Department, Mahidol University, Salaya, Thailand

Strain-induced crystallization and mechanical properties of rubber and thermo-plastic elastomer

Excellent mechanical properties of rubber and thermos-plastic elastomer, such as high tensile strength and strong cut resistance with low modulus, are owed to crystal structure and crystallites size of strain-induced crystallization. Synchrotron X-ray makes it possible to measure crystallization behaviour and stress-strain relation simultaneously. The size of crystallites is 3.12 nm x 5.51 nm x 3.00 nm in natural rubber at strain 6.0. This small size of crystallites makes natural rubber strong as high elongation, high tensile strength and tough cut resistance. In the case of thermos-plastic elastomer, hard segment is network point and soft segment is flexible rubber chain. During deformation, hard segment orients and soft segment align and become strain-induced crystal. These behaviours of strain-induced crystallization depend on stereo-regularity and molecular weight distribution of polymer.

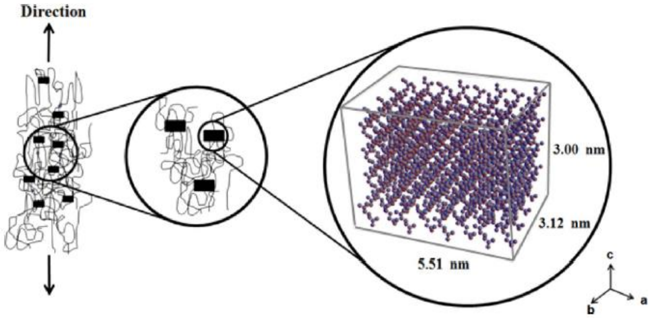


Figure 1. Schematic model of strain-induced crystallites in natural rubber.

Keywords: Strain-Induced crystallization; Rubber; Thermos-plastic elastomer; Mechanical properties.

Plenary Speakers 6

Date and Time : 07.12.2017, 09:00-09:30
Room : LHC 001
Name : Prof. Chan Kiat Hwa
Affiliations : Division of Science, Yale-NUS College, 16 College Avenue West, Singapore

Complexity in the relationship between peptide structure and their self-assembly tendencies

Designer synthetic self-assembling peptide sequences, such as RADA16, show how well-defined synthetic oligopeptides can be used to prepare hydrogels. Unlike proteins derived from animal and plant sources, synthetic peptides made from natural amino acids can be easily purified with no concern about biological contamination. In addition, the composition of synthetic peptides is well defined and peptide properties can easily be tuned at the molecular level. Indeed, peptide hydrogels have been explored for many medical uses, including, but not limited to, high throughput screening of anticancer drugs, promotion of central nervous system regeneration, hemostasis, and angiogenesis. The design of such self-assembling peptides for biomedical purposes has most commonly been performed through rational design and large-scale screening. In this regard, however, the relationship between structure and self-assembly tendencies is not well understood. To address this gap in understanding, a systematic study of how fundamental structural changes in peptide side chains influence self-assembly outcome was carried out. From the parallel study of several classes of peptides, it was found that the same structural change does not actually effectuate the same change in peptide self-assembly outcome. This has important implications on how peptide design for new novel applications can proceed.

Keywords: Peptide; Self-assembly; Design.

Plenary Speakers 7

Date and Time : **07.12.2017, 09:00-09:30**
Room : **LHC 002**
Name : **Prof. Sushil K. Misra**
Affiliations : **Physics Department, Concordia University, 1455 de Maisonneuve Boulevard West, Montreal, Quebec, H3G 1M8, Canada**

A review of EPR studies on magnetization of nanoparticles of dilute magnetic semiconductors doped by transition-metal ions

This talk reviews recent EPR studies on the magnetic properties of nano-particles of dilute magnetic oxide semiconductors (DMS) doped with transition metal ions. These nanoparticles are SnO_2 doped with Co^{2+}, Fe^{3+}, Cr^{3+} ions, CeO_2 doped with Ni^{2+}, Co^{2+} ions, and ZnO doped with Fe^{3+} ions. The EPR studies reveal that the method of synthesis, surface properties, and size of nanoparticles are important factors that determine the magnetic properties of DMS nanoparticles. In addition, they indicate that there may occur coexistence of ferromagnetic and paramagnetic phases. The saturation magnetization, as estimated from EPR signal, depends both on the doping level of impurities and annealing temperature. Undoped DMS also exhibit ferromagnetism due to oxygen vacancies. Furthermore, the EPR spectrum depends very sensitively on the size of nanoparticle.

Keywords: EPR Studies; Dilute Magnetic Oxide Semiconductors; Magnetic Properties.

Plenary Speakers 8

Date and Time : 07.12.2017, 09:30-10:00
Room : LHC 001
Name : Prof. Ajay K. Dalai
Affiliations : Department of Chemical and Biological Engineering, University of Saskatchewan, Saskatoon, SK, S7N 5A9, Canada

Development of Advanced Nanomaterials for Transportation Fuels from Biomass

Fischer-Tropsch (FT) and higher alcohol synthesis (HAS) processes are important for the conversion of synthesis gas (syngas) (from biomass, coal or natural gas) to transportation fuels. These fuels are free from sulfur and nitrogen compounds and are thus quite clean with high octane and cetane numbers. In this presentation, the feasibility of using new nanocatalyst formulations for FT and HAS are discussed with a focus on the conversion of biomass derived syngas to green diesel and alcohols. For FT synthesis, the effectiveness of both unpromoted and promoted Fe and Co on carbon nanotubes (CNTs) is examined. The effects of pore diameter and structure of iron and iron catalysts supported on CNTs on FT reaction rates and product selectivity are presented. Two types of CNTs with different average pore sizes (12 and 63 nm), however with comparable surface area, were examined. The CNTs were prepared by chemical vapor deposition method, where as the metals were loaded with incipient impregnation method and the catalysts were characterized by ICP, BET, XRD, TPR, SEM and TEM analyses. According to TEM images of iron catalysts supported on narrow pore CNTs (np-CNT) and wide pore CNTs (wp-CNT), a majority (~80%) of the iron oxide particles were deposited inside the nanotubes' pores. These particles on the Fe/wp-CNT (17 nm) were larger than those on Fe/np-CNT sample (11 nm). Also, the degree of reduction and metal dispersion of the Fe/np-CNT catalyst was much higher compared to the other catalyst leading to better FTS in terms of CO conversion and C_5+ selectivity of the np-CNT catalyst. In addition, novel cobalt catalyst supported on CNTs promoted with Co, Ru and K with low deactivation was created, extensively characterized and studied for FT reactions. The data show that the catalyst is quite promising with high catalyst activity and C_5+ selectivity. A series of alkali and metal (Rh and Co) promoted MoS_2 catalysts supported on CNTs were prepared and extensively tested for HAS reactions in a fixed-bed system. Our research has shown that the total alcohol space time yield (STY) using trimetallic catalyst is 0.281 g/g of cat.h at optimum reaction conditions. The catalysts were pelletized and confirmed for their activities and product selectivities for Gas-to-Liquid Technologies (GTL).

Keywords: Fischer-Tropsch Synthesis; Higher Alcohol Synthesis; Iron; cobalt.

Plenary Speakers 9

Date and Time : 07.12.2017, 09:30-10:00
Room : LHC 002
Name : Prof. Ani Idris
Affiliations : Faculty of Chemical and Energy Engineering, Universiti Teknologi Malaysia, 81310 UTM Johor Bahru, Johor, Malaysia.

Superparamagnetic Iron Oxide Nanoparticles (Spions) for Tissue Engineering

Superparamagnetic iron oxide nanoparticles (SPIONs) have been recognized as an attractive material in biomedical applications such as magnetic cell seeding, cell expansion, cell sheets construction, drug delivery vehicle, cancer hyperthermia treatment and tissue engineering. Several researchers have demonstrated that magnetic nanoparticles have the osteoinduction effect even without external magnetic force. In this paper, an inclusive review is presented on the research and development related in the usage of SPIONs mostly; γ-Fe2O3 in tissue engineering scaffolds. The preparation of γ-Fe2O3, electrospinning of these scaffolds and combining this process with other techniques so as to produce three dimensional constructs to overcome the disadvantages in the two dimensional electrospun mats are also elaborated. Other issues concerning the mechanical properties, biocompatibility, technology limitations and parameter influences are also elaborated. Our findings revealed the SPIONs filled poly-vinyl alcohol (PVA) matrix has suitable Young’s modulus and biocompatibility to be used for tissue engineering.

Keywords: SPIONs; Tissue engineering; Electrospinning; Nanofibers.

Plenary Speakers 10

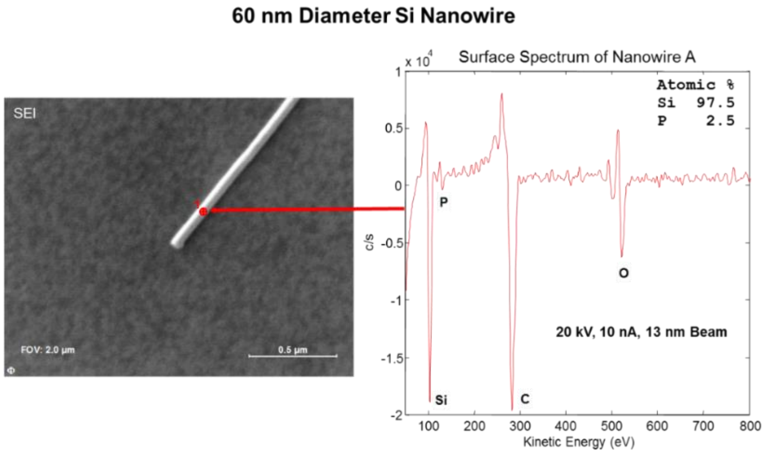
Date and Time : 07.12.2017, 10:00-10:30
Room : LHC 001
Name : Dr. Wolfgang Betz
Affiliations : Physical Electronics, Am Berg 4, 97252 Frickenhausen, Germany

Applications of 2- and 3-dimensional Analysis on Nanostructured Materials using XPS, Auger and Time-of-Flight SIMS with MS/MS

Modern surface analytical techniques such as Field Emission Scanning Auger Microscopy, X-ray Photoelectron Spectroscopy and Time-of-Flight Secondary Ion Mass Spectrometry can address key analytical questions relevant to develop new materials.

The very shallow probing depth of these techniques of only 0.1 – 10nm, together with the high spatial resolution of down to 6nm make them key contributors for the development of new materials. All these techniques allow the use of in-situ etching for the removal of surface contaminants, the investigation of layered materials and to study diffusion phenomena. Depending on the thickness and composition of the material, different etching sources such as ultra-low energy monoatomic Argon sputtering, Focused Ion Beam (FIB), Argon Gas Cluster Beams (GCIB) or C_{60} Cluster Guns are used.

In this talk, examples of the successful analysis 2D and 3D analysis of Nanostructured material such as single Nanowires and Nanocones will be presented. Furthermore, the analyses of multilayered organic and in-organic films with thicknesses in the nanoscale regime will be discussed.



Keywords: Surface analytical techniques; Ultra-low energy monoatomic argon sputtering; Focused Ion Beam (FIB); Argon Gas Cluster Beams (GCIB).

Plenary Speakers 11

Date and Time : 07.12.2017, 10:00-10:30
Room : LHC 002
Name : Prof. Felicia Iacomi
Affiliations : Faculty of Physics, Alexandru Ioan Cuza University of Iasi, Romania

Functional hybrid nanocomposites

Powders, layers or thin films of hybrid nanocomposites were obtained using as matrices polydimethylsiloxane (PDMS) or graphene (G) or reduced graphene oxide (rGO) and as fillers different oxide nanopowders (SnO_2, Fe_2O_3, etc.) or nanoparticles (Ag/PDMS, Fe2O3/PDMS, G/SnO/PDMS, etc). Some of layered nanocomposites (Ag/PDMS) were submitted to an UV irradiation process to investigate their structural stability. The hybrid nanocomposites were characterized using XRD, SEM, and XPS methods. Their electrical, optical, magnetic and sensor properties were investigated. It was established that a certain functionality could be increased by selecting properly the nanocomposite chemical composition, the synthesis conditions and post synthesis treatments.

Keywords: Hybrid Nanocomposites; Structure; Morphology; Functional properties.

Plenary Speakers 12

Date and Time : 07.12.2017, 14:00-14:30
Room : LHC 001
Name : Prof. Toyoko Imae
Affiliations : National Taiwan University of Science and Technology, 43 Section 4, Keelung Road, Taipei, Taiwan

Fabrication and application of carbon-based composites

Different types of carbon materials like fullerene, carbon nanotube (CNT), graphene, graphene oxide, carbon nanohorn (CNH), carbon nanofiber, carbon microcoil and carbon quantum dots are focused on many research fields because of their unique chemical, physical, mechanical and optical properties. However, since most of carbon materials are less dispersible in medium, they are sometimes hybridized with different compounds. Then as-prepared composite materials possess multiple characteristics originated from component compounds and thus application territory is expanded. For this purpose, the first step is the functionalization of carbon materials. The easy procedure is the oxidization, where carbon materials can load some oxidized functional groups such as carboxyl, hydroxyl, ketone and ether groups. Thus, oxidized carbon materials can be easily hybridized with other materials through chemical and physical bonding.

First, this report concerns to the hybrid formation of multiwalled CNT with Pt nanoparticle-encapsulated dendrimer (DENPtNPs). DENPtNPs were chemically immobilized on CNT. Subsequently, electrochemical sensors consisting of CNT/DENPtNPs was developed by fabricating them on working electrode. The electrochemical performance of sensors was investigated for the methanol oxidation by cyclic voltammetry. Sensors possessed the stable durability and the high electrocatalytic activity.

The second composite is the hybrid of CNH and a small amount (~1 wt%) of DENPtNPs. This composite along with CNT/DENPtNPs was provided to evaluate the hydrogen evolution reaction (HER). The excellent HER, durability and stability of composite electrodes were obtained due to chemical bonding immobilization of PtNPs on carbon materials and its substantial graphitized structure.

The in situ polymerization of conductive monomer on graphene is the next composite. Supercapacitors are one of the most talented devices for energy storage. However, the energy density on the non-faradic carbon-based electric double layer capacitors (EDLCs) is not enough high, and the faradic pseudocapacitors (PC) fabricated by conductive polymers and metal oxides are not enough stable at stronger electrochemical conditions. Thus, the hybridization of EDLC and PC materials covered such weakness of each system. The obtained composites displayed a capacitance performance with a wide potential window, excellent charge/discharge properties and non-observed internal resistance drop.

Keywords: Carbon nanotube; Carbon nanohorn; Graphene; Conductive polymer.

Plenary Speakers 13

Date and Time	**:**	**07.12.2017, 14:00-14:30**
Room	**:**	**LHC 002**
Name	**:**	**Prof. Tamoghna Mitra**
Affiliations	**:**	**Department of Chemistry, University of Liverpool, Crown St, Liverpool L69 7ZD, UK**

Porous Organic Molecular Solid for Separations

Porous materials are an important class of compounds. Porous materials, such as terracotta, charcoal and dried plant husks, have been used for millennia for filtration and purification. In modern times, porous materials such as zeolites have found extensive use in separation processes such as petrochemical cracking, ion-exchange, and the separation and extraction of gases and solvents. Other synthetic porous materials like Metal-Organic-Framework (MOF), Covalent-Organic Framework (COF) have emerged as important materials for separations. Porosity in these materials emerges as extended solids in which the molecular building blocks are linked together by strong covalent bonds. In contrast, porosity in molecular crystal emerges as consequences of either inefficient packing of an awkwardly shaped molecule or the molecule have an intrinsic cavity in the molecule. 2What set these porous molecules apart from extended frameworks is that they are solution processable and their intrinsic cavity can be engineered. These unique features allow the use of these materials for shape and size selectivity separations. Using this strategy we have demonstrated we can isolate isomers of organic feedstocks (such as mesitylene and other C-9 isomers, hexane isomers etc.), rare gases, chiral molecules and CO_2 and N_2 for the post-combustion separation process.

In this talk, I would focus on selected examples that have been achieved in Liverpool to introduce broader concepts to the audience who are new to this field.

Keywords: Porous molecular crystal; Separation of materials; Size and shape selectivity.