IRAN-CHINA

Virtual Symposium on Nanoscience and Nanotechnology

NANOIRCN 2021

Date: March 3–4, 2021

UT5

5 Top Iranian Universities of Technology

NanoIRCN 2021 aims to initiate and promote scientific collaboration between Iranian and Chinese scientists. Virtual Symposium on Nanoscience and Nanotechnology organiz by the consortium of 5 top Iranian Universities of Technology (UT5), in order to facilitate direct contact of the leading scientists of these universities with their Chinese counterpart. Furthermore, in this event a special program to introduce Iranian startup companies in this field to Chinese Technoparks and investment agencies is considered. We propose that the yearly event of NanoIRCN to be held virtually in 2021, and be continued in the consecutive years in Iran and China.

The topics of this event include:

Nanomaterials, Nanobiotechnology and anomedicine,
Nanoelectronics, Nanofabrication , and Nanocharacterization

Distinguished Speakers

Prof. Yiqiang Zhan

Fudan University

Prof. Dr. Shi, Li Yi

Shanghai University

Prof. Alireza Moshfegh

Sharif University of Technology

Prof. Mohammad Hossein Enayati

Isfahan University of Technology

Dr. Lei Huang

Shanghai University

Dr.Mehdi Karevan

Isfahan University of Technology

Prof. Faramarz Hossein Babaei

K.N.Toosi. University of Technology

Prof. Saeed Sarkar

Tehran University

Prof. Seyed Shamsodin Mohajerzadeh

Tehran University

Prof. Shuai Yuan

Shanghai University

Dr. Hamid Omidvar

Amirkabir University of Technology

Dr.Roohollah Bagherzadeh

Amirkabir University of Technology

Ms. Jane Wu

Nanopolis Suzhou

Iran Nanotechnology Innovation Council (INIC) | Chineese Academy of science | Iran National Science Foundation | National Center for Nanoscience and Technology | Fudan University | Shanghai University | University of Tehran | Suzhou Institute of Nano-Tech and Nano-Bionics (SINANO-CAS)

Highly efficient and stable black phase FAPbI3 perovskite solar cells

Prof. Yiqiang Zhan

Abstract. Metal-halide perovskite which has the structure of ABX3, has become one of the most intensively studied optoelectronic materials, especially in the application of solar cell. Most of the perovskite solar cell with high efficiency are based on the mixed A cations or X ions. However, this comes at the cost of long-term stability, due to the loss of volatile methylammonium and phase segregations. It has been reported that the a-FAPbI3 has the ideal cubic crystal structure, and lower band gap compared to mixed cation perovskite. However, the black a-FAPbI3 is unstable at room temperature, easy to transform to photo inactive δ-FAPbI3. Therefore, obtaining efficient and stable FAPbI3 PSCs is of vital importance for the perovskite research field. Here, we report a novel sequential deposition method employing MASCN vapour treatment of yellow phase FAPbI3 perovskite films for making highly crystallized, pure black phase FAPbI3 PSCs and achieve a power conversion efficiency up to 23.5%. We attain a high open-circuit voltage (VOC) of 1.18 V corresponding to a loss of only 300 meV with respect to the band gap energy of 1.48 eV setting a new record in the whole PV field.

Linking Thermoelectric Generation in Polycrystalline Semiconductors to Grain Boundary Effects Sets a Platform for Novel Seebeck Effect-Based Sensors

Prof. Faramarz Hossein Babaei

Abstract: Data available on the thermoelectric properties of polycrystalline semiconductors are inconsistent, riddled with gaps, and ascribe stronger Seebeck effects to polycrystalline samples rather than single crystals without explanation. Here, we demonstrate that a grain boundary positioned perpendicular to the applied temperature gradient contributes significantly to the Seebeck voltage generation in the sample, elevating its Seebeck coefficient. This contribution is analytically linked to the height and width of the energy barrier experienced by charge carriers diffusing from one grain to the next. These are primarily extrinsic properties and can be affected by external physicochemical parameters. Occurrence of ***chemo-*** and ***piezo-thermoelectric*** effects are analytically predicted. Experimental results on SnO_2 and ZnO samples with different nanostructures verify the predictions. The presented model sets a novel platform for designing a range of Seebeck effect-based sensors, and unveils the potential of the polycrystalline semiconductors with appropriately designed intergranular regions as thermoelectric materials.

Plastic Deformation Induced Nanocrytstallization

Prof. Mohammad Hossein Enayati

Abstract: Vapour deposition, plasma processing, gas-condensation, chemical precipitation and crystallisation from the amorphous phase are well established processing routes for obtaining nanocrystalline materials. However, it is well known that mechanical deformation, as a top-down solid-state synthesis route, can also be applied for production of a nanocrystalline structure. Comparison of different preparation methods in terms of cost and productivity demonstrates that mechanical deformation is the most cost effective route capable of producing nanocrystalline materials in large quantity. Grain refinement to the nanometre size is governed by the plastic deformation induced during mechanical working. In general, the grain/crystallite size decreases continuously with number of deformation cycles until a minimum (saturation) size is approached. Further refinement seems to be difficult to achieve for a fixed set of experimental conditions. In this talk the most relevant features of different techniques for producing nanocrystalline materials based of mechanical deformation are overviewed and discussed.

Controllable Nano Oxide Particles and Application Technologies Research Progress in Centre for Nanoscience and Technology, Shanghai University

Prof. Shi Li Yi

Abstract: Nano oxide particles can be widely applied to such fields as electronic ceramics, functional coatings, personal care products, environmental catalysis, advanced batteries, and precision polishing. This report gives brief introduction of relevant research progresses at Research Centre for Nanoscience and Technology, Shanghai University, in the aspects of controllable preparation, surface modification and stable dispersion technology development of nano oxide particles, with also introduction of industrialization base construction for nano oxide particles, as well as their applications in hybrid functional coatings, oil drilling fluids, air purification, electronic functional ceramics, sunscreen cosmetics and lithium-ion batteries.

Innovation and Commercialization: Nanotechnology Industry in Suzhou Industrial Park

Jain Wu

Abstract: Established in 1994, Suzhou Industrial Park, short for SIP, is the flagship cooperation project between Chinese and Singaporean governments. The last two decades have seen SIP rising to one of the top stars regarding the economic strength and innovation vitality in the course of China's opening-up and reform. Entering into the 21st century, the local government rolled out a new development strategy for industrial and economic transformation and upgrading, and Nanotechnology Industry was then chose as one of the new driving forces accompanied by series of tangible moves such as setting up a managing entity, building up an industrial park for nanotechnology innovation and commercialization and formulating supportive policy to lure elites and STEM experts. Ms. Jane WU's short introduction will help give a glimpse to the developing status of the city and nanotechnology industry with the hope of generating possible connection and cooperation with other distinguished experts and institutions participating in the summit.

Design and fabrication of monolithic catalyst for plasma-catalytic oxidation of toluene

Asso. Prof. Lei Huang

Abstract: As one of the promising techniques for the abatement of Volatile organic compounds (VOCs), non-thermal plasma (NTP) technique has been attracting close attention recently due to its low temperature, convenient start-up and shutdown procedures, its low-cost, and being applicable to a wide range of VOCs. The synergetic positive effect between plasma and catalysis would be a key to improve efficiency and decrease the energy consumption. Honeycomb monolith catalyst gives lower pressure drop across the reactor compared with the packed-bed reactor. However, the generation of plasma might be suppressed by the separated channel walls between the two electrodes. In this sense, the monolithic catalyst with designed pore structure might solve this problem. Recently, we tried to use foam-like monolithic catalyst which might combine both the advantages of low pressure drop and plasma generation due to the open pore structure, and, therefore, it would be worthwhile to be investigated. We demonstrated that copper foam is an effective monolithic support to support one dimensional CuO nanowires and Mn-Co compounds in a dielectric barrier discharge (DBD) non-thermal plasma reactor for the oxidation of toluene. The shape of copper foam could be tailored to the desired cylindrical form to fit the DBD reactor. were facilely in-situ grown on the surface of the copper skeleton as active components, through a heating process and a followed dip-coating process. The abatement of toluene was applied to evaluate the performance of such a monolithic copper foam in the combined plasma–catalytic process. In addition, material extrusion additive manufacturing is also being applied to design different porous structures for VOC abatement via NTP.

Controllable preparation, dispersion and application of highly dispersed nanoparticles

Prof. Shuai Yuan

Abstract: Nanoparticles have excellent optical, electrical and mechanical properties, etc., and are widely used in photoelectric conversion, new materials and other fields. The dispersion and stability of nanoparticles are the key problems that restrict their application. Our team has studied a series of controllable preparation, surface control, dispersion and stabilization methods of nanoparticles. First of all, according to the "bottom-up" strategy, by controlling the nucleation process and crystal growth process from molecules to nanoparticles, we can finely control the crystal form, morphology and size of nanoparticles. Secondly, based on the stabilization mechanism, we study the surface modification of nanoparticles and the stabilization methods in different solvent systems and high solid content conditions. Then, the applications of highly dispersed nanoparticles in functional composites, injection reagent in oilfield and other fields were investigated.

Nanotechnology at the interface of 3D printing and Bio-engineering

Dr. Mehdi Karevan

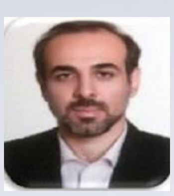
Abstract: One main issue in the perfect and better to say expected fulfilment and implementation of nano-science and thereof advantages in nano-based products and technologies is the exploitation of nano-events when unique properties of nanomaterials or/and nano-structures come into matter. One of the areas of nanotechnology with increasing interest among researchers and industries falls at the common borders of bio-based polymeric nanocomposites processed via advanced technologies such as 3D printing. However, first of all, the fabrication techniques addressing perfect distribution/dispersion of nanomaterials within the polymeric matrix resulting in homogeneous bulk specimens are of high importance whilst still ongoing challenges need to be overcome. The issue is even more highlighted in the case of emerging technologies of 3D printing techniques mainly introduced in design and development of bio and tissue engineering parts. Therefore, it seems the technology of 3D printing is somehow lagging behind the nano and bio-composite science in some points of view specifically when novel nano/bio materials are to be incorporated in bio-based matrices. Above this, in technologies such as f*used deposition* modeling (FDM) filaments with limited composition available cannot be even appropriately close to what researchers desire in fabrication of bio-based parts including tissue scaffolds or implants reinforced with nano/bio phases with drug delivery characteristics. Moreover, nanocomposite filaments of desired flexibility/toughness are not always fulfilled using conventional extrusion techniques, which, in turn, limits their FDM processing. This talk starts with a brief introduction to conventional methods of nanocomposite fabrication with particular concentration on nano-materials dispersion mechanisms followed by a focus on direct 3D printing technology in the development of polymeric nanocomposites utilizing a rather novel 3D printing method when the need for the filaments is eliminated. We will discuss how the direct 3D printing addresses stumbling block issues in nano and bio material dispersion within polymeric matrices where a broader range of matrix phases and nanomaterials meets researchers needs in design of bio- and nano engineered parts at the interface of nano and 3D printing technologies.

Electrochemical biosensor properties of metal oxide nanostructures for clinical diagnostics

Dr. Hamid Omidvar

Abstract: Nanostructured metal oxides have recently become important as materials that provide an effective surface for biomolecule immobilization with desired orientation, better conformation and high biological activity resulting in enhanced sensing characteristics. Nanostructured metal oxides with unique optical, electrical and molecular properties along with desired functionalities and surface charge properties provide interesting platforms for interfacing biorecognition elements with transducers for signal amplifycation. The electrochemical biosensor is the analytical devices that transduce biochemical events such as enzyme-substrate reaction and antigen-antibody interaction to electrical signals (e.g., current, voltage, impedance, etc.). Since Clark developed the 1st version of electrochemical biosensor for blood glucose, various types of biosensor have consecutively been introduced and commercialized for diverse applications. In this electrochemical biosensor, an electrode is a key component, which is employed as a solid support for immobilization of biomolecules (enzyme, antibody and nucleic acid) and electron movement. Electrochemical techniques such as cyclic voltammetry, on the other hand, are simple and can be utilized for the rapid and cost-effective development of biosensors. The characteristics of an electrochemical biosensor can be improved by differential pulse voltammetry (DPV). Electrochemical impedance spectroscopy (EIS) is a non-destructive electrochemical analytical technique that has recently been used for signal transduction and which has been particularly useful for clarifying the mechanisms of charge transfer resistance arising due to electron transport between a biomolecule and the electrode surface. Electrochemical devices have advantages in terms of size, cost, detection limit, response time, long-term stability and power requirements, and therefore have great promise for a wide range of biomedical and environmental applications. Nanostructured metal oxides with various surface architectures have been used to produce a number of electrochemical biosensing devices with improved sensitivity and selectivity.

Nanofiber-Based Stretchable Electronics and Power Harvesting Devices



Dr. Roohollah Bagherzadeh

Abstract: This talk is mainly focused on scientific strategies to integrate electronic devices into nanofibers and textile materials. Wearable electronics fabricated on lightweight and flexible substrate are widely believed to have great potential for portable devices. Several promising applications, for example e-skin, smartwatches, and bracelets, have been successfully achieved for the replacement of conventional electronic gadgets. Lightweight and wearable power supply modules with high energy storage performance are desirable for wearable technology. One strategy is to directly integrate a conventional rechargeable energy storage device, such as a battery or a supercapacitor (SC), into fabrics. Also nanochemistry is an emerging sub discipline of the chemical and materials sciences that deals with the development of methods for synthesizing nano scale bits of a desired material and with scientific investigations of the nano material obtained.

Nano materials have numerous possible commercial and technological applications including use in electronic. In the last few decades, there has been significant progress in one-dimensional (1D) nanostructures with nanoscale and molecular scale properties that can satisfy the demands of the 21st century, for example, carbon nanotubes, inorganic semiconducting and metallic nanotubes/wires, conjugated polymer nanofibers/tubes, etc. These nanostructures have a deep impact on both fundamental research and potential applications in nanoelectronics or molecular electronics, nano devices and systems, nanocomposite materials, bio-nanotechnology and medicine.

Role of Nanostructures in Improving Solar-driven Photoelectrochemical Water Splitting to Produce Hydrogen

Prof. Alireza Moshfeg

Abstract: With increasing the world population and rise in energy demands from one side and severe environmental impacts (i.e. the release of CO_2 and other contaminants produced by the widespread use of finite fossil fuels) from other side, extensive efforts have been devoted by many researchers in the last two decades to develop efficient technology for generating a clean and renewable source of energy which is pivotal for future carbon-free society. Photoelectrochemical (PEC) solar water splitting on an appropriate semiconductor (SC) catalyst to produce hydrogen is one of the most ideal strategies because it requires only water and sunlight (1). But, solar to hydrogen (STH) conversion efficiency is quite low, due to some intrinsic limitations such as bandgap energy, carrier lifetime, diffusion distance and photostability of a semiconductor examine in the process. In addition, slow charge transfers at the electrode/electrolyte interface and fast recombination of electron-hole pairs limit the PEC reaction rate. The emergence of nanomaterials with adjustable shapes and dimensions ensure progress in PEC/photocatalytic (PC) water splitting. Thus, it is necessary to use nanostructured materials with high surface to volume ratio that facilitate charge separation and suppress electron-hole pair recombination rate. Suitable materials focused mainly on the development of semiconductors that have band gap energy in the visible range of solar spectrum such as Fe_2O_3, $BiVO_4$, WO_3 and CdS. Moreover, three classes of 2D materials including graphene, transition metal dichalcogenides (TMDs), and graphitic carbon nitride (g-C_3N_4) with remarkable electronic and optical characteristics as well as their main roles in the photoelectrocatalytic production of hydrogen are discussed. Combined 2D layered materials interfaced with other SCs can markedly enhance the PEC/PC efficiencies via band gap alteration and heterojunction formation. The lecture addresses all these issues and introduce several methods to chemically modify nanostructures for achieving efficient photoelectrochemical water splitting towards hydrogen generation. But due to massive strain on freshwater resources globally (about 97 % of the entire world's water resources is present in the sea), it is an ideal to study PEC by using seawater splitting process. Some aspects related to solar driven direct seawater splitting to hydrogen and oxygen will be described by introducing several high-performance nanostructured catalysts with abundant active sites and corrosion resistance in saline electrolyte. Finally, kinetics and mechanism of the PEC reaction will be discussed in the presence and absence of light for better comparison.

Program Schedule

Wednesday March 3, 2021

Time	Speaker	Title
8:30 – 8:35	Opening	
8:35 – 8:45	Prof. F. Yazdandoost	Chancellor welcome to the audience
8:45 – 9:00	Prof. H. Taghirad	Nano-IRCN Figures and Facts
9:00 – 9:45	Prof. Li Yi Shi	Control Nano oxid particles and application technologies research progress in center for nanoscience and technology
9:45 – 10:00		Virtual Exhibition of Nanotechnology Companies
10:00 – 10:45	Prof. F. Hossein Babaie	Linking Thermoelectric Generation in Polycrystalline Semiconductors to Grain Boundary Effects Sets a Platform for Novel Seebeck Effect-Based Sensors
10:45 – 11:30	Dr. H. Omidvar	Electrochemical biosensor properties of metal oxide nanostructures for clinical diagnostics
11:30 – 12:00		Virtual Exhibition of Nanotechnology Companies
13:30 – 14:15	Prof. S. Mohajerzadeh	Phosphorene nano sheets on silicon substrates suitable for high performance field effect transistors
14:15 – 15:00	Dr. L. Huang	Design and fabrication of monolithic catalyst for plasma-catalytic oxidation of toluene
15:00 – 15:45		Virtual Exhibition of Nanotechnology Companies
15:15 – 16:00	Prof. Y. Zhan	Highly efficient and stable black phase FAPbI3 perovskite solar cells
16:00 – 16:45	Dr. M. Karevan	Nanotechnology at the interface of 3D printing and Bio-engineering
16:45 – 17:30		Virtual Exhibition of Nanotechnology Companies

Thursday March 4, 2021

Time	Speaker	Title
8:30 - 9:00	Prof. S. Sarkar	TBA
9:00 - 9:45	Prof. A. Moshfegh	Role of Nanostructures in Improving Solar-driven Photoelectrochemical Water Splitting to Produce Hydrogen
9:45 - 10:00		Virtual Exhibition of Nanotechnology Companies
10:00 - 10:45	Prof. S. Yuan	Controllable preparation, dispersion and application of highly dispersed nanoparticles
10:45 - 11:30	Dr.R. Bagherzadeh	Nanofiber-Based Stretchable Electronics and Power Harvesting Devices
11:30 – 12:00	Virtual Exhibition of Nanotechnology Companies	
13:30 – 14:15	Prof. M. H. Enayati	Plastic Deformation Induced Nanocrytstallization
14:15 – 15:00	MS. J. Wu	Innovation and Commercialization: Nanotechnology Industry in Suzhou Industrial Park
15:00 – 16:30		Round Table & Closing Speech

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