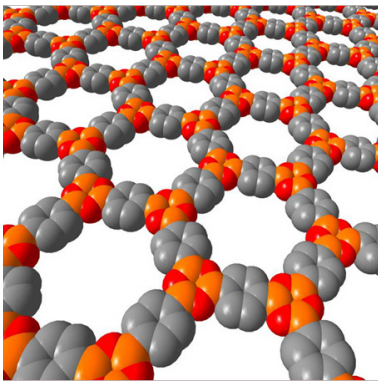
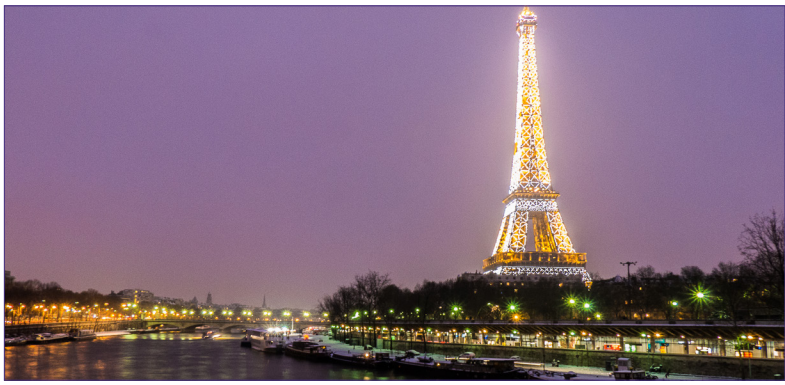
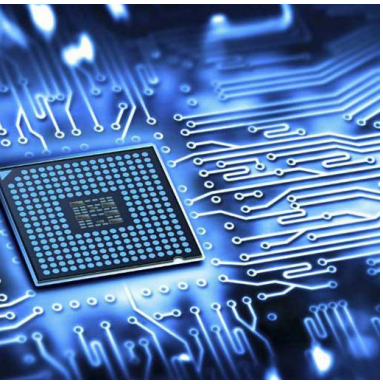
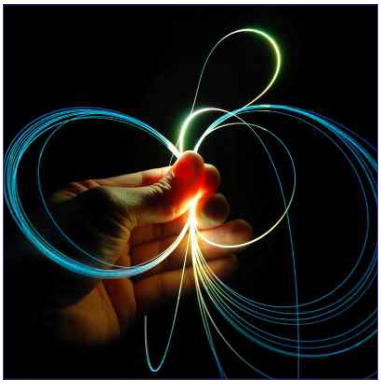
Scientific Tracks & Sessions
February 25, 2019

Material Science 2019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MEMS at Bosch: Products and technology demands

Andrea Urban
Robert Bosch GmbH, Germany

Micro Electro Mechanical Systems (MEMS) at Bosch look back on more than 25 years of development and production. MEMS elements are small mechanical systems, acting either as sensors or as actuators. From the historical point of view MEMS manufacturing technology started based on the established silicon semiconductor process technology. In contrast to semiconductor components, MEMS sensors and actuators are 3-dimensional movable elements. This required the development of additional, new and application specific MEMS manufacturing technologies besides typical semiconductor processes. Nowadays, some of these specific processes are MEMS key manufacturing technologies. Silicon Deep Reactive Ion Etching (DRIE), also known as the "Bosch Process", is one of the worldwide established MEMS key manufacturing processes on the market. The starting point of this plasma trench etch process for silicon dates back to the development in the early 1990's at Bosch Corporate Research Center on a prototype equipment. With the "Bosch Process" 3-dimensional structures in silicon can be etched with high etch rates and high aspect ratios at high mask selectivity and without restrictions in crystal orientation. This plasma etch process was an enabler for a large variety of interesting bulk and surface micro machined MEMS products, which nowadays penetrate and support the daily life of all of us. Throughout the years, a wide base of equipment suppliers for MEMS key manufacturing processes and tools established on the market. MEMS provides low-cost mass products like microphones, micro mirrors, pressure and inertial sensors for automotive, consumer and IoT applications. Autonomous driving or virtual reality as new applications are increasingly pushing inertial sensors performance improvements like higher sensitivity and resolution. A close co-operation between equipment suppliers and MEMS manufacturers helps to improve equipment hardware and processes in parallel to product development, in order to fulfil enhanced MEMS product requirements for the future.

Speaker Biography

Andrea Urban is a senior expert working on the development of new process technologies and their transfer into series production for upcoming generations of MEMS sensors. She completed her diploma in Materials Engineering and Surface Technologies in 1992 at Fachhochschule Aalen, Germany. She joined the Robert Bosch GmbH Corporate Research and Technology Center in Stuttgart, Germany in 1992. She is working as a technology specialist mainly related to inertial sensor manufacturing, which strongly influenced the development and installation of MEMS acceleration sensors and gyroscopes for mass-manufacturing in Bosch's production line. She is the co-inventor of the "Bosch Deep Reactive Ion Etching Process". She entrusted with the co-ordination of the European Semiconductor Equipment Asessment I-SPEEDER project, which had a significant impact on the equipment tool basis for advanced Deep Reactive Ion Etching. She joined in 2003 the new founded Engineering Sensor Process Technology division at Robert Bosch GmbH, Reutlingen, Germany.

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µPlasmaPrint: Digital on-demand surface engineering

Bilel R and **Hugo D H**
Innophysics B V, The Netherlands

Atmospheric pressure micro-plasmas allow cost-effective area-selective surface modifications and chemical functionalization. Plasma patterning technologies are used in combination with inkjet printing or fluid dispensing and can be implemented in biosensor and tissue engineering applications. InnoPhysics has developed and commercializes the µPlasmaPrint technology, which utilizes a multineedle-to-plate dielectric barrier micro-discharge at atmospheric pressure and enables area-selective functionalization by means of a dot-wise patterning of the plasma treatment/deposition with a resolution from millimeters down to 150 µm.

Recently InnoPhysics has made significant changes on hardware and process options in order to enhance the µPlasmaPrint resolution and to improve the processing and substrates flexibility. Latest developments will be shown related to process characterization through surface wettability mapping, in-situ monitoring of the plasma energy for improved process feedback and the development of a stand-alone µPlasmaPrint head with integrated electrode to enable the application of µPlasmaPrint not only on 2D, flat substrates, but also more complex, 3D workpieces. On the process side, developments will be presented to enable non-fouling hydrophilic coatings in plastic biomedical devices by combining µPlasmaPrint with liquid coating dispensing. Furthermore recent developments which enable selective chemistry to obtain patterns of chemically functionalized substrates as an alternative to direct µPlasmaPrint deposition will be shown. Examples will involve a direct, patterned plasma ALD-like approach to obtain microscale patterns of In_2O_3: H.

Speaker Biography

Bilel R is an entrepreneurial plasma physicist with strong background in plasma-surface interaction, surface engineering, and enabling cold atmospheric plasma technologies. He is currently principal researcher and leader of the R&D department of InnoPhysics, the company proprietary of the digital plasmaprint patented technology. He holds a PhD in Plasma Physics from Padua University, Italy

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Vertical graphene network as platform for electrochemical and bio applications

Mineo Hiramatsu[1], Keigo Takeda[1], Hiroki Kondo[1] and **Masaru Hori[2]**
[1]Meijo University, Japan
[2]Nagoya University, Japan

Graphene (monolayer and few layers) is a two-dimensional material with the large anisotropy between in-plane and out-of-plane directions. Carbon nanowalls (CNWs) are few-layer graphenes standing vertically on a substrate forming a self-supported network of 3-dimensional wall structures. This kind of carbon nanostructure is also called as carbon nanoflakes, carbon nanosheets, graphene nanosheets, and graphene nanowalls. CNWs are modified with several types of surface termination and decoration with metal nanoparticles and biomolecules. In addition, the potential window of CNW film is as wide as that of boron-doped diamond electrode. The maze-like architecture of CNWs with large-surface-area graphene planes can be suitable for the platform in electrochemical and biosensing applications. For the energy storage and power generation applications, CNW films can be potentially used as electrodes of capacitor, secondary battery, dye-sensitized solar cell, polymer electrolyte fuel cell, and implantable glucose fuel cell.

CNWs and similar vertical graphene materials can be synthesized by plasma enhanced chemical vapor deposition techniques on heated substrates (600-800˚C) employing methane and hydrogen mixtures. After synthesizing CNWs, the surface of CNWs was decorated with Pt nanoparticles by the reduction of chloroplatinic acid. It was confirmed that Pt-supported CNWs as electrodes of fuel cell had excellent durability comapred with the conventional carbon black. We report the current status of fabrication and structure control of CNWs, together with the performances of possible applications (fuel cells, hydrogen peroxide sensor, and scaffold for cell culturing), where CNW electrode was used.

Speaker Biography

Mineo Hiramatsu is a full Professor of department of Electrical and Electronic Engineering and the Director of Research Institute, Meijo University, Japan. His main fields of research are plasma diagnostics and plasma processing for the synthesis of thin films and nanostructured materials. He served as chairman and member of organizing and scientific committees of international conferences on plasma chemistry and plasma processing. He was awarded the Japan Society of Applied Physics Fellow in 2017.

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Stabilization of laterite with rubber latex and various applications

EMERUWA Edjikémé, OFFO Owochi Quentin Aristide, KOUADIO Koffi Clement, KOUAKOU Con and **Honoré**
Felix Houphouet-Boigny-Cocody University, Ivory Coast

Avoiding the emission of greenhouse gases and air pollution related to the manufacture of clinker cement led us to consider the use of a natural binder for stabilization. Thus latex contents ranging from 0 to 30% were used to stabilize laterite specimens. These specimens were subjected to physical tests (water resistance test, absorption test) and mechanical tests (dry compression test). The results obtained indicate, on the one hand, that specimens made with latex contents less than 15% dissolve completely in water while those of 20%; 25% and 30% are water resistant. The absorption rate of the test pieces decreases as the latex content increases in the test pieces. It goes from 14.45% for specimens to 15% to 5.87% for 30% specimens. On the other hand the compression test indicates an increase in strength when the latex content increases. It goes from 0.37 MPa for latex-free specimens to 3.15 MPa for 30% specimens. Also, the study of the rheology shows that the specimens pass from a brittle behavior to a plastic behavior when the latex content increases. The behavior of the test pieces in the various tests (water resistance test, absorption test and compression test) makes it possible to envisage the use of this material in several fields including the field of construction, the road domain, space development for the sport.

Speaker Biography

EMERUWA Edjikémé is a Professor at the Universities of Felix Houphouet-Boigny-Cocody University, Ivory Coast. He obtained his doctorate in the University of Limoges, France in 1889 and completed his masters in Materials Science at University of Limoges, France and CESS in ceramics, ENSCI, Limoges, France. He is the inventor of multiple objects like one of them is SABLATEX. He is the author of 4 registered certificates OAPI industrial drawings and writer of 4 books. He was awarded with Patronat award continuously from the year 2014-2016. He received National excellence award for research results and innovation of the year 2018 and Special Jury Prize winner of the "Green Africa Booster", Yamoussoukro in June 2018.

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Study of the influence of cement stabilized soil granulary on its thermal diffusivity: The case of the Odometa (Benin) lateritic gravelly soil

O D Samah[1], K B Amey[2], W N Bayor[2], M Gbedahi[3], A Vianou[3] and **E Sanya[3]**

[1]Centre of Construction and Housing, Togo

[2]National High Engineering School, Togo

[3]University of Abomey- Calavi, Benin

When there is a difference in temperature between two systems or two bodies, heat exchange by heat transfer is naturally occurs which is one of the best known modes either by conduction, convection or radiation. But there are often temperature differences between the points of the universe, the phenomena of heat transfer appear as universal. In many countries of the South Sahara, especially those with a hot climate, there is a massive use of locally available materials such as sand, clay, lateritic gravelly soil, etc. in the construction of roads and housing constructions.

The present study highlights the influence of soil granularity on its thermal diffusivity in pavement structures. This lateritic gravelly soil is taken from a quarry in Odometa, a town located in Benin. To do this, the identification tests carried out on the material have allowed, according to the Highway Research Board (HRB) classification system, to specify that the material is of class A-2-7.Indeed, the grain size analysis gives for grain sizes of 0.08mm, 14.6% passing and for grains of 31.5mm, 100% passing.

Similarly, the Atterberg limits tests yield the following results: liquidity limit WL=49; plasticity limit WP=31; the plasticity index IP=18.

The Proctor test gives for raw material: ω_{opt}=8.3% with ds_{opt}=2.125, CBR (at 95% of OPM)=45 and for the material stabilized at 4%: ω_{opt}=8.2 with ds_{opt}=2,278, CBR (95% of OPM) = 197.1. The specific gravity is ρs=2,684

To better appreciate this phenomenon, the comparative tests are performed on lateritic gravelly soil and silty sand with the same granularity (d<1.25mm) and stabilized with cement. The results obtained respectively give a value of 1.85 10^{-2} m²/s and 3.45 10^{-2} m²/s for their thermal diffusivity.

Speaker Biography

O D Samah has completed his Civil Engineering and Master of Technical Sciences at the age of 28 years from Leningrad Institute of Construction, USSR and Doctorate at the age of 52 years from Abomey-Calavi University, Cotonou, Bénin. He is the Director General of Regional Road Maintenance Training Centre, Lomé, Togo. He has publications that have been cited several times, and some of them are indexed in well knowned and reputed journals.

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Thermo-chemo-mechanical modeling of a filled rubber behaviour submitted to thermal ageing

R Bouaziz, S Lejeunes, D Eyheramendy and **K D Ahose**
Mines ParisTech Materials Center, France

This work focuses on the finite strain thermo-mechanical modeling of the dynamical behavior of carbon black filled butadiene using a multiphysics coupling approach. This material, as many filled rubbers, exhibits a complex thermo-dynamical behavior that strongly depends on the chemo-physical evolution due to severe thermo-mechanical loadings. The self-heating phenomenon, the frequency dependency and the Payne effect are taken into account in a phenomenological thermo-visco-hyperelastic model.

Speaker Biography

R Bouaziz has completed his PhD at the age of 27 years from University of Lille 1, France. He is a postdoctoral researcher in Centre des Matériaux (Mines ParisTech).

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Formation of composite in the icosahedral phase of the quasicrystal with graphene in the production of hydrogen

Reza Jamshidi Rodbari and **Lourdes Cristina Lucena Agostinho Jamshidi**
R & C Jam Catalyst Co-LTD, Brazil

The development of new materials with different properties and industrial applications is being explored and investigated. Further, it is necessary to obtain materials with good physical and thermodynamic properties such as: high hardness, low thermal and electrical conductivity, good corrosion resistance and high mechanical resistance. The composites are materials used with wide variety and purposes in several industrial areas. They are produced and designed to be more resilient, light and functional, with unique properties and cost-effective cost. But it should be noted that global technology has generated great diversity in the market and globalization of the economy; however, an intense environmental impact. Hydrogen is one of the ideal source of electric power transformation, thus being able to be used in fuel cell systems for power generation efficiently. The structure of the films from the metal matrix plus graphene oxide, observes a barrier in the formation in the layers. Researches that were developed with quasicrystalline alloys plus graphene / graphene oxide addition, have shown that this formed composites are excellent for hydrogen storage and other industrial applications. In this work, the use of physical-chemical characterization techniques such as; XRD to analyze the formation of the composite between the quasicrystalline alloy and graphene, scanning electron microscopy-SEM, allowing the study of the surface microstructure of the composite and the other experimental analyzes to evaluate the material produced.

Speaker Biography

Reza Jamshidi Rodbari is a Doctoral in Material Science and Engineering at the Federal University of Pernambuco, Brazil. He is the Member of the board, Executive Director at R & C Jam Catalyst Industrial Group, in the sector of energy sustainability and petrochemical industry. He has contributed himself by participating in events like International Congresses on Petrochemicals and Chemical Engineering in 2013 at San Antonio and also in 2014 at Las Vegas. He was the part of the organizing committee of the World Conference and Expo on Petrochemicals and Natural Resources during 2018 at Prague. He has two books with ISBN, an International Patent in the Catalyst Area and has 35 article publications.

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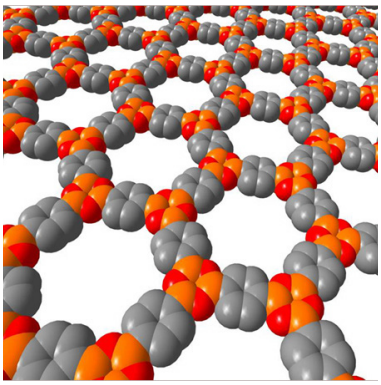
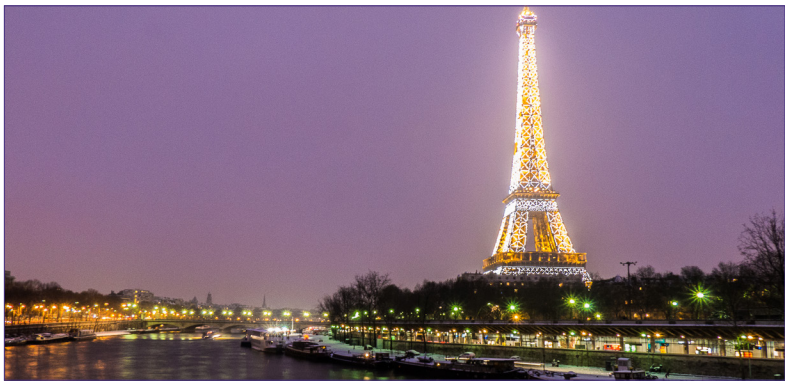
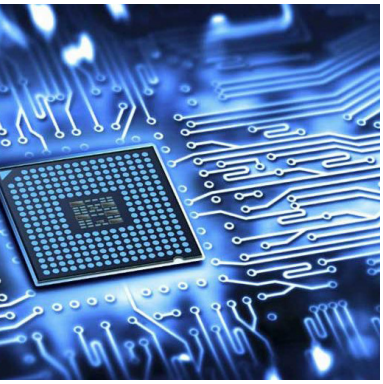
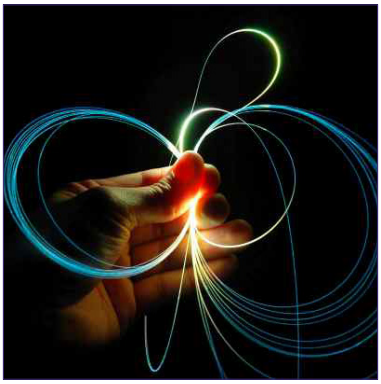


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Ultrasonic synthesis of Fe-doped, N-doped and undoped titanium dioxide particles

Innocent Pumure
University of Central Missouri, USA

We used focused probe sonication to synthesize Titanium dioxide particles using varying concentrations of F^{3+} and Fe^{2+} for the Fe-doped TiO_2 and varying concentrations of melamine, a nitrogen rich source, for N-doped TiO_2. All samples were analyzed using Raman spectroscopy. Rutile phase of TiO_2 was obtained for all Fe-doped particles and the anatase form was obtained for all N–doped TiO_2. The ultrasonically synthesized particles were centrifuged and then incinerated in a muffle furnace at 650°C before analysis. Extended periods of direct and continuous bath and probe ultrasonication without incineration of undoped TiO_2 produced the rutile phase only and no anatase form was observed. The rutile phase was produced after 40 minutes with probe sonication and after 90 minutes with bath sonication. The photocatalytic utility of the synthesized particles was initially tested using the degradation of Rhodamine B when mixed with either doped TiO_2 or undoped TiO_2 and then irradiated with natural sunlight without stirring. A UV-visible absorption-scattering method was used to approximate the electronic band gaps of the synthesized particles and the assessment of the deviation from the expected 3.2 eV.

Speaker Biography

Innocent Pumure is currently working as an Associate Professor in the chemistry department of University of Missouri, USA. His expertise is in the field of water quality, extraction, mining, leaching, chemometrics, and vibrational spectroscopy.

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Gigantic transverse dielectric screening in Quasi-2D materials

Vladimir U Nazarov[1] and **Eugene E Krasovskii**[2]

[1]Academia Sinica, Taiwan

[2]University of the Basque Country, Spain

The electrical and optical properties of quasi-two-dimensional (Q2D) materials are predominantly known within their macroscopic in-plane dimensions. In the latter regime, the strictly 2D models, neglecting the finite thickness of the systems, serve, in most cases, as already a satisfactory approximation to study the corresponding phenomena. Here, on the contrary, we explore the reaction of the Q2D materials to the static and dynamic electric fields applied perpendicularly to the systems' layer(s), when finite, although microscopic, transverse extent of the system plays a defining role. Counter-intuitively, in spite of the robustness of the inter-atomic bonds, we discover the full or almost full screening of the external field in the interior of the Q2D crystals. The dramatic effect of these findings on the photoemission spectroscopy of the Q2D materials is revealed and discussed, leading, in particular to the failure of the conventional dipole theory of photoemission for these systems. In order to better understand the underlying physical processes, we introduce the Q2D jellium model which qualitatively reproduces results of our Ab initio calculations.

Speaker Biography

Vladimir U Nazarov completed his Ph.D in physics and currently an associate research fellow at the Research Center for Applied Sciences, Academia Sinica, Taiwan. His research focuses on the fundamentals of Time-Dependent Density-Functional Theory (TDDFT) and its applications to optics and transport in bulk materials and low-dimensional structures. He has his habilitation (in Russia, Doctor of Physical and Mathematical Sciences) from the Far-Eastern National University, Russia. The past positions of him include the Leading researcher at the Institute for Automation, Far-Eastern Branch of Russian Academy of Sciences, associate professor at Kyushu Institute of Technology, Japan, visiting professor at the Institute for Solid State Physics, Japan, and visiting professor at Chonnam National University, South Korea.

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Analysis in large deformation of a rigid plastic prestressed beam in ultra-high performance fiber-reinforced concrete

Abelim Passoli, Emmanuel ET Olodo and **Clement Ahouannou**
University of Abomey-Calavi, Benin

One of the major concerns in designing of prestressed beams in Ultra-High Performance Fiber- Reinforced Concrete (UHPFRC) is improvement of their ductility fracture due to the nature of the materials used in their manufacture. This can induce plastic behaviours which is necessary to take into account by designing of such structures, especially when they are of large spans. In the present work, we have proposed an analytical model in large deformation of a rigid plastic prestressed UHPFRC beam embedded at one end and having at other end rolled support. It is approached to support a local uniform load and external moment. The proposed non-linear model can find exact analytical solutions for the determination of the local arrows and the associated charge by the technique of Lagrange multiplier which allows the finding of stationary points of differentiable function of one or several variables under constraints. The results of this work can be useful in design and calculation of long span prestressed structures with plastic rigid behavior.

Speaker Biography

Abelim Passoli is a doctorate in Engineering Sciences (DOCs3s4-SPI) at the University of Abomey-Calavi, Benin. He is a graduate of the National Conservatory of Arts and Crafts (Cnam) of Paris in France and Higher National School of Technology (ENSUT) in Dakar, Senegal. As a construction and planning engineer, he held several senior positions in the public and private sector with more than 26 years of experience in the field of transport and public works and the management of various phases of road infrastructure, urban infrastructure, rural equipment project studies and public contracts. As a specialist in transport economics, since 2004 he has been involved in the technical and economic studies of infrastructure projects in Togo and in the sub-region through the SITRASS network in the expertise and valuation of companies real estate assets.

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The study on the selective electroplating of copper foil on the semiconductor

Szu Han Chao and **Shih Chieh Hsu**
Tamkang University, Taiwan

We successfully fabricated a pre-defined patterned copper (Cu) substrate for the thin-GaN light-emitting diodes (LEDs) without barriers by the selective electroplating technique in this study. The contours of the Cu bumps with different current density were measured, and we observed that the average thickness decreases with reinforcement of the current density. The current density under the condition between 40 and 80 mA/cm^2 was proved to possess the best morphology in our experiments.

Speaker Biography

Szu Han Chao is a PhD student in the department of Chemical and Materials Engineering at Tamkang University, Taiwan. Her major research interests are Raman, Light-emitting diodes and Optical simulation. This presentation is part of collaboration with her Professor Shih Chieh Hsu. He has completed his PhD at the age of 30 years from National Central University and postdoctoral studies from Research Center for Applied Sciences, Academia Sinica. He is the associate professor (2015-present), Department of Chemical and Materials Engineering, Tamkang University, Taiwan. He has published more than 20 papers in reputed journals and has been serving as an editorial board member of repute.

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Electrospinning of cellulose acetate fibre and study on its structural and morphological change

Sushmita Majumder, Md Abdul Matin, Ahmed Sharif and **M Tarik Arafat**
Bangladesh University of Engineering and Technology, Bangladesh

Electrospun polymer fibre is a major breakthrough in the biomedical field due to its remarkable contribution in fibre-based sensors, drug delivery, tissue engineering and medical diagnosis. This has been possible due to the multidimensional structures of nonwoven fibre mat which can be obtained by electrospinning by the control of process parameters. In this work cellulose acetate (CA) fibre mat was synthesized using a single solvent system of pure acetone and a solvent system of 2:1 acetone/N,N Dimethyl acetamide (DMAc). Scanning electron microscopy (SEM) analysis showed that CA with acetone yielded a mixture of ribbon and cylindrical shaped fibre whereas homogeneous cylindrical nanofibres were obtained with acetone/DMAc. Fourier transform infrared spectroscopy (FTIR) confirmed the peaks of CA. Electrical conductivities of CA solution were measured and found that the conductivity increased with decreasing fibre diameter.

Speaker Biography

Sushmita Majumder has completed her B.Sc. at the age of 25 years from Bangladesh University of Engineering and Technology (BUET), Bangladesh. At present she is enrolled in master's program in materials and metallurgical engineering at BUET. She has also been a lecturer in the same department of BUET since 2017. She is an enthusiastic young researcher who dreams to perform forefront research on materials science in her upcoming graduate program.

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Magnetic property of the quasicrystal $Al_{62.2}Cu_{25.3}Fe_{12.5}$ in the formation of nanostructured materials applied in the Petrochemical industry

Lourdes Cristina Lucena Agostinho Jamshidi and **Reza Jamshidi Rodbari**
R & C Jam Catalyst Co-LTD, Brazil

Quasicrystals are materials with good physical, thermodynamic, electronic, surface and magnetic properties, due to this, it has a wide industrial applicability. However, we always attract attention many researchers in technology innovation in the development of nano-structured materials. Mainly advantages that the quasicrystalline alloys propitiates in the catalytic reactions. The magnetic behavior of the quasicrystalline $Al_{62.2}Cu_{25.3}Fe_{12.5}$, and the conduction electrons are essentially the location of the eminence of the unpaired electronic spins that are present in the quasicrystalline alloy; (Mn, Fe) and rare earth metal atoms are studies explored in magnetism. The magnetic properties of the Al-Cu-Fe alloy, which is stable in the icosahedral phase, show a linear relationship between magnetic susceptibility and electron state density at the Fermi(FE) energy level, including temperature dependence, and the Pauli energy in the paramagnetic. For this purpose, it makes the techniques of Physical-chemical characterization, such as: Diffraction (XRD) and Scanning Electron Microscopy (SEM), Energy Dispersive Spectroscopy (EDS), Paramagnetic Resonance Spectroscopy (EPR), Vibrant Sample Magnetometer (MAV) and others.

Speaker Biography

Lourdes Cristina Lucena Agostinho Jamshidi is a Doctoral in Chemical Engineering, Masters of Mechanical Engineering-emphasis in Materials Science. She completed her Bachelors degree in Physics-Solid state, Industrial Chemistry and Chemistry. She is a specialist in the teaching of Mathematics by IMPA/UFPB and did her specialization course in chemistry EDX/MITX from the Massachusetts Institute of Technology and 22 courses of Human Resources in Oil and Natural Gas Program (PRH-28), National Petroleum Agency-Natural Gas (ANP) PETROBRAS (Brazil). She has more than 60 publications on international and national journals (Environment, Education and Technology of Petroleum). She is also the reviewer of International Journal of Elsevier and other National scientific journals and contributed herself by partcipating in International Congresses of Omics on Petrochemicals and Chemical Engineering and also the part of the organizing committee of the World Conference and Expo on Petrochemicals and Natural Resources in the year 2018 at Prague. She is the author of two Books with ISBN and has an International Patent in Catalyst Area.

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