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KEYNOTE PRESENTATIONS

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Rapid additive manufacturing anywhere, anytime

A range of technologies have been developed for additive manufacturing (AM). Volumetric additive manufacturing (VAM), which selectively solidifies a part of photosensitive liquid within a contained volume, is relatively new, but has the potential for rapid AM. However, same as most existing technologies, it is not applicable for AM at anytime and anywhere. In microgravity environments (e.g., in space missions) and harsh environments (e.g., on ships and vehicles during maneuvering, or in airplanes during flight), AM with liquids or powders is highly problematic.

We have proposed the concept of rapid solid-state volumetric additive manufacturing aiming for rapid AM in any environment. This concept has been demonstrated using a UV cross-linkable thermal gel, which is solid at room temperature, and becomes an easy-to-flow liquid upon cooling to below 10 °C. Thus, after cross-linking at room temperature in the solid state, the un-cross-linked part can be removed by washing in iced water. The shape memory effect (SME) refers to the capability of a material to return its original shape after being severely and quasi-plastically deformed, but only at the presence of the right stimulus. This feature is applicable to most polymeric materials, including most thermset, and ensures high dimensional accuracy after the un-cross-linked part is removed. As for high-strength polymers, UV cross-linkable vitrimer, which has a reversible/dynamic cross-linking network so that it is thermoset at lower temperatures and becomes thermoplastic at higher temperatures, should be the right material for rapid solid-state VAM.

In this talk, we present our recent progress, including a water-content dependent heating/ cooling/water-responsive shape memory hydrogel and a UV cross-linkable vitrimer-like polymer. UV cross-linking in the solid state for rapid additive manufacturing is demonstrated using these two materials.

Biography

Dr Wei Min Huang is currently an Associate Professor (tenured) at the School of Mechanical and Aerospace Engineering, Nanyang Technological University, Singapore. With over 25 years of experience on various shape memory materials (alloy, polymer, composite and hybrid), he has published over 200 papers in journals, such as *Accounts of Chemical Research*, *Advanced Drug Delivery Reviews*, and *Materials Today*, and has been invited to review manuscripts from over 300 international journals (including *Progress in Polymer Science*, *Nature Communications*, *Advanced Materials, and Advanced Functional Materials*, etc), project proposals from *American Chemical Society*, *Hong Kong Research Grants Council*, etc, and book proposals from *Springer*, *Elsevier* and *CRC*. He has published two books (*Thin film shape memory alloys – fundamentals and device applications*, *Polyurethane shape memory polymers*) and is currently on the editorial board of over three dozen of journals.

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Composite Sandwich Materials for Developing Rotor Blades of a Quadcopter Drone

Carbon fabric and polymeric foam materials have been used to fabricate composite sandwich rotor blades for achieving the goal of light weight and high efficiency. A procedure for developing the composite sandwich rotor blades used in a quadcopter drone is presented. The objective is to use 4 rotor blades (each rotor blade is composed of two blades) to lift up the drone of 50kg. The geometry of the rotor blade is designed using the blade element momentum method to meet the requirement of the theoretical lifting force of the rotor blade exceeding 15kg. A method constructed on the basis of the finite element method together with an appropriate failure criterion is used to determine the number of composite layers in the skin of the rotor blade. A mould comprising upper and lower parts was used to form the foam core of the rotor blade. Then the blade foam core wrapped around by a preselected number of carbon fabric sheets coated with epoxy resin via the use of a specific pattern was placed in the mould to be cured. A number of rotor blades were fabricated via the use of two different wrapping patterns. The cured rotor blade coupled with a motor was subjected to lifting force testing. The lifting forces measured at different rotating speeds were used to validate the theoretical ones. The rotor blades were then subjected to static load tests to study the failure behaviors (failure modes and loads) of the blades with different wrapping patterns. Theoretical failure modes and loads of the rotor blades are also determined using the proposed method for blade failure analysis. The experimental failure results have verified the accuracy of the proposed method. The results obtained in this study have shown that the proposed procedure for composite sandwich rotor blade development is feasible and able to produce acceptable rotor blades for drones.

Biography

Dr. Tai Yan Kam earned his PhD in the area of Structural Mechanics from Northwestern University, USA, 1982. He is presently professor of Mechanical Engineering Department, National Yang Ming Chiao Tung University, Taiwan. He served as Dean of the College of Engineering in 1994-2000 at National Chiao Tung University. He has conducted consulting works at several national industrial as well as defense research institutions in Taiwan to help develop mechanical systems, fighter planes, and missiles. He was the recipient of the 2002 Taiwan National Invention Award. He has published nearly 100 SCI papers in many prestigious international journals and owned over 50 patents. His research interests are in the area of composite materials and structures.

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Investigations into Human Body Fluid-assisted Fracture of Biodegradable Alloys for Temporary Implant Applications

Magnesium (Mg) alloys possess great potential for their use as temporary implants such as pins, wires, screws, plates. Use of Mg alloys will completely avoid the cumbersome procedure of second surgery (which is required when such implants are constructed out of traditional materials such as titanium alloys or stainless steels). However, Mg also has limitations as a temporary implant material, viz., their unacceptably high corrosion rates and concurrent hydrogen evolution, and stress corrosion cracking (SCC) and/or corrosion fatigue (CF) under the simultaneous action of the corrosive human-body-fluid and the mechanical loading. This presentation will provide an overview of SCC and CF of different Mg alloys in simulated body fluid (SBF) and the associated fracture. The presentation will also discuss the need of investigations under such mechano-chemical conditions that appropriately simulate the actual human body conditions, and present new data generated under such conditions in the presenter's research group.

Biography

Professor Raman Singh's expertise includes: Alloy Nano/Microstructure-Corrosion Relationship, Stress Corrosion Cracking (SCC), Corrosion/SCC of Biomaterials, Corrosion Mitigation by Novel Material (e.g., Graphene), Advanced and Environmentally Friendly Coatings, High Temperature Corrosion. He has supervised 50 PhD students. He has published over 250 peer-reviewed international journal publications, 15 books/book chapters and over 100 reviewed conference publications. His professional responsibilities include editor-in-chief of two journals, Fellow of ASM International and Engineers Australia, over 40 keynote/plenary talks at international conferences (besides numerous invited talks), leadership (as chairperson) of a few international conferences.

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Biopolymer membrane-based material in Fuel Cell Application

Today's humanity faces distressing dilemmas that we face daily. Humanity growth, food security, water and toxicity, energy, resource shortages, and climate change are all incredibly severe issues. It is indeed worth noting that energy reserves and the environment are the most pressing concerns, and that experts are working on solutions. The fuel-cell system is a viable option. However, the fuel cell commercialization is seen to move very slowly due to several factors including the high material cost to develop important components in the fuel cell. This work presents an insight into the general overview of the biopolymer membrane-based material such as alginate and chitosan which has a very low cost because it is present in abundance naturally, the recent strategies of biopolymer membrane and the modification of biopolymer membrane in fuel cell application. Biopolymer with characteristics such as water-soluble, biocompatible and reproducible material that may be cast or evaporated to form membranes or coherent films. Due to their poor mechanical properties, brittleness, low water resistance, and lack of specific functional groups, membranes produced from biopolymer-based material only have a limited range of applications. Different approaches have been explored in order to enhance the properties of these polymers, including the introduction of plasticizers or cross-linking agents, compositing as well as managing the drying process. Thus, biopolymers-based material with improved features and functionalities have been widely used in a variety of applications. Further modification and advancement of biopolymers-based material membranes in fuel cell application also explained in detail in this work.

Biography

Dr Norazuwana Shaari has completed his PhD from Fuel Cell Institute, Universiti Kebangsaan Malaysia, Malaysia (2018) and postdoctoral researcher from same University in 2019. He has published more than 37 papers in reputed journal. Her PHD is in Fuel Cell Engineering, Development of biopolymer electrolyte membrane based on alginate and inorganic filler graphene oxide. Currently, senior lecturer in Fuel Cell Institute. Actively doing research in high performance electrolyte membrane from various types of polymers such as Alginate, PVA, SPEEK, PBI etc. Also, develop the advance nanomaterials for membrane modification such as modified graphene oxide, graphene quantum dots, graphitic carbon nitride, metal organic framework, Ni based filler, and 3D structured material. Active in journal, book, popular article writing in order to share the knowledge to the many layers of community in field of renewable energy, fuel cell development, membrane technology and advanced nanomaterials.

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Potential use of electrospun nanofibers towards functional coatings with anti-corrosion and anti-icing properties

One approach in the development of the multifunctional coatings is to learn from nature and to mimic it. Electrospinning technique allows to produce polymeric nanofibers mats with very high surface to volume area and relative low costs. Different oils were encapsulated as a core of the core-shell nanofibers, generating oils reservoirs when incorporated into the coatings. Surface wettability of various combinations of nanofibers and oils was investigated. The loss of lubricants over time was followed by performing contact angle measurement. Furthermore, nanofibers chemical resistance was investigated by immersing them in corrosive solutions with the pH ranging from 1 to 14 for various periods of time (from 1 hour to 24 hours). Nanofibers structure is preserved for corrosive droplets with a pH of 1 and 7, while for a higher pH of 14 their morphology is lost, polymer dependent. Oil amount incorporated as core material was investigated by mean of IR spectroscopy. Incorporation of the nanofibers in the coatings had a beneficial effect for coating adhesion on metallic surfaces. Contact angle with water at temperature ranging from room temperature down to -20°C were performed. A delay in the ice formation was confirmed, pointing out the potential use of nanofibers for developing coatings with icephobic properties. Additionally, the effect of incorporating the core-shell nanofibers in the coatings was evaluated regarding their performance in protecting metallic surfaces against corrosion.

Biography

Dr. Ioana Carmen VLADU (former MARCUS), got in 2012 her PhD in Material Science from Institut de Ciencia de Materials de Barcelona and Universidad Autonoma de Barcelona, Spain. Since May 2012 she is Senior Researcher/Project leader at CEST - Centre of Electrochemical Surface Technology, Austria and acquired expertise in the field of surface functionalization and characterization. She is/was the coordinator several projects (Cr Free REAL - H2020-Clean Sky 2, NanoSHeal, nanoMEM, LubRes, ESpun), or project leader on CEST (e.g., IMPACT - H2020 – Clean Sky 2 and JOICE project).

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Synthetic antiferromagnets for biomedical and flexible spintronic applications

Synthetic antiferromagnets (SAFs) composed of two ferromagnetic layers separated by a thin non-magnetic spacer are receiving renewed attention in many fields including spintronics and biotechnology. The present talk focuses on $[Co/Pd]_N/Ru/[Co/Pd]_N$ SAF thin films with perpendicular magnetic anisotropy (PMA) as building-blocks for the synthesis of SAF microdisks for biomedical applications and the fabrication of magneto-resistive spintronic devices on flexible substrates, which are of interest for wearable electronics, soft robotics and biomedicine [1-3]. Thin film stacks consisting of multiple repeats of single PMA-SAF were prepared with the aim of fabricating free-standing SAF microdisks by lithographic processes [1]. The samples fulfill all the key criteria required for biomedical applications together with the ability to vary the total magnetic moment without significantly affecting any other magnetic features. The same stack was used to build-up giant magneto-resistive heterostructures on large-area flexible substrates by direct deposition on PEN tapes [2] and by using a transfer-and-bond approach exploiting the low adhesion between Au and SiO_x [3]. As-prepared flexible systems show magnetic and transport properties comparable to those of samples deposited on rigid substrates along with a high mechanical robustness that allow their integration on curved surfaces. To prove the high potential of such systems, they were integrated in on-skin interactive electronics to realize touchless human-machine interfaces, which are intuitive to use, energy efficient, and insensitive to external magnetic disturbances [2].

[1] G. Varvaro et al., *Nanoscale* 11 (2019) 21891

[2] P. Makushko et al., *Adv. Funct. Mater.* 31 (2021) 2101089

[3] M. Hassan et al., *Nanoscale Advances* 3 (2021) 3076

Biography

Gaspare Varvaro (PhD in Material Science, 2007, University "La Sapienza" of Roma, Italy) works as researcher at the National Research Center (Italy) since 2010. His research activity spans from the fabrication to the characterization of magnetic and magneto-transport properties of nanostructured magnetic materials including single-phase, magnetic composites and hybrid/multifunctional systems (nanoparticles, thin films, multilayers and nano-patterned systems) for fundamental studies and applications (biomedicine, sensors, information storage, energy). His research activity was witnessed by about 75 papers, 4 book chapters, and more than 200 contributions to national and international conferences/workshops and prestigious scientific institutions (Google Scholar citations: ~ 1250; h-index: 21).

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Bioactivity assessment of bacterial cellulose membranes enriched with parsley and lovage herbal extracts

Bacterial cellulose (BC) is a polymer produced by Gluconacetobacter xylinus. It has extremely interesting properties for food and biomedical industry such as: flexibility, nontoxicity, biocompatibility, aesthetic appearance, good mechanical, and barrier properties. However, BC has no innate bioactivity, thus deve-developing a bioactive BC membrane is of current interest. The aim of this study was to assess the bioactivity of BC enriched with extracts obtained from herbs belonging to Apiaceae family, which is studied to a lesser extent compared to Lamiaceae family. Dry parsley and lovage extracts were obtained by microwave-assisted extraction with ethanol as solvent by varying the extraction conditions. Total phenolic content (TPC) and antioxidant (AA) were used to assess their bioactivity. Additionally, their inhibition of S. aureus, E. coli, and Candida albicans was determined in order to assess their antimicrobial potential (AMA). A static fermentation procedure was used to produce BC by G. xylinus that was later enriched with the herbal extracts. The obtained BC membranes were characterized by scanning electron microscopy (SEM), tensile testing, and antimicrobial activity by disk diffusion assay against the 3 microbial stains. The results showed that lovage, generally, had a higher TPC and AA than parsley (2783.15 mg Gallic acid equivalents (GAE)/100 g dry weight (DW) vs. 600.33 mg GAE/100 g DW, and 27.24 mM Trolox/100g DW vs. 7.60 mMT/100g DW, respectively). However, the antimicrobial activity of the 2 herbs were comparable. The obtained BC presented a good appearance with a fibrillar 3D structure, and good mechanical properties. Additionally, BC enriched with lovage displayed the highest inhibition against S. aureus. Thus, ethanolic extracts obtained from lovage and parsley could be used to enhance the bioactivity of BC.

Biography

I have been a faculty member at the University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca, Romania, for 13 years. I was an EU-FORA Fellow (2018-2019) in the Nutrition and Bromatology, Toxicology and Legal Medicine Department, Faculty of Pharmacy, University of Seville working on chemical risk assessment. My research activities include microbiology, food biotechnologies, preserving methods, food industry process design. I have been an EU-FORA Fellow in the Nutrition and Bromatology, Toxicology and Legal Medicine Department, Faculty of Pharmacy, University of Seville working on chemical risk assessment. I deliver lectures and practical seminars for: Food Industry Equipment and Facilities, Food Equipment Management, Agri-Food Marketing.

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Broadly applicable hydrogel fabrication procedure for mechanobiology investigation

Mechanobiology represents a merging field between materials science, chemistry, physics and biomedicine, that in the recent years has raised increasing interest for tissue engineering and regenerative medicine. In fact, mechanical signals are overarching cues in how cells perceive and respond to their microenvironments.[1] In this regard, hydrogels that mimic the natural tissue in term of stiffness and adhesiveness have emerged as essential tools for mechanobiology investigations. Synthesis and functionalization of these tools, however, are still difficult and artisanal. Here, we optimized materials designed as 2D substrates based on Polyacrylamide (PAA) and 8-arm polyethylene glycol (PEG).

PAA-based hydrogels were optimized in term of functionalization with adhesive proteins, overcoming the low conjugation efficiency of previous protocols[2] as well as in term of synthesis' throughput. We introduced N-hydroxyethyl acrylamide (HEA) to exploit its interactions with fibronectin, a cell-adhesive natural protein. Furthermore, to understand how the density and the distribution of cell adhesive sites impact on cellular fate, we developed an easy, tunable system using 8-arm Norbornene terminated PEG in which the stiffness and the density of the adhesive sites can be finely and independently tuned. Using YAP/TAZ mechanosensors as universal mechanical rheostats, we optimized a system[3] in which the stiffness can be tuned from <1 to >10kPa and the concentration of adhesive sites from 0.5 to 3 mM. By these tools we confirmed the stiffness as a dominant signal in cellular mechanotransduction but we also shown the impact of adhesiveness at rigidities corresponding to normal and pathological states of living tissues.

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Transport of CO_2- rich gas mixtures through polymeric membranes for CO_2/CO separation.

Carbon monoxide is a feedstock for industrial synthesis of fuels and chemical produced by partial oxidation of C- containing compounds, steam-reforming of natural gas and innovative processes as CO_2 recycling by plasma conversion. The produces gas mixtures contain CO_2 which has to be separated from CO before fuels/chemical synthesis. We present a study on the CO_2/CO separation performances of Matrimid, polyetherimide and polylactic acid membranes using CO_2/CO/N_2/O_2 feed gas mixtures. Tests were carried out by mass spectroscopy- based approach to monitor the instantaneous composition of permeate gas mixture and evaluate gas diffusivity and permeability coefficients of feed mixture components. Tests were carried out between 298 and 345 K activation energies for penetrant transport were evaluated. Experimental results reveal that at 298 K Matrimid exhibits ideal CO_2/CO selectivity ~ 16 and CO permeability of 0.50 ± 0.03 barrer: other membrane samples exhibit similar selectivity values but lower CO transport rates. Increasing temperature, the ideal selectivity of membrane samples decreases reaching values ~ 10 at 340 K. No variation was observed in the CO_2/CO selective properties exposing membrane samples to CO_2- rich gas mixtures. In the examined temperature interval membrane samples exhibit absorption- selective character favoring CO_2 permeation.

R. Checchetto et al. *Sep. Purif. Technol*. **277** (2021) 119477; R. Checchetto et. al. *J. Membrane Sci*. **659** (2022) 120768.

Biography

Riccardo Checchetto has completed his PhD from University of Padova, Italy and postdoctoral studies in Osaka Nationale Research Institute, Japan. He is Adjunct Professor at Dept. of Physics, Trento University (Italy). He has published more than 80 papers in reputed journals and has been serving as an editorial board member of *Separations*.

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Electrospun Mats for the Delivery of Drugs in the Oral Cavity

Electrospinning is a versatile technique to produce nano and submicron fibers' mats. Such materials have applications in drug delivery, tissue engineering, biotechnology, solar cells, biosensor, etc. We studied electrospun mats to release drugs in the oral cavity, which presents a high vasculature in the sublingual region, allowing drugs to absorb and avoid first-pass metabolism. Also, the oral cavity presents infections and inflammation that require local release systems.

One type of application for electrospun masts is the rapid release of drugs. We have prepared electrospun mats for the fast release of sildenafil citrate. We took advantage of the nanofibers' high surface/volume ratio to release the drug intended to treat children with pulmonary hypertension.

For the same purpose, we prepared electrospun mats to release propranolol hydrochloride, intended for administering the drug to children with hemangiomas.

All fibers were observed by SEM and characterized by FTIR, DSC, and TGA. Fast dissolution was demonstrated *in vitro*.

We also study a multilayered system to release the anti-inflammatory drug dexamethasone phosphate. The first layer consists of a polyvinylpyrrolidone (PVP) with the drug (8 mg). The second layer was of PVP containing the mucoadhesive Noveon® AA-1 polycarbophil. The third layer was the backing of polycaprolactone. The approach is to place the system close to the surgical wound, e.g., extraction of the third molar. The first layer will rapidly dissolve and allow the second layer to adhere to the gingiva, occluding the drug, favoring the absorption. We evaluated the release layer's dissolution time and observed a fast dissolution of the drug-containing layer, but the backing system did not dissolve for several hours. We measure in vitro the mucoadhesive properties of the system, which behaves like a good mucoadhesive.

The last system was for the release of nystatin; an antimycotic used to treat candida infection, mainly in HIV-positive patients.

Nystatin was dispersed in a polyelectrolyte complex (chitosan and Arabic gum) film. The film was covered with a layer of electrospun PVP/ Noveon® AA-1 polycarbophil to improve the adhesiveness of the material. Mucoadhesive testing against sublingual pig mucosa demonstrates improvement in the force of detachment and adhesiveness work. The system was effective against strains of candida *in vitro*.

We conclude that electrospun mats are excellent platforms to release drugs in the oral cavity.

Biography

Jose M. Cornejo-Bravo has completed his PhD from the University of California San Francisco, USA. He had Sabbatical stays at the University of California San Diego, USA. He is a Professor at the Faculty of Chemical Sciences and Engineering, Autonomous University of Baja California, Tijuana, Mexico. He has published more than 70 papers in reputed journals and has been serving as an editorial board member of reputed journals.

Osman Adiguzel

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Shape Reversibility and Crystallographic Basis of Memory Behavior of Shape Memory

A series of alloy systems take place in a class of adaptive structural materials called intelligent or smart materials by giving stimulus response to changes in the external conditions. Shape memory alloys take place in this group by exhibiting a peculiar property called shape memory effect. This phenomenon is initiated by cooling and deformation and performed on heating and cooling, with which shape of materials cycle between the original and deformed shapes in reversible way. Therefore, this behavior can be called Thermoelasticity. This is plastic deformation, strain energy is stored in the material and released on heating by recovering original shape, and these alloys are mainly used as deformation absorbent materials in control of civil structures subjected to seismic events. The origin and crystallographic basis of this phenomenon lies in the fact that the crystal structure of materials changes with variation of temperature and pressure.

Shape memory effect is governed by successive structural phase transformations; thermal and pressure induced martensitic transformations. These transformations occur on cooling and stressing. Thermal induced martensitic transformation occurs on cooling with cooperative movement of atoms in <110 > -type directions and ordered parent phase structures turn into twinned martensitic structure along with lattice twinning reaction and ordered parent phase structures turn into twinned martensitic structure. Twinned structures turn into detwinned structure, by means of stress induced martensitic transformation with deformation.

These alloys exhibit another property called superelasticity, which is performed with stressing and releasing the material in elasticity limit at a constant temperature in parent phase region, and shape recovery occurs instantly and simultaneously upon releasing, by exhibiting elastic material behavior. Although it exhibits elastic material behavior, stress-strain diagram exhibit nonlinear behavior, stressing and releasing paths are different, and hysteresis loop refers to energy dissipation. Superelasticity is also result of stress induced martensitic transformation and ordered parent phase structure of material turns into detwinned martensite structure with stressing. We can shortly say that lattice twinning and detwinning plays important role in reversible behavior of shape memory alloys.

Copper based alloys exhibit this property in metastable beta-phase region. Lattice twinning is not uniform in these alloys and gives rise to the formation of unusual complex layered structures, like 6R, 9R or 18R structure.

In the present contribution, x-ray diffraction and transmission electron microscopy (TEM) studies were carried out on copper based CuZnAl and CuAlMn alloys. X-ray diffraction profiles and electron diffraction patterns exhibit super lattice reflections inherited from parent phase due to the displacive character of martensitic transformation. Specimens of these alloys were aged at room temperature for a long term. X-ray diffractograms taken during ageing show that diffraction angles and peak intensities and character changed, and this result refers to redistribution of atoms in diffusive manner.

Keywords: Shape memory effect, martensitic transformation, thermoelasticity, superelasticity, twinning, detwinning.

Biography

Dr. Adiguzel graduated from Department of Physics, Ankara University, Turkey in 1974 and received PhD- degree from Dicle University, Diyarbakir-Turkey. He has studied at Surrey University, Guildford, UK, as a post-doctoral research scientist in 1986-1987, and studied were focused on shape memory effect in shape memory alloys. His academic life started following graduation by attending an assistant to Dicle University in January 1975. He became professor in 1996 at Firat University in Turkey, and retired on November 28, 2019, due to the age limit of 67, following academic life of 45 years. He supervised 5 PhD- theses and 3 M. Sc- theses and published over 80 papers in international and national journals; He joined over 120 conferences and symposia in international level with contribution.

He served the program chair or conference chair/co-chair in some of these activities. Also, he joined in last six years (2014 - 2019) over 60 conferences as Keynote Speaker and Conference Co-Chair organized by different companies. Additionally, he joined over 70 online conferences in the same way in pandemic period of 2020-2021.

Dr. Adiguzel served his directorate of Graduate School of Natural and Applied Sciences, Firat University, in 1999-2004. He received a certificate awarded to him and his experimental group in recognition of significant contribution of 2 patterns to the Powder Diffraction File – Release 2000. The ICDD (International Centre for Diffraction Data) also appreciates cooperation of his group and interest in Powder Diffraction File.

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Graphene-based 3D *scaffolds* in future tissue engineering

Graphene has been proclaimed as a marvel substance with the possibility to revolutionize 3D printing. Currently, clinical nanomedicine and nanobiotechnology have impressively requested the propagation of new organic/inorganic analogues of graphene (as one of the intriguing biomedical research targets) for stem-based tissue engineering. Graphene-based composites are mostly used for the fabrication of 3D structures such as *scaffolds* for tissue engineering. Graphene and its chemical derivatives have been a pivotal new class of nanomaterials and a model system for quantum behavior. Two-dimensional graphene materials have been widely used in various biomedical research areas such as tissue engineering, drug delivery, bioelectronics, and imaging. The utilization of graphene-based materials in 3D *scaffolds* creates a revolutionary impact on the tissue engineering field by providing biocompatible and biomimicking *scaffolds*. The different physicochemical properties of graphene nanomaterials permit a favorable microenvironment for the enhanced growth of cells and thus provide required stimuli for cellular differentiation to specific cell lineage. The use of polymer nanocomposites combined with the versatility of additive manufacturing techniques (AM) provide great potential to meet the demands of a wide range of clinical needs by creating personalized implants, organ printing, drug delivery devices as well as regenerative *scaffolds*. In particular, the incorporation of graphene and its derivatives can improve the dimensional accuracy as well as the mechanical, electrical and biological properties of novel biomedical devices. The porous morphology, large surface area, eclectic permeability of gases, outstanding mechanical power and biodegradability authorize graphene materials to be the better ingredient for *scaffold* engineering.

Biography

Laila M. Montaser MD is a distinguished Prof. of Clinical Pathology. She served as the Chair Emeritus, Founder leader of Clinical Pathology Department, Faculty of Medicine, Menoufia University, Egypt. Prof. Montaser is an internationally recognized stem cell technology professional. She has key competence in stem cell technology and regenerative medicine policy reinforced by global level and international experience in research, formulation and capacity building. In the era of COVID-19, she was awarded twenty seven certificates of appreciation for successfully presenting forty four Global Webinars 27/44 (61.4 %) from her home office amid the lockdown of COVID-19 pandemic crisis.

Tokeer Ahmad

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Tools & Challenges in Nanocatalysis

Multifunctional nanostructures as nanocatalysts find the possibility for their applications in water splitting processes for hydrogen generation as a renewable source of green energy. The studies of some multifunctional nanoparticles by chemical synthesis reveal the formation of monophasic nanostructures with fairly uniform distribution of nearly spherical particles, high specific surface area and visible optical band gap. Photocatalytic generation of hydrogen in water splitting process by using as-prepared nanoparticles has also been studied under the visible light irradiations which showed a significant H2 evolution reaction rate. The development of nanostructured catalysts has also been preferred to carry out the heterogeneous catalytic organic transformations because of greater number of surface-active sites for catalytic processes, high catalyst recovery rate, especially their environment friendly nature and their ease of synthesis. Besides the advances in nanocatalysis, certain challenges including not well-defined morphologies due to loss of control over it and loss of catalytic activity during operation need to be addressed. Herein, we discuss some nanocatalysts for certain

Biography

Prof. Tokeer Ahmad did his masters (chemistry) from IIT Roorkee and Ph.D. from IIT Delhi. Presently, he is full Professor at Jamia Millia Islamia, New Delhi. Prof. Ahmad has supervised 10 PhD's, 74 postgraduates, 9 research projects, published 130 research papers and two books with research citation of 4520, h-index of 40 and i10-index of 84. Prof. Ahmad is active reviewer of 112 journals, delivered 105 Invited talks and presented 121 conference papers. Prof. Ahmad has received DST-DFG award, ISCAS Medal, Inspired Teacher's President Award, Distinguished Scientist Award and elected as Member of National Academy of Sciences India. Prof. Ahmad has been figured in World Top 2% Scientists by Stanford University, USA and has also been conferred the prestigious Maulana Abul Kalam Azad Excellence Award of Education for the outstanding contribution in the field of education.

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Solid State Recycling of Aluminium: A Sustainable Approach

Lightweight, durable and infinitely recyclable, aluminium has become an essential element of daily life. When demands high, the waste correspondent will be increasing though. The impact of aluminium production on the environment has been profound. Aluminium recycling has been activated in the early 1900s where it proposes to concentrate the energy uptake and to save the surroundings. The primary aluminium production required 113 gigajoule per tonne of energy, but on the other hand, secondary production of aluminium recycling needs only 13.6 gigajoule per tonne of energy. Currently, there are quite number of methods that had been introduced as a new approach of recycling metal chips which comply of direct conversion of chips into a compact metal through either cold pressed, hot extrusion or hot forged. This new approach sometimes called solid state recycling will definitely eliminate the melting steps. Hence, the savings in terms of energy consumption, production time and environmental impacts obtained by this technique are astounding. As such, this is an opportune moment to introduce the sustainable direct recycling approach as an alternative technique of solid state recycling which gives best solution contributing sustainability livelihood.

Biography

Dr. Amri is a Professor in the Faculty of Mechanical and Manufacturing Engineering at Universiti Tun Hussein Onn Malaysia (UTHM). He has received his B.Sc. and M.Eng. from Universiti Teknologi Malaysia (UTM) and Phd from the International Islamic University of Malaysia (IIUM) with partly attachment at University of Kentucky (UKY), USA. His current research topics includes aluminium recycling technology where he has developed several new techniques in solid state recycling and also the integration of sustainable product development and remanufacturing. He has written and co-authored more than 100 scientific papers in Scopus and WOS database and four text books.

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Designing of 2D material based heterostructure for solar photocatalytic water splitting

The field of 2D materials has been dominated by graphene and subsequently open new avenues for inorganic sheet like materials. Transition metal chalcogenides & MXenes are important new 2D materials which shows variable surface properties with exfoliation to 2D structures. We explored both Ti_3C_2(MXene) and MoS_2 based 2D materials with high electron mobility derived through exfoliation process and used for hydrogen energy application. New tertiary heterostructures were designed by depositing cauliflower-shaped CdS and nanosized Cu_2O on exfoliated 2D MoS_2 & Ti_3C_2. CdS was deposited using hydrothermal technique and the effect of different anions on shape and size was studied. Materials were characterized by HRTEM, Raman, XPS, SEM and UV-VIS spectroscopy. TEM and SEM proves the proper distribution of CdS and Cu_2O on the nanosheets with desired interface formation. Direct photocatalytic water splitting was monitored using both the tertiary composite under visible light. Water splitting activity in the presence of lactic acid is found to be 11.53mmol/g/h and 13.2mmol/g/h on MoS_2-CdS-Cu_2O and Ti_3C_2-CdS-Cu_2O respectively with good repeatability under visible light. Efficient interfacial charge separation is manifested from demised photoluminescence intensity which supports the suppression of hole-electron recombination in the tertiary heterostructure. Substantial increased hydrogen evolution on tertiary materials is discussed based on the proposed mechanism of dual p-n junction based on XPS and Mott-Schottky analysis. Increased efficiency and stability of the developed noble metal-free catalyst is due to the synergistic effect of improved visible light absorption, dual p-n junction formation and high electron mobility of 2D sheet leading to enhanced interfacial charge separation.

Biography

Dr T. Mishra has completed his PhD from Utkal University, India and postdoctoral studies from Friedrich–Alexander University, Germany. He is currently working as Senior Principle Scientist and Professor of CSIR-National Metallurgical Laboratory, a premier research organization. He has published more than 65 papers in reputed journals, 4 book chapter and 8 patents and has been serving as an editorial board members of reputed journals. He has developed three technology out of which two are already implemented in Industries. Currently he is the fellow of royal society of chemistry (FRSC).

Soshu Kirihara

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Stereolithographic Additive Manufacturing of Practical Components

In stereolithographic additive manufacturing (STL-AM), 2-D cross sections were created through photo polymerization by UV laser drawing on spread resin paste including nanoparticles, and 3-D models were sterically printed by layer lamination. The lithography system has been developed to obtain bulky ceramic components with functional geometries. An automatic collimeter was newly equipped with the laser scanner to adjust the beam diameter. Fine or coarse beams could realize high resolution or wide area drawings, respectively. As the row material of the 3-D printing, nanometer sized metal and ceramic particles were dispersed into acrylic liquid resins at about 60 % in volume fraction. These materials were mixed and deformed to obtain thixotropic slurry. The resin paste was spread on a glass substrate with 50 μm in layer thickness by a mechanically moved knife edge. An ultraviolet laser beam of 355 nm in wavelength was adjusted to 50 μm in variable diameter and scanned on the spread resin surface. Irradiation power was automatically changed for an adequate solidification depth for layer bonding. The composite precursors including nanoparticles were dewaxed and sintered in the air atmosphere. In recent investigations, ultraviolet laser lithographic additive manufacturing (UVL-AM) was newly developed as a direct forming process of fine metal or ceramic components. As an additive manufacturing technique, 2-D cross sections were created through dewaxing and sintering by UV laser drawing, and 3-D components were sterically printed by layer laminations with interlayer joining. Through computer-aided smart manufacturing, design, and evaluation (Smart MADE), practical material components were fabricated to modulate energy and material transfers in potential fields between human societies and natural environments as active contributions to Sustainable Development Goals (SDGs).

Biography

Soshu Kirihara is a doctor of engineering and a professor of Joining and Welding Research Institute (JWRI), Osaka University, Japan. In his main investigation “Materials Tectonics as Sustainable Geoengineering” for environmental modifications and resource circulations, multi-dimensional structures were successfully fabricated to modulate energy and materials flows effectively. Ceramic and metal components were fabricated directly by smart additive manufacturing, design and evaluation (Smart MADE) using high power ultraviolet laser lithography. Original stereolithography systems were developed, and new start-up company “SK-Fine” was established through academic-industrial collaboration.

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Pathogenic α-synuclein cell-to-cell transmission mechanism and related therapeutic development

α-Synucleinopathies is characterized with accumulation of misfolded α-synuclein (α-syn), including Parkinson's disease (PD), Dementia with Lewy Bodies (DLB), and Multiple System Atrophy (MSA). Emerging evidence indicates that pathogenesis of α-synucleinopathies may be due to cell-to-cell transmission of prion-like preformed fibrils (PFF) of α-syn. We identified several receptors (Lag3, Aplp1, neurexins) that specifically bind with α-syn fibrils but not α-syn monomer. Lymphocyte-activation gene-3 (Lag3) exhibits the highest binding affinity with α-syn fibrils, and α-syn fibrils binding to Lag3 initiated pathogenic α-syn endocytosis, propagation, transmission, and toxicity. Lack of Lag3 (Lag3-/-) and anti-Lag3 can substantially delay α-syn PFF-induced loss of dopamine neurons, as well as biochemical and behavioral deficits in vivo. The identification of Lag3 that binds α-syn PFF provides a target for developing therapeutics designed to slow the progression of PD and related α-synucleinopathies. Biocompatible antioxidant nanozyme, PtCu nanoalloys (NAs), is applied to fight against α-syn spreading. The results show that PtCu NAs significantly inhibit α-syn pathology, cell death, and neuron-to-neuron transmission by scavenging reactive oxygen species (ROS) in primary neuron cultures. Moreover, the PtCu NAs significantly inhibit α-syn spreading induced by intrastriatal injection of PFF. It is the first time to observe nanozyme can block prion-like spreading, which provides a proof of concept for nanozyme therapy.

Biography

Dr. Mao received his PhD (Physical Chemistry) at the National Center for Nanoscience and Technology, Chinese Academy of Sciences in 2010. He then worked as postdoc in the labs of Profs. Drs. Ted and Valina Dawson at the Institute for Cell Engineering, Department of Neurology, Johns Hopkins School of Medicine (JHSOM) during 2010-2016. After postdoctoral fellowship, he worked as Assistant Professor in 2017 and became Associate Professor in 2021 at JHSOM. He has published more than 50 research articles in many high-impact journals (*Science, Nature, Nature Medicine, PNAS, Nature Comm, Nano Today*) focusing on pathogenic protein cell-to-cell spreading.

INVITED PRESENTATIONS

Seongwoo Woo

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Improving the Reliability Design of Mechanical Systems such as Refrigerator

To enhance the lifetime of mechanical system such as automobile, new reliability methodology – parametric Accelerated Life Testing (ALT) – suggests to produce the reliability quantitative (RQ) specifications—mission cycle—for identifying the design defects and modifying them. It incorporates: (1) a parametric ALT plan formed on system BX lifetime that will be X percent of the cumulated failure, (2) a load examination for ALT, (3) a customized parametric ALTs with the design alternatives, and (4) an assessment if the system design(s) fulfil the objective BX lifetime. So we suggest a BX life concept, life-stress (LS) model with a new effort idea, accelerated factor, and sample size equation. This new parametric ALT should help an engineer to discover the missing design parameters of the mechanical system influencing reliability in the design process. As the improper designs are experimentally identified, the mechanical system can recognize the reliability as computed by the growth in lifetime, LB, and the decrease in failure rate. Consequently, companies can escape recalls due to the product failures from the marketplace. As an experiment instance, two cases were investigated: 1) problematic reciprocating compressors in the French-door refrigerators returned from the marketplace and 2) the redesign of hinge kit system (HKS) in a domestic refrigerator. After a customized parametric ALT, the mechanical systems such as compressor and HKS with design alternatives were anticipated to fulfill the lifetime – B1 life 10

Biography

Dr Woo has a BS and MS in Mechanical Engineering, and he has obtained PhD in Mechanical Engineering from Texas A&M. He majors in energy system such as HVAC and its heat transfer, optimal design and control of refrigerator, reliability design of thermal components, and failure Analysis of thermal components in marketplace using the Non-destructive such as SEM & XRAY. In 1992.03–1997 he worked in Agency for Defense Development, Chinhae, South Korea, where he has researcher in charge of Development of Naval weapon System. He was working as a Senior Reliability Engineer in Refrigerator Division, Digital Appliance, SAMSUNG Electronics. Now he is working as associate professor in mechanical department, Ethiopian Technical University.

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Improvement of the anticorrosion resistance of nickel by polypyrrole coating electrosynthesized in phtalate medium

In this work we investigated the possibility of enhancing anticorrosion properties of polypyrrole (PPy) films obtained electrochemically on nickel substrate. The oxidation of pyrrole monomer has been achieved in aqueous medium containing potassium phtalate as supporting electrolyte using cyclic voltammetry and gal-galvanostatic methods. Several techniques such as Fourier transform infrared (FTIR) and X-ray photoelectron and (XPS) spectroscopies were carried out for vibrational and elemental characterization of the elaborated films. The XPS analysis confirm the absence of any peaks related to Ni^{2+} anion bound to the polymer chain, hence, the absence of any complex formed between Ni (II) and PPy. In addition, the adherence of the films, evaluated by the standard sellotape test, reached 100%. The electrochemical impedance spectroscopy (EIS) and anodic polarization curves showed that the coating exhibits an important anodic protection behavior.

Biography

Zaynab Aouzal has completed her PhD in 2019 from Mohammed first University faculty of science, Oujda, Morocco. She has her expertise in conducting polymers and their electrosynthesis. Her focus is based on the use of conjugated polymers as coating for application in corrosion protection. She has published 10 papers indexed international journals and 2 moroccan patents.

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Study of the Dominant Physic-Chemical Properties of Different Clay Species

Clay is some sort of dominantly using raw material for the industrial usages because of the specific attitudes of clays for those applications. The analysis of the fundamental physic-chemical and mechanical properties of three selected clay varieties was the expectations of the current research. The selected clays were named as anthill clay, brick clay and roof tile clay based on their primary usages and mode of occurrence. The natural moisture contents, acidities and sizes of the particles of raw clays and the water absorptions, bulk densities, splitting tensile strengths and compressive strengths of prepared bricks were investigated by following standard test methodologies and instruments. In addition, the microstructures of raw clays and prepared bricks were analyzed using an optical microscope. There were discovered relatively higher acidity from anthill clay, higher natural moisture content from roof tile clay, well graded grain arrangement in roof tile clay, poorly graded grain pattern from brick clay, gap graded grain pattern from anthill clay, higher portion of finer particles from roof tile clay accordingly with the results of both microscopic analysis and wet sieve analysis of raw clays, relatively higher water absorption from anthill clay brick, higher splitting tensile strength and compressive strength from roof tile clay bricks as the upshots of the existing research.

Biography

Mr. Suresh Aluvihara has completed his first degree in the year 2017 from a recognized government university in Sri Lanka. He is a postgraduate research scholar at the Department of Chemical and Process Engineering, University of Peradeniya, Sri Lanka. He has over 36 research publications that have been cited over 15 times with Hi- index publications. He has participated over 46 world recognized research conferences under the role of keynote speaker, invited speaker and featured speaker.