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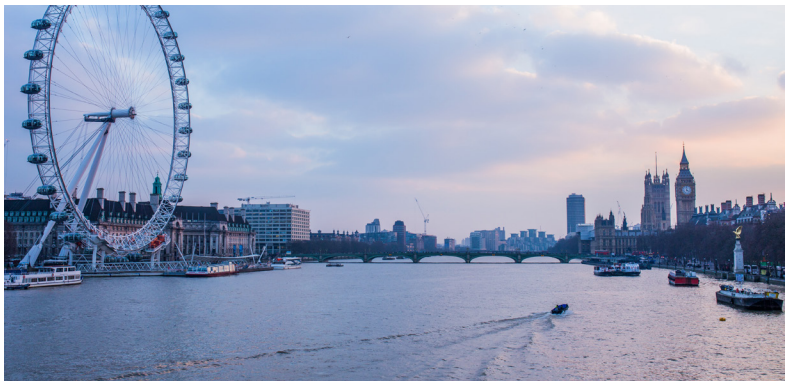


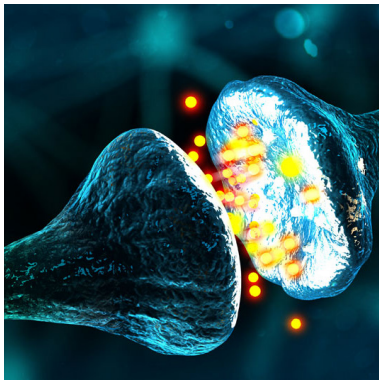

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Carbon nanoweb-based metal anode for sodium rechargeable batteries

Young Soo Yun
Kangwon National University, Korea

Because of its remarkably high theoretical capacity and favourable redox voltage (−2.71V vs. the standard hydrogen electrode), Na is a promising anode material for Na ion batteries. In this study, microporous catalytic carbon nano templates (MC-CNTs) based on nanoweb-structured carbon nanofibers with various carbon microstructures are prepared from microbe-derived cellulose via simple heating at 800 or 2400°C. MC-CNTs prepared at 800°C have amorphous carbon structures with numerous topological defects and exhibit a lower voltage overpotential of ~8mV in galvanostatic charge/discharge testing. In addition, MC-CNT-800s exhibit high Coulombic efficiencies of 99.4-99.9% during consecutive cycling at current densities ranging from 0.2 to 4 mA cm^{-2}. However, the carbon structures of MC-CNTs prepared at 800 °C are gradually damaged by cycling. This results in significant capacity losses after about 200 cycles. In contrast, MC-CNTs prepared at 2400 °C exhibit well-developed graphitic structures and maintain predominantly stable cycling behaviours over 1000 cycles with coulombic efficiencies of ~99.9%. This study demonstrates the superiority of catalytic carbon nano templates with well-defined pore structures and graphitic microstructures for use in Na metal anodes.

Speaker Biography

Young Soo Yun has completed his Ph.D. degree from Inha University, South Korea. He is the professor of Kangwon National University, South Korea. He has over 100 publications that have been cited over 2,000 times, and his publication h-index is 21. His specific research field is carbon-based electrochemistry for energy storage.

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Calprotectin detected gold nanoparticles by Lecithin-Tranexamic acid as a targeted biosensor

Wei-Lun Wang
Gene'e Tech Co. Ltd, Taiwan

Calprotectin constitutes up to 60% of soluble protein content in the cytosol of neutrophil granulocytes and it can be found at a lower concentration in monocytes, macrophages and squamous epithelial cells. Calprotectin enters into pus and abscess fluid during neutrophil cell death, along with other antimicrobial proteins. A biosensor is an analytical device, used for the detection of an analyte, that combines a biological component with a physicochemical detector. However, rapid screen has been a time trend in today's medical field. Using the new nanoparticles (NPs), a natural and precise one that combine Lecithin and Tranexamic acid, is that watch the change of the absorption wavelength 500 - 850nm could be resulted in the concentration of calprotectin from stool. And then obtain the relative data could be the gastrointestinal health.

Speaker Biography

Wei-Lun Wang is PhD in graduate Institute of Fisheries Science of National Taiwan University. Currently he is working in R&D in Gene'e Tech Co., Ltd.

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Paclitaxel-loaded magnetic nanoparticles as a targeted drug delivery system

Yu-Ming Wang
Chang Gung University, Taiwan

Paclitaxel, a microtubule-stabilizing antineoplastic cytotoxic drug, inhibits invasiveness of several cell types. In this work, an anticancer drug delivery system that combines magnetic nanoparticles with a layer-by-layers system will be proposed. The monodisperse superparamagnetic iron oxide (SPION) was prepared by thermal decomposition. The surface of the iron oxide particles was functionalized with a carboxyl group. Functionalized Fe_3O_4@TMS-EDTA combined with layer-by-layers system: Poly(l-lysine)/poly(l-glutamic acid) (PLL/PGA). Next, biotinylated paclitaxel is combined with Fe_3O_4@TMS-EDTA/PLL/PGA system. The system of Fe_3O_4@TMS-EDTA/PLL/PGA/biotinylated paclitaxel has a strong antiangiogenic activity, a property that might contribute to its antineoplastic activity *in vivo*.

Speaker Biography

Yu-Ming Wang is currently pursuing his master's in graduate Institute of Biochemical and Biomedical Engineering of Chang Gung University, Taiwan.

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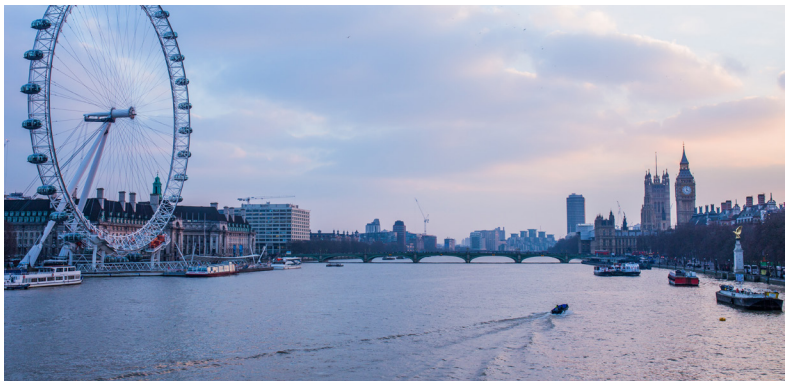


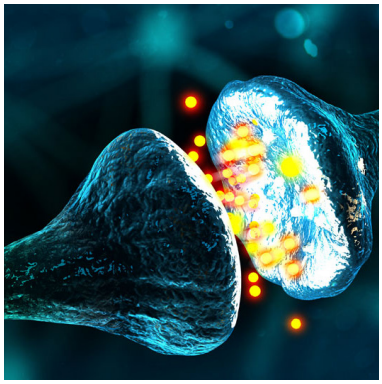

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Graphene - based nanocomposite materials for the development of human organs

Alexander Seifalian
The London Bio Science Innovation Centre, UK

Repair or replacement of many human organs still considers as unmet clinical need, including facial organs, trachea or coronary artery bypass grafts. The key important components in the development of these organs are materials can be used as the scaffold. Commercially there are not many materials to be used for human implantation, this is due to toxicity of material, immunological response or do not have the right physiochemical properties. We have developed a family of nanocomposite materials for biomedical application based on functionalised reduced graphene oxide (FRGO). Graphene considers as a wonder material, it is the strongest material on the planet, super-elastic and conductive. The functionalised GO is nontoxic and antibacterial. We functionalised GO and used it as a building block for nanocomposite materials. The materials can be fabricated to human organs with the 3D printer or other fabrication methodologies. The scaffold from these materials is functionalised with bioactive molecules and stem cells technology, so physiologically simulate the human organs. The data for development of organs using these materials will be presented. In addition, I present our data on translation work we carried out from laboratory to patients with nanocomposite materials for trachea, facial organs such as ear and nose.

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Influence of biopolymer and the polyol newtonian fluid on properties of extrusion inks of carbon nanotubes

Ali Aldalbahi
King Saud University, Saudi Arabia

Extrusion printing inks were prepared with multiwall carbon nanotube (MWNT) and iota-carrageenan (IC), a biopolymer thickening agent containing two sulphated groups, extracted from red seaweeds and with glycerine, a polyol newtonian fluid. After adjusting for the proper viscosity of both the inks i.e. IC-MWNT and G-MWNT, they were extruded by a syringe printer on glass slide, IC gel films and PET transparent sheet. Conductive tracks of the deposited printed inks were characterized with microscope, SEM, profilometer, contact angle measurement and conductivity determination. Conductivity of IC-MWNT track was 9±1 S/m and that of G-MWNT was 2942±84 S/m on glass substrate of one layer thick. This is because a smaller number of CNT is present in G-MWNT track as confirmed by SEM study. Profilometry showed that increased number of extruded layers gave increased cross-sectional area. SEM study showed that printing ink is embedded into surface of IC film, discontinuous on glass slide and smoother on PET sheet.

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Effect of organic ligand-decorated ZnO nanoparticles on electricity conversion efficiency of solar cell

Alireza Samavati
Universiti Teknologi Malaysia, Malaysia

Efficiency improvement of the industrial scale solar cells to capture sunlight as an important renewable energy source is attracting significant attention to prevent the consumption of a finite supply of unsustainable fossil fuels. ZnO nanoparticles decorated with an imine-linked receptor have been used in the fabrication of a photocathode based on dye-sensitized solar cells for the purpose of photovoltaic efficiency enhancement. Various characterization techniques have been employed to investigate the structural, morphological and optical behaviors of the solar cell having ZnO nanoparticles and ZnO nanoparticles decorated with an organic ligand as a photocathode layer. The decorated nanoparticles have a stable wurtzite structure and an average grain size of 45 nm, confirmed by the TEM image and XRD through the Scherrer equation. The ZnO sample emits wide peaks in the visible range and the emission intensity of the ZnO-DOL sample increases along with a red-shift (0.38 eV) in the band gap. This shift can be explained using deep level transition, surface plasmon energy of a surfactant, andcoupling of ZnO with local surface plasmon energy. UV-Vis absorption spectra together with photoluminescence spectra confirm the higher absorption rate due to organic ligand decoration on ZnO nanoparticles. The greatest solar power-to-electricity conversion efficiency (h) of 3.48% is achieved for the ZnO-DOL sample. It is enhanced by 3.13% as compared to that of the ZnO-based solar cell. The ZnO-DOL device exhibits a higher external quantum efficiency (EQE), responsivity (Rl) and photocurrent-to-dark current ratio; this confirms the improvement in the solar cell performance.

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Predictive modelling of low-dimensional materials: Synthesis to properties

Boris I Yakobson
Rice University, USA

Comprehensive tools of materials modelling allow one to make verifiable predictions of novel physical structures with specific, often useful or even extraordinary, properties. Recent examples from our work will be presented. First, briefly about evolutionary selection growth of monocrystal achieved for graphene and how it should work particularly efficiently for other binary compositions of lower symmetry, like h-BN or metal dichalcogenides. I will skip all 2D boron, borophene, because it is given to different Symposium. But will focus instead on MX_2 family, where a combination of DFT and phase-field simulations proves useful for understanding planar and even non-Euclidean growth on nonplanar substrates, with intentional defect design for bringing new functionality. I will also share a few-years long saga on how we went from defining an efficient electronic structure descriptor "Elus" to identifying best TMD-candidates and to experimental verification of their catalytic efficiency.

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Nano fountain probe technology for *in vitro* single cell studies

Horacio D Espinosa
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We present a broadly-applicable Nano fountain Probe technology for single cell delivery and analysis using biomolecules and functional nanoparticles. The nano fountain probe is a scanning probe nano delivery tool which makes use of on-chip fluid reservoirs and integrated microchannels to deliver liquid solutions to sharp-aperture dispensing tips. The unique tip geometry allows for both sub-100nm nanopatterning on substrates for subsequent cell culture, as well as direct biomolecular delivery inside cells with minimum invasiveness. The spatial and force resolution of the atomic force microscope are leveraged to control the probe with nanometer and nano newton precision during nanopatterning and *in vitro* transfection experiments. We begin by describing nanopatterning capabilities and their application to cell adhesion and nanomaterial-mediated delivery studies, followed by *in vitro* single cell transfection of biomolecules (DNA, RNA, plasmids). In this presentation, an emphasis is placed on the broad utility of the nano fountain probe as a nano delivery tool with the goal of motivating future studies in cell biology. Direct-write nanopatterning of several biomolecules and functional nanoparticles using the nano fountain probe will be presented. Examples include DNA and protein, as well as gold and drug-coated diamond nanoparticles. Models of the deposition process describing the effects of probe geometry, liquid properties and patterning parameters on resolution will be discussed. These models enable optimization of the patterning process, resulting in sub-100nm resolution. The need for high resolution delivery arises in nanoscale studies of protein and cell functions such as the creation of adhesion templates, where for example, protein clustering in cell focal adhesion occurs at 5 to 200nm length scales. Similarly, this resolution allows extremely precise spatial control of dosing in nanomaterial-mediated drug delivery studies. As an example, patterning drug-coated diamond nanoparticles, in which the dosing is controlled with yoctogram precision, will be presented. Direct *in vitro* transfection of functionalized nanoparticles and biomolecules will be discussed. The transfection of fluorescently-labeled diamond nanoparticles, on multiple cancerous and normal cell lines, will be illustrated. Likewise, the temporal delivery of proteins and RNA molecular beacons will be discussed in the context of non-destructive cell analysis.

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Application of nanomaterials in the development of optical and electrical biosensors for health and environmental monitoring

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Nanomaterials have gained importance for their exceptional properties that may be optical, electrical, chemical, mechanical or magnetic in nature. Their unique physio-chemical properties make them most suitable for a wide range of applications ranging from electronics to healthcare. This presentation will highlight the latest results on use of nanomaterials in the development of optical and electrical lab-on-a chip biosensing platforms from our laboratory. These biosensors employ unique physio-chemical features of nanomaterials that are aimed at ultrasensitive detection of cancer and cardiovascular disease biomarkers in human serum, pathogenic bacteria, toxic chemicals on a chip, as well as optical and electrical based nano-biosensing of cellular interactions with external stimuli. These biosensors are fabricated with nanomaterials, such as bio-functionalized graphene or carbon nanotubes, luminescent quantum dots or other metallic nanoparticles on electrical or optical transducer platforms that transform biological signals into measurable electrical or optical signals, respectively. The experience gained from laboratory scale biosensing is extended to the point-of-care hand-held diagnostic prototype device fabrication, which has been successfully tested for detecting multiple cancer and cardiovascular disease biomarkers in real patient samples. Finally, the talk also provides an overview of the available biosensor platforms and integration of nanomaterials for the detection of various analytes and considerations for prospects of nanomaterials in the biosensor technology.

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Population balance modeling for polydisperse fluid-nanoparticle flows

Jianzhong Lin
Zhejiang University, China

Polydisperse fluid–particle flows arise in many technological and environmental application including but not limited to aggregation, ocean spray, flocculation in water treatment, bubble dynamics in fluids, aerosol dynamical processes in both chemical engineering and air pollution. Contrary to monodisperse fluid-particle flows, the principal feature of these flows is size (or chemical composition, etc.) distribution of particles, which leads to the different coupling characteristics between particles and fluid. The numerical simulation of the polydisperse fluid-particle flows is challenging due to the polydisperse nature. To characterize the effect of polydispersity on dynamics of fluid-particle flow, the mesoscale modeling approach based on the Smoluchowski mean-field theory is preferred. The key of the modeling approach is to establish a transported population balance equation (PBE) having many phase-space variables to describe the particle size distribution, particle velocity distribution etc. The direct numerical solution of the transported PBE is intractable for most applications due to the large number of independent variables. The useful alternative is to convert the PBE to transport equations in terms of the moments of the number density function. However, the moment transport equations are not closed. In this work, a Taylor-series expansion method of moments (TEMOM) is applied to achieve the closure of moment transport equations. The emphasis will be placed on several key issues relevant to this method when coupled it to Navier-Stokes equation. The possible direction for the development of this method and its advantages and shortcomings are also discussed

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Cheap, green and clean high quality nanocellulose from seaweed

Mark Dorris
Edinburgh Napier University, UK

Typically, nanocellulose in the form of cellulose nanofibrils (CNF) is derived from higher plants via acid hydrolysis and/or mechanical disruption. The production processes involved limit the use of this material in high value biomedical applications. Bacterially produced nanocellulose is considered a suitable alternative for biomedical use. Both methods involve time-consuming and energy and labour-intensive processes. Edinburgh Napier University has developed a method to derive high quality CNF from the macroalgae (seaweed) species Laminaria hyperborea which is at least an order of magnitude lower in energy requirements than existing processes. The material produced has been fully characterized and is similar in many aspects to bacterially produced CNF, namely in terms of high aspect ratio, increased water retention, homogeneity, and purity of product. This process is also much faster than existing methods, with seaweed to CNF conversion time measured in hours rather than weeks, and it uses no harsh chemicals. Also, *Laminaria hyperborea* is higher in cellulose content than other *Laminaria* species and it is estimated that a sustainable harvest could potentially deliver up to 50,000 metric tons of cellulose per year for Scotland alone. Novel applications for this abundant source of CNF should be explored.

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Synthesis of acidity triggered cisplatin encapsulated slow release zinc oxide targeted drug delivery nano composite for cancer treatement

Rajapakshe
University of Peradeniya, Sri Lanka

Cisplatin is a frequently used anticancer drug with a cis configuration that facilitates the covalently binding of the coordination complex to DNA strands and thus crosslinking the DNA strands triggering the cells to die in a programmed manner. However, cisplatin is associated with several side effects which can be either reduced or overcome if cisplatin could be encapsulated in a suitable host material and directed towards cancer cells in a targeted manner. To achieve these targets, we have prepared porous nanoparticles of zinc oxide (ZnO) and encapsulated cisplatin in them and studied their release kinetics in buffered solutions of defined pH values. Since cancerous cells are more acidic compared to normal cells and that ZnO is stable in neutral pH media while decompose slowly in low acidic conditions, it can be a highly suitable host to release drug slowly only at the vicinity of the cancer cells. We developed a novel surfactant-assisted method to synthesize porous nanoparticles of ZnO. The encapsulation of cisplatin was characterised by XRF, SEM, FT-IR and XRD studies. The release kinetics of cisplatin at different pH values was investigated by measuring the amount of Pt released as a function of time using ICP-AES. It shows the release of cisplatin is pH dependent and there is hardly any release of cisplatin at neutral and basic pH values. As such, at physiological pH of blood and that of healthy cells cisplatin is not released while at mildly acidic pH values of cancer cells cisplatin is slowly released.

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