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Abstract Book

Renewable and Sustainable Energy Virtual

September 24-26, 2021

PLENARY FORUM

DAY 1

RENEWABLE AND SUSTAINABLE ENERGY Virtual

SEPTEMBER

24, 2021

GMT 07:00 – 13:00

V-Renewable2021

Edgar Harzfeld

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New solutions for storing and using surplus electricity in Methanol

The decline of fossil fuels requires the expansion of renewable energy production. The use of wind and pv energy is associated with strong fluctuations that are insufficiently adapted to the demand. The use of storage systems can help to reduce the mismatch. While short-term storage systems such as batteries rely on charging and discharging cycles, long-term storage systems such as methanol storage can be charged and discharged over any time range. Current studies show a wide variety of possible applications for long-term storage systems based on methanol. Methanol can contribute to the decentralised supply of electricity, heat and fuel as well as to grid stabilisation. In an emergency case, it can even supply entire consumer clusters autonomously for several days.

Biography

Edgar Harzfeld, Professor at Stralsund University. Studies and research in Leipzig and Zurich. Since 1996 at the Faculty of Electrical Engineering and Computer Science of Stralsund University responsible for electrical power supply and renewable energy systems. Since 2004 - 2021 numerous research projects on the subject of electrical energy storage technologies.

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Toshihiko Shakouchi

Mie University, Japan

Innovative desalination of seawater and waste water treatment by liquid columns and decompression boiling

Desalination of seawater includes boiling/evaporation method and membrane methods using reverse osmosis membranes, both of which requires a large amount of operating power. In this study, the concept of an efficient seawater desalination method and equipment using liquid columns of seawater and desalinated fresh water, decompression boiling and evaporation/ condensation, and recovery of condensation latent heat are introduced. The equipment consists of seawater and freshwater columns approximately 10 m high with top spaces. The pressure of the top space, the evaporation and condensation area, of the seawater column, for example, is reduced approximately 30 mmHg (abs.) using the seawater column, after which it is heated from the general seawater temperature of 25°C to 30°C to boil and evaporate the seawater. The vapor is cooled by the seawater at approximately 25°C in a heat exchanger, and then, it is condensed and sent to the fresh water column. At this time, the condensation latent heat is recovered to preheat the newly flowing seawater. The evaporation or condensation rate, namely, the production rate of freshwater, by the new desalination equipment is also estimated by the results of the existing quadruplex effect vacuum evaporator used in the salt production industry. This new desalination method and its associated equipment also can be used to purify polluted water and waste water.

Biography

Toshihiko Shakouchi, Professor at Mie University. Studies in Nagoya University, Japan and Ehime University, Japan. Since 1969 to1994 at Dept.of Mech. Engineering., Mie University, Assistant Professor, Associate Professor. Since 1992-1993: Guest Researcher, LSTM, Univ. Erlangen Nuernberg, Germany. Since 1994-date: Professor at Mie University.

Luís Miguel Lopes Alcaide[1], Marek Wiśniewski[2]

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Hydrogen-reach gas from biomass, catalytically enhanced water splitting under non-thermal plasma conditions

Plasma-activated H_2O splitting into H_2 and O_2 has been intensively investigated since H_2 is an important chemical/energetic feedstock for synthetic fuels. It is known that the reaction can occur under NTP conditions (without a catalyst), however, the presence of C-solid phase increases the reaction rate drastically. The overall process reaches the equilibrium, which can be manipulated by increasing specific energy input (SEI) due to increased average electron density. The H_2O splitting in excited states (e.g. under NTP or high-temperature conditions) is dominated by electron-impact dissociation (forming H_2 and O atoms and ions), the ionization process (forming H_2O^+ ions), and dissociative electron attachment (forming H_2 and O^- ions). However, a fraction of the ions from these processes can recombine to H_2O in gas-phase – equilibrium state. Therefore, the catalyst incorporation, especially nanocarbons, seems highly reasonable for increasing H_2O conversion rate and disabling the recombination process.

The biomass-derived carbons, in general, affect the physical characteristics of the plasma discharge, which enhance the electric field and enable the formation of surface discharges and micro-discharges, thus (i) promoting gas-phase H_2O dissociation and (ii) working as excellent oxygen scavengers.

Additional impact of this work was to elucidate the mechanism of the process based on the results from *in-situ* FTIR experiments. It is shown here that surface C=O as well as C-O-C functionalities are of decisive importance during the process. Moreover, due to systems complexity – a “great zoo” of different charged and uncharged species new spherical carbon-nanomaterials are formed.

Biography

Marek Wiśniewski has completed his PhD from Nicolaus Copernicus University in Toruń, Poland, and a postdoctoral fellow from Claude Barnard University in Lyon, France. He is the member of Chair of Materials Chemistry, Adsorption and Catalysis, and Physicochemistry of Carbon Materials Research Group. He has published over 80 papers in reputed journals. He is interested in synthesis of novel carbon structures and studies of their unusual properties..

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KEYNOTE FORUM

DAY 1

RENEWABLE AND SUSTAINABLE ENERGY Virtual

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Michihisa KOYAMA

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Metal-free and flexible Li-ion batteries based on CNT tissues

The use of renewable energy as a main primary energy source can be perceived as a common target of all the countries in the world to reach a carbon-neutral society by 2050. Toward this difficult goal, the photovoltaic and wind power generations are expected to play essential roles. Their intermittent power outputs will be a big hurdle to be a main primary energy source, thus, economically feasible energy storage measures are necessary. In this presentation, the role of hydrogen as a key storage technology in the era of intermittent renewable energies as a main power generation option will be discussed focusing on the battery and hydrogen energy systems. The concept of hybridizing the battery and electrolyzer for economically feasible hydrogen production will be introduced.

Biography

Michihisa Koyama received his Ph.D. from the University of Tokyo in 2002. After serving as Assistant Professor at Tohoku University and Professor at Kyushu University, he is now serving as Professor at Shinshu University, Program-Specific Professor at Kyoto University. His research activities cover the wide aspects of energy from materials to systems, further to future energy vision. He was awarded The Young Scientists' Prize, The Commendation for Science and Technology by the Minister of Education, Culture, Sports, Science and Technology in 2014, and the Award of the Society of Computer Chemistry, Japan in 2021.

Almantas Pivrikas[1]

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Printed and low embodied energy solar cells

Solar cells made from disordered materials such as polymers, organic small molecules, dye-sensitized structures, nanoparticles as well as perovskites offer novel opportunities to reduce fabrication costs, lower the energy embedded in the solar cells during manufacturing thereby allowing for reduction of greenhouse gas emissions. All these novel materials long range structural order and have one common feature – their electrical conduction is inferior compared to highly-crystalline inorganic semiconductors such as silicon. It this presentation the key differences between traditional and novel low embodied energy solar cells is highlighted. The difference in device photophysics between these devices and technologies is compared. It is explained why the novel materials utilizing solar cells are promising for commercial applications and what are their present weak points, efficiency and performance limiting factors. Recent advances in device efficiency, stability and degradation are discussed. The importance of novel experimental measurement techniques for solar cell performance characterization is briefly highlighted [1,2]. Our work relating to hot photocarrier utilization in photovoltaic systems [2] as well as the peculiarities of electrical device performance, charge carrier transport and recombination in crystalline and novel low embodied energy semiconductors is presented [3].

[1] B. Philippa et al. & A. Pivrikas, Nature Scientific Reports 4, 5695 (2014).

[2] M. Stolterfoht et al. & A. Pivrikas Nature Scientific Reports 5, 9949 (2016).

[3] A Armin, Y Zhang, PL Burn, P Meredith, A Pivrikas, Nature materials 12, 593 (2013).

[4] A Pivrikas, B Philippa, RD White, G Juska, Nature Photonics 563 10, (2016).

Biography

Dr. Almantas Pivrikas has graduated Bachelor and Master's degrees in physics at Vilnius University, Lithuania. He obtain his PhD degree at the end of 2006 at Abo Akademi University. After postdoctoral research at Johannes Kepler University Linz, Austria and The University of Queensland in Brisbane, Australia, he is now employed at Murdoch University, Perth. His area of expertise lies within opto-electronic devices, such as photovoltaic cells, light emitting diodes, fieldeffect transistors and sensors. He discovered an unexpected photophysical phenomena in organic materials, name as non-Langevin photocarrier recombination, which led to significant improvement in fundamental knowledge as well as device performance improvements.

James Klausner

Michigan State University USA & United Arab Emirates University UAE. Email id: james.klausner@uaeu.ac.ae

High Temperature Thermochemical Energy Storage

Significant growth of renewable energy production is viewed as fundamental to decarbonizing electricity generation and industrial heat. The highly variable characteristic of renewable energy necessitates a variety of low cost and scalable energy storage solutions, depending on the duration of storage needed. Energy storage technologies will ideally handle hourly, daily, weekly, and seasonal variations to enable a reliable net zero carbon energy supply. Thermochemical energy storage has gained significant interest to address the need for low cost grid scale storage due to its high energy density. The storage of excess energy from renewable electricity generation considered in this talk is attained by the endothermic reduction of magnesium manganese oxide (Mg-Mn-O) at high temperature (> 1350°C) and low oxygen partial pressure. Oxidizing the reduced media using air or oxygen releases the stored energy in the form of high exergy (temperature) heat. This talk considers energy storage using a bed of Mg-Mn-O pellets packed within a highly insulated steel pressure vessel. Excess renewable electricity from the grid is used to resistively heat the reactive Mg-Mn-O pellets to 1500°C, and a gas blower is used to evacuate pure oxygen that evolves as the packed bed is thermally reduced. To put electricity back on the grid, compressed air reacts with the Mg-Mn-O bed in the oxidation mode, the air is heated, and it expands across a turbo-generator. The storage technology can be deployed at \$10/$kWh_{thermal}$ with a volumetric energy density of 2300 MJ/m^3 (3 times that of molten salt storage). Potential strategies for commercial deployment will be discussed.

Biography

Dr. James Klausner is an MSU Foundation Professor and Mechanical Engineering Department Chair at Michigan State University (2016-present). He formerly served as Chair of the ASME Heat Transfer Division (2011-2012). He serves on the board of directors for the American Society of Thermal Fluid Engineers and the International Titanium Association Foundation. For three and a half years he served as a Program Director at the U.S. Department of Energy Advanced Research Projects Agency-Energy (ARPA-E). Prior to that he held the Newton C. Ebaugh Professorship in Mechanical and Aerospace Engineering at the University of Florida (1989-2015). He received his Ph.D. degree in 1989 from the University of Illinois, Urbana-Champaign. He has made substantial fundamental contributions to understanding the dynamics of boiling heat transfer systems. He has made many fundamental and applied research contributions in high temperature thermochemistry, waste heat and solar driven desalination, and high heat flux phase-change heat transfer. Dr. Klausner has authored more than 150 refereed publications, and his theoretical work on boiling dynamics is included in the Handbook of Heat Transfer. He is the author of ten patents and four provisional patents. He is a Fellow of the American Society of Mechanical Engineering and the American Society of Thermal Fluid Engineers. He is a recipient of the ASME Heat Transfer Division Memorial Award and the 75th Anniversary Award.

Giuliana Impellizzeri

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Molecularly imprinted photocatalysts for selective degradation of emerging water contaminants

WHO estimated that by 2025 half of the world's population will live in water-stressed areas. Consequently, new technologies needs to be investigated to alleviate this problem. Heterogeneous photocatalysis is one of the emergent and innovative methods for wastewater treatment. However, the photocatalysis is not a selective process, since it does not differentiate between highly-hazardous pollutants and low-toxicity ones. A fascinating method for preparing adsorbents having high selectivity and affinity for low-concentration substances is the molecular imprinting (MI). This is a synthesis method consisting of printing of a molecule (called "template") onto a matrix during its preparation process, followed by the removal of the template, so to leave cavities having the size and structure of the imprinted molecules. A molecular memory is, thus, introduced into the matrix, which becomes able to rebind the template with high selectivity.

The winning idea was to match the MI with the photocatalysis, to achieve a selective adsorbance of organic contaminants into the imprinted cavities (through the MI process) and the degradation of the water pollutants (thorough the photocatalysis).

In this work, molecularly imprinted ZnO nanonuts with a common drug (paracetamol), and molecularly imprinted TiO_2 with some pesticides were synthetized by easy chemical methodologies. The morphology and structure of the materials were deeply investigated. The photodegradation of contaminants in aqueous solution was demonstrated under UV light irradiation. The selectivity of the photodegradation process was additionally tested. The results demonstrated as the MI can be applied to obtain highly selective photocatalytic material for applications in wastewater remediation.

Biography

Giuliana Impellizzeri has obtained her PhD in Physics from the University of Catania in Italy. She is Senior Scientist at the CNR-IMM. She has published more than 150 papers in international referred journals, holding an H-index of 30 (source: Scopus). She is Editor of Materials Science in Semiconductor Processing journal (Elsevier), and Associated Editor of Frontiers in Chemistry, Catalysis and Photocatalysis (Frontiers). She participated to many national and international projects with the role of work package leader and unit coordinator. She is project evaluator for the European Commission and for the Italian Minister of Education.

Soshu Kirihara

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Stereolithographic Additive Manufacturing of Ceramic Geometries for Energy Conversion and Storage

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 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 obtained thixotropic slurry. The resin paste was spread on a glass substrate at 50 µm in layer thickness by a mechanically moved knife edge. An ultraviolet laser beam of 355 nm in wavelength was adjusted at 50 µm in variable diameter and scanned on the spread resin surface. Irradiation power was changed automatically for enough 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. Though the computer aided smart manufacturing, design and evaluation (Smart MADE), practical materials components were fabricated to modulate energy and material transfers in potential fields between human societies and natural environments as active contributions to Sustainable Development to 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” for environmental improvements of “Geotechnology”, 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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Akira Nishimura

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Renewable Hydrogen Supply Chain Utilizing LNG Cold Heat

The power produced from renewable energy sources should ideally converted into H2 for the purpose of long-term storage and long-distance transportation. In this study, it was assessed several wind turbines of 3 MW class were installed in Yokkaichi city, and that the electricity generated, estimated based on meteorological data, was converted into H2 by electrolysis of water and transported to consumers in Yokkaichi city, Nagoya city or Iiyama city after (1) compression, (2) liquefaction, (3) conversion into compressed methane or liquefied methane, (4) conversion into organic hydride, and (5) conversion into ammonia. These procedures for conversion and transportation were assessed from the viewpoint of energy efficiency, CO2 emission reduction and resilience evaluation. In addition, the assist effect of a cold heat generated from phase change of LNG on liquefaction of H2 was also evaluated from the viewpoint of energy efficiency. As a result, it was found that the energy consumption and CO2 emission during the transportation in the case of liquefied methane were smaller compared to the other cases. The annual available power energy which was supplied for two-person household satisfied the energy demand of 36.7 households when the wind power output was 3 GW. The energy loss ratio was the smallest in the case of liquefaction of H2 utilizing the cold heat generated from phase change of LNG. The energy assist ratio of the cold heat provided by LNG to the total energy needed for liquefaction process of H2 was 64.3 %.

Biography

Akira Nishimura received the B.S. Eng., the M.S. Eng. And De. Eng. degrees in Chemical Engineering from Nagoya University, Japan in 1995, 1997 and 2000, respectively. He worked at Center for Integrated Research in Science and Engineering, Nagoya University as research associate from 2000 to 2002. He moved to Mie University in 2002 and an assistant professor and promoted to associate professor from 2014. His current researches are smart city utilizing renewable energy, H2 production from biogas, clarification on heat and mass transfer characteristics of PEFC and CO2 reduction by photocatalyst. He has published 79 papers in reviewed journals.

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The role of HVAC and UPS in the deployment of Demand Response: organizational and technical limitations in four case studies

Demand Response (DR) is largely the reserve of large industrial consumers in advanced economies with robust interconnected electricity networks. It is now widely agreed that DR must become more attractive to smaller energy consumers enabling the aggregation of the energy assets of those customers to increase the amount of flexibility available for DR. The complicated timetabling and settings of individual consumers/prosumers along with the granularity and diverse locations hinder the opportunities to grow and leverage this resource to balance the electricity network.

Heating, Ventilation and Air Conditioning (HVAC) systems and Uninterrupted Power Systems appear as one of the systems with the higher potential to leverage. This paper presents a detailed discussion of the pilot buildings as part of the DR BoB EU project. This paper also highlights the approach to make use the HVAC systems in a coordinated and granular approach, and the need for complex social interactions within buildings to be integrated with the technical upgrades when implementing DR solutions.

Biography

Dr Rodriguez is a Course leader in Construction Management. His study focuses on BIM, waste management, energy and EIQ in the built environment. He holds a PhD in Construction from the Technical University of Madrid, where he worked as a research coordinator, including a number of international and national research projects as the Solar Decathlon Europe Competition Strategies Manager first edition (2010). Additionally, he worked as an independent consultant and architect within the Madrid area for residential buildings, independent reviewer for high impact factor energy journals and as an expert for the Spanish scientific construction institute (Torroja Institute - CSIC).

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PLENARY FORUM

DAY 2

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Dirk M. Guldi

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Step-Change in Solar Energy Conversion Schemes

At the heart of unlocking the potential of global clean, renewable energy is the concerted effort of Advanced Charge Management (ACM) and Advanced Photon Management (APM). Recent advances regarding molecular ACM have documented the maturity of energy conversion schemes. Adding now APM to ACM by means of down- and/or up-conversion and creating synergies is essential to further boost the efficiency of these sun-driven energy conversion schemes. A full-fledged comprehension of APM is essential as an enabler for creating versatile platforms that are broadly applicable not only in the area of solar electricity, but also solar fuels. APM is, in the molecular context, based on either down-converting photons by means of Singlet Fission (SF), on one-hand, or on Triplet Fusion (TF)/Two Photon Absorptions (TPA) for up-converting them, on the other hand. To harvest photons in the high-energy regime, SF, the molecular analog to multiple exciton generation, stands out. It allows high-energy, singlet-excited states to be down-converted into twice as many low-energy, triplet-excited states, thereby improving solar-cell performance. This is, however, limited to the part of the solar spectrum, where, for example, the SF-materials feature a significant absorption cross-section. To harvest photons in the low-energy regime, necessitates non-resonant, indirect excitation via TF/TPA. Our transdisciplinary research has enabled in recent years to gather a comprehensive understanding of molecular down- and up-conversion.

Biography

Dirk M. Guldi completed both his undergraduate studies (1988) and PhD (1990) at the University of Cologne (Germany). Following postdoctoral appointments at the National Institute of Standards and Technology (USA), the Hahn-Meitner Institute Berlin (1992), and Syracuse University, he joined the faculty of the Notre Dame Radiation Laboratory in 1995. He was promoted a year later from assistant to associate professional specialist, and remained affiliated to Notre Dame until 2004. Since 2004, he is Full Professor in the Department of Chemistry and Pharmacy at the Friedrich-Alexander University in Erlangen. Since 2018, Dirk M. Guldi is Co-Editor in Chief of *Nanoscale* and *Nanoscale Horizons* and he has been named among the world's Highly Cited Researchers by Thomson Reuters.

Wei Lu

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Simulations for Energy Storage

The electrification of the drivetrain is crucial to solve our energy problems and fill the gap to sustainable and zero emission mobility. We are now within reach of mass-marketed vehicles using Li-based batteries. Full engineering analysis of batteries and battery systems must be regularized, and engineering develop-development is needed to allow creation of products and tools for integration of battery systems into vehicles. Electric vehicles and hybrid electric vehicles face significant battery-related challenges, including limited driving range and high battery cost resulting from the capacity fade of batteries during usage. The prediction of capacity fade and lifetime of batteries is important for cell design, determination of the optimal operation condition and control, and cell maintenance. Various mechanisms contribute to capacity fade. An integrated approach considering different aspects of the fading mechanisms is necessary. In this talk I will present some of our recent work in these areas, including a comprehensive capacity fade model and its experimental validation and application for battery optimization; a multiscale approach that couples mechanics and electrochemistry consistently at both particle and electrode scales which enables simulating various electrode phenomena, and its validation against explicit simulation of particle networks; and simulation of concurrent dendrite growth, SEI formation and penetration of lithium metal electrodes; and a new materials strategy to stop dendrite formation by a soft piezoelectric film. The materials strategy for improving the battery performance and application of machine learning for battery design will also be discussed.

Biography

Dr. Wei Lu is Professor at the Mechanical Engineering Department, University of Michigan, Ann Arbor, and Director of research center: Advanced Battery Coalition for Drivetrains. He uses multi-scale and multi-physics approaches to analyze battery degradation. He has over 170 publications in peer-reviewed journals and over 180 presentations and invited talks in international conferences, universities and national labs including Harvard, MIT and Stanford. His awards include NSF CAREER award, ASME Robert J. McGrattan Award; ASME Fellow; ASME Gustus L Larson Memorial Award, Robert M. Caddell Memorial Research Achievement Award; Faculty Recognition Award; Department Achievement Award; Novelis/CoE Distinguished Professor Award; Ted Kennedy Family Faculty Team Excellence Award; George J. Huebner, Jr. Research Excellence Award. He was invited to the National Academies Keck Futures Initiative Conference multiple times.

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M.H. Mamat[1*], M.F. Malek[1], A.S. Ismail[1], N. Parimon[1], M.Z. Musa[1], N. Vasimalai[2], I.B. Shameem Banu[2], and M. Rusop[1]

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[2]School of Physical and Chemical Sciences, B.S. Abdur Rahman Crescent Institute of Science & Technology, Vandalur, Chennai 600 048, India.

Properties of Solution-Immersion Grown ZnO Nanorod Arrays for Solar Cell Applications

In the past decade, numerous types of solar cell have been widely studied and considered in the various applications including agriculture, space, and electronic devices. The studies have been focused to prepare solar cell with good performance while maintaining low-cost fabrication, which required for large-scale volume and to fulfil the rigorous performance obligations of the emerging areas. In this research, solar cells were fabricated using zinc oxide (ZnO) nanorod array films. These nanostructures were produced and grown on substrates using solution immersion method. This method is cost-effective fabrication process, which could produce nanorod array films in large scale. The results obtained in this research show that ZnO nanorod arrays are good candidates for solar cell applications particularly dye-sensitized solar cell (DSSC) and hybrid solar cell. These ZnO nanorod array films produce good and high efficiency solar cell and could be utilized in the emerging areas.

Biography

Associate Professor Ir. Ts. Dr. Mohamad Hafiz Mamat graduated from Department of Electrical& Electronic Engineering and Information Engineering, Nagoya University, Japan in 2005 and received both MSc degree and PhD degree in Electrical Engineering from Universiti Teknologi MARA (UiTM) Shah Alam, Malaysia. Currently, he is the Head of NANO-ElecTronic Centre (NET) of UiTM. His research area is in the field of nanoelectronics, which focuses on nanomaterial syntheses and fabrication of electronic devices such as sensors and solar cells. He was awarded both Professional Engineer (Ir.) and Professional Technologist (Ts.) in 2018. He has published over 370 papers in the journals and conference proceedings.

Maatouk Khoukhi

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Impact of Dynamic Thermal Conductivity Change of EPS Insulation on the Heat Transfer through Building Envelope

This paper investigates the effect of dynamic thermal conductivity (λ) change of EPS insulation on temperature change through a conventional wall assembly at different positions of the insulation with the assembly in question. The simulation has been performed using the polystyrene (EPS) insulation in extremely hot conditions of Al Ain (UAE) at four level of densities denoted as low density LD (12 kg/m3), high density HD (20 kg/m3), ultra-high density UHD (30 kg/m3) and super-high density SHD (35 kg/m3), and three moisture content levels (10%, 20%, and 30%) compared to dry insulation material for LD. According to the findings, in the case of the application of the variable λ-value of the insulation, compared to that obtained when the constant λ-value for polystyrene (EPS) insulation is adopted under the same conditions, the temperature profile through the wall assembly during the daytime is greater. In the event of applying the constant and variable λ- values, the temperature shift on the inside is seen to decline as the location of the insulation material is positioned towards the surface of the inner wall. These results suggest that considering betterment in the insulation's thermal conductivity would provide the best dynamic thermal efficiency by placing the material in the middle of the wall assembly, taking into account the dynamic change in the thermal conductivity of the insulation.

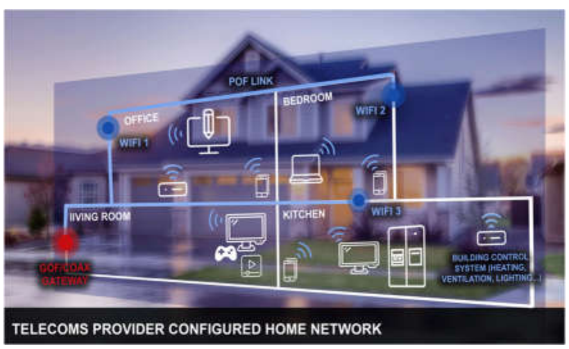
Biography

I earned my doctorate in Mechanical Engineering from Tohoku University-Japan in collaboration with New South Wales University-Australia. My research interests cover mainly three interrelated areas of renewable energy, bio-insulation materials, and building energy systems. Most of my publications come out from research development work performed for well-known international companies, organizations, and universities. I have a long record of academic and industrial experience and I have been actively involved in several research projects supported by several grants from Samsung, NEDO, and universities' internal and external grants. The total budget of my projects exceeds 2 Million USD. I have published more than 100 journal and conference papers and I am a reviewer for several journals in my field of specialization.

Mohd Syuhaimi Ab Rahman
Universiti Kebangsaan Malaysia, Malaysia.

Energy Efficient High Speed Network for in-Building Application

The green technology wavelength division multiplexing based on Polymer Optical Fiber (WDM-POF) network solution is presented. Green technology polymer optical fiber (POF) splitter has been fabricated by environmental friendly fusion technique, as an effective transmission media to split and recombine a number of different wavelengths for in-building network infrastructure. Two different wavelengths from ecologically friendly light emitting diode (LED) were fully utilized to transmit two different sources of systems; Ethernet connection and video transmission system. Red LED which in 650nm wavelength capable to download and upload data through Ethernet cable while green LED in 520nm wavelength transmits a video signal. Special filter has been placed between the splitter and receiver-end to ensure WDM-POF network system can select and generate a single signal as desired. Efficiency of both devices and network were observed. The material, fabrication method, system & application approach in this presentation are based on the environment friendly solution to reduce the power consumption & wastage without affecting the system performance. Our Green POF splitter and WDM-POF network solution proposed in this paper are the first reported up to this time.



Biography

Mohammad Syuhaimi Ab-Rahman began his career at Universiti Kebangsaan Malaysia (UKM), in mid-2007 as a lecturer and appointed as a senior lecturer in early 2008. In January 2010, he was appointed as Associate Professor in the Department of Electrical Engineering, Electronics and Systems. His specialization is in the field of electronic engineering specifically in optical communication system. He has been involved in many impact researches, academic writing, teaching, supervision, leadership positions, registered prototype and innovation, policy development and community services. He was promoted to full Professor at the age of 33 years old; which is very young and rare in Malaysia. This has demonstrated his outstanding personality and contribution to the field of science and technology. He was Deputy Dean Academic in Faculty of Engineering and Built Environment before been promoted to Director of Alumni Relation Center, Universiti Kebangsaan Malaysia. He is also professional engineer registered under Board of Engineering Malaysia.

GM Shafiullah

Discipline of Engineering and Energy, Murdoch University, Perth, Western Australia, Australia.
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A Hydrogen-focused Microgrid for Regional and Remote Community

Due to high initial investment and maintenance costs, governments are becoming more reluctant to provide capital funding of grid extensions to deliver electricity to remote locations or rural areas. Thus, to ensure reliable and cost-efficient energy supply and decarbonisation of the energy supply by utilising locally generated, clean and sustainable renewables is essential for future energy security and economic development. However, the main challenge in transitioning towards 100% renewable energy (RE) is the variable and intermittent nature of these resources which requires technical adaptation, in particular relating to balancing variable supply and demand for energy. The innovative idea of storing RE in an energy carrier such as hydrogen, which is storable, transportable and utilizable has encouraged interest worlwide recently. Renewable hydrogen not only opens up the opportunity to supply remote communities and transport routes with a secure and reliable electricity and fuel supply but also to support international decarbonization efforts and the Paris Agreement. Recently, microgrids have been presented as a viable and effective solution to profilerate the application and RE integrated power systems by minimizing the problems associated with variability and intermittency of the renewables. Considering the above, this study proposes a 100% RE integrated microgrid system with hybrid hydrogen and battery-based energy storage system (ESS) for remote/rural areas considering operational, technical, social, economic, and environmental benefits that such a system can bring forward. Outcomes of this research will be a useful tool for power utilities, regional indigenous service providers, mining companies and government bodies in their planning for deployment of microgrids for regional and rural communities to supply power to the community.

Biography

Dr GM Shafiullah is currently a Senior Lecturer in Electrical Engineering at Murdoch University, Australia. After completing PhD in 2013 from Central Queensland University, Australia, GM joined as a Post-Doctoral Research Fellow at Electrical and Renewable Energy Engineering, Deakin University, Australia. GM's research interests include power systems stability, energy efficiency, renewable energy and its enabling technologies, microgrid and smart gird. He has coauthored of more than 140 refereed published book chapters, journal articles, and conference papers including IEEE Transactions, Elsevier, IET, Wiley, MDPI and AIP Journals. He has an h-index of 27 and over 2500 citations. He is currently the Associate Editor of Energies- MDPI, Infrastructures- MDPI and Smart Grid -Frontiers in Energy Research.

Ji Wang

Piezoelectric Device Laboratory, School of Mechanical Engineering and Mechanics, Ningbo University, 818 Fenghua Road, Ningbo, 315211 Zhejiang, China. E-mail id: wangji@nbu.edu.cn

The Extended Galerkin/Rayleigh-Ritz Method for Approximate Solutions of Nonlinear Vibration Equations

An extension has been made with the popular Galerkin/Rayleigh-Ritz method by integrating the weighted equation of motion or Lagrangian functional over the time of one period of vibrations to eliminate the harmonics from the deformation function. A set of successive equations of coupled higher-order vibration amplitudes is obtained, and a nonlinear eigenvalue problem is presented for the frequency-amplitude dependence of nonlinear vibrations of successive displacements. The subsequent solutions of vibration frequencies and deformation are actually consistent with other successive approximate methods such as the traditional harmonics balance method. This is a novel extension to Galerkin/Rayleigh-Ritz method which has wide applications in approximate solutions particularly for vibration problems in solid mechanics. This extended Galerkin/Rayleigh-Ritz method can also be utilized for the analysis of free and forced nonlinear vibrations of structures as a new technique with significant advantages.

Biography

Professor Ji Wang is the founding director of the Piezoelectric Device Laboratory, Ningbo University. Professor Ji Wang also held visiting positions at Chiba University, University of Nebraska-Lincoln, and Argonne National Laboratory. He received his PhD and Master degrees from Princeton University in 1996 and 1993 and bachelor from Gansu University of Technology in 1983. Professor Wang has been working on acoustic waves and high frequency vibrations of elastic and piezoelectric solids for resonator design and analysis with several US and Chinese patents, over 200 journal papers, and frequent invited, keynote, and plenary presentations in major conferences around world.

Aliashim Albani[1] and Mohd Zamri Ibrahim[1]

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Current Progress and Challenges of Wind Energy in Malaysia

As one of the world's fastest-growing alternative sources of energy, the wind is poised to provide a viable alternative to dwindling fossil fuels, which have continually contaminated the atmosphere through the release of greenhouse gases. Although wind energy has shown to be a sustainable source of renewable energy, it is not viable at many locations, especially at low wind speed regions, such as Malaysia. However, the current studies showed that specific locations in this country showed a promising result and gave hope for this country in wind energy. Furthermore, the absence of a wind energy policy in the country, the high capital costs of the investment, and the instability of the electricity grid due to the intermittent nature of wind energy are all essential barriers to the expansion of wind energy development. Therefore, this paper focuses on the progress and challenges of wind energy in Malaysia by providing a brief critical study and presenting the findings from the current research.

Biography

Aliashim Albani is a Senior Lecturer at the Faculty of Ocean Engineering Technology and Informatics, Universiti Malaysia Terengganu. Expertise in Environmental Engineering Technology; and specializing in Renewable Energy and Applied Geospatial. He is recognized as a Professional Technologist and a Professional Geospatialist by the Malaysia Board of Technologist (MBOT) and The Institution of Geospatial & Remote Sensing Malaysia (IGRSM). Experienced in conducting feasibility studies for several wind energy proposals and measurement campaigns. Involve in several high-impact renewable energy research projects and consultations. He has published more than 30 papers in reputed journals and served as an editorial board member of several reputed journals.

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DAY 2

RENEWABLE AND SUSTAINABLE ENERGY Virtual

SEPTEMBER

25, 2021

GMT 07:00 – 13:00

V-Renewable2021

Kiran Sreedhar Ram, Daniel Dodzi Yao Setsoafia, Hooman Mehdizadeh-Rad, David Ompong, Naveen Kumar Elumalai and Jai Singh

College of Engineering, IT and Environment, Purple 12, Charles Darwin University, Darwin, NT 0909, Australia

Operating Temperature of Non-Fullerene Acceptor Based Bulk Heterojunction Organic

A comprehensive study of the operating temperature (T_{cr}) of three non-fullerene acceptor based bulk heterojunction organic solar cells (BHJ OSCs), two conventional (OSC1 and OSC2) and one inverted (OSC3) structure, is presented in detail. A quantitative analysis of the thermal power generated by pho-photon absorption in transport layers and electrodes, thermalisation of photoexcited charge carriers, tail state recombination and resistive heating in a BHJ OSC is carried out in this study. For all three BHJ OSCs, the dependence of operating temperature T_{cr} on the voltage is simulated and found that OSC1 and OSC2 have nearly equal T_{cr} at about 320 K, a little higher than that in OSC3 at 319 K for most of its operating voltage range. It is also found that the thermal power generated due to thermalization (P_T) and absorption in other than the active layer (P_{Abs}^{ol}) in OSC3 is smaller than that in both OSC1 and OSC2 and the thermal power generated due to the resistive heating (P_R) is larger in OSC3 than in OSC1 and OSC2 leading to the net power generated in the active layer of OSC3 higher than that in OSC1 and OSC2. Thus, although the operating temperature of all three cells remain in the range of 320 K to 321 K. [1], OSC3 may be regarded to be superior in its photovoltaic performance [1].

References:

1. Sreedhar Ram, K., Setsoafia, D.D.Y., Mehdizadeh-Rad, H., Ompong, D., Elumalai, N.K. and Singh, J. (2021), Operating Temperature of Non-Fullerene Acceptor Based Bulk Heterojunction Organic Solar Cells. Phys. Status Solidi A. Accepted Author Manuscript. https://doi.org/10.1002/pssa.202100255

Biography

Kiran Sreedhar Ram is currently pursuing his PhD from Charles Darwin University, Australia. He has completed Master of Electrical and Electronics Engineering at Charles Darwin University, Australia and Bachelor of Technology from Kerala University, India. He is passionate about his research and has published papers in reputed journals. His main area of research interest is in organic solar cells. He always dreams of indulging in a profession related to research and development which would enable him to make best use of his potential.

Md. Akhtaruzzaman [1], M. Shahiduzzaman [2,*], N. Amin [3,*], Ghulam Muhammad [4], M.A. Islam [5], K. Sobayel [1,6,*] and K. Sopian [1]

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Impact of Ar Flow Rates on Micro-structural Properties of WS2 Thin Film by RF Magnetron Sputtering

Tungsten disulfide (WS2) thin films were deposited on soda lime glass (SLG) substrates using radio frequency (RF) magnetron sputtering, at different Ar flow rates (3 sccm to 7 sccm). The effect of Ar flow rates on the structural, morphology and electrical properties of the WS2 thin films were investigated thoroughly. Structural analysis exhibited that all the as-grown films showed highest peak at (101) plane corresponds to rhombohedral phase. Crystalline size of the film ranged from 11.2 nm to 35.6 nm while dislocation density ranged from 7.8x1014 to 26.29x1015 lines/m2. All these findings indicate that as-grown WS2 films are induced with various degree of defects which was visible in the FESEM images. FESEM images also identified the distorted crystallographic struc-ture for all the films except the film deposited at 5 sccm of Ar gas flow rate. EDX analysis found that all the films were having sulfur deficit and suggested that WS2 thin film bears edge defects in its structure. Further, electrical analysis confirms that tailoring of structural defects in WS2 thin film can be possible by the varying Ar gas flow rates. All these findings articulate that Ar gas flow rate is one of the important process parameters in RF magnetron sputtering that could affect the morphology, electrical properties, and structural properties of WS2 thin film. Finally, simulation study validates the experimental results and encourages the utilization of WS2 as buffer layer of CdTe based solar cell.

Biography

Dr. Md Khan Sobayel Bin Rafiq was born in Dhaka, Bangladesh. He obtained his B. Sc. in Physics in 2003 and completed his Advanced Engineering Course in Military Engineering in 2006. He has completed his Masters in Energy & Operational Management from Staffordshire University, UK and attained his PhD from The National University of Malaysia (UKM), Malaysia. He started his carrier in military since 2003 but thirst of acquiring knowledge brought him in the field of scientific research. He is currently serving as Post-Doctoral Research Fellow at Solar Energy Research Institute (SERI) in The National University of Malaysia (UKM). His research interest includes design and fabrication of thin film solar cell, perovskite solar cell, layer optimization in thin films, coating, renewable energy and material physics, with over 20 scientific publications. He had received two national awards in his early days: for development of handy tools for military personnel and for contribution in National ID card project. Dr Sobayel is a member of American Association for the Advancement of Science and IEEE

Osman Adiguzel

Department of Physics, Firat University, Elazig, Turkey, Email id: oadiguzel@firat.edu.tr

Thermoresponsive Reactions and Energy Storage in Shape Memory Alloys

Some materials take place in class of advanced smart materials with adaptive properties and stimulus response to the external changes. Shape memory alloys take place in this group, due to the shape reversibility and capacity of responding to changes in the environment. These alloys exhibit a peculiar property called shape memory effect, which is characterized by the recoverability of two certain shapes of material at different temperatures. This phenomenon is initiated by thermomechanical treatments and performed with Thermoresponsive reactions by heating and cooling. These alloys are deformed plastically in low temperature condition; strain energy is stored in the material and released on heating by recovering original shape. Stressing and releasing paths are different at the stress-strain diagram and this result refers to energy dissipation. This effect is based on Thermoresponsive transformations called thermal and stress induced martensitic transformations. Thermal induced transformations are exothermic reactions and occur along with lattice twinning on cooling and ordered parent phase structures turn into twinned martensitic structure. Twinned structures turn into detwinned martensite by means of stress induced martensitic transformation by stressing material. Shape recovery is performed by endothermic austenitic transformation on heating and detwinned martensite structures turn into the ordered parent phase structure. Thermal induced martensitic transformation occurs with the cooperative movement of atoms in <110 > -type directions on {110}-type planes of austenite matrix by means of lattice invariant shear. These transformations are solid state reactions, and these reactions do not occur at the equilibrium temperature at Gibbs Free Energy Temperature Diagram and a driving force is necessary for the transformations.

Copper based alloys exhibit this property in metastable β-phase region, which has bcc-based structures. Lattice invariant shears are not uniform in these alloys, and the ordered parent phase structures martensitically undergo long-period complex layered structures. These structures can be described by different unit cells as 3R, 9R or 18R depending on the stacking sequences on the close-packed planes of the ordered lattice.

In the present contribution, x-ray diffraction and transmission electron microscopy studies were carried out on two 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 the transformation. X-ray diffractograms taken in a long-time interval show that diffraction angles and intensities of diffraction peaks change with the aging time at room temperature. This result reveals a new transformation in diffusive manner.

Key Words: Shape Memory Effect, Martensitic Transformations, Energy Storage, Lattice Twinning and 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 on shape memory alloys. He worked as research assistant, 1975-80, at Dicle University and shifted to Firat University, Elazig, Turkey in 1980. He became professor in 1996, and he has already been working as professor.

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PLENARY FORUM

DAY 3

RENEWABLE AND SUSTAINABLE ENERGY Virtual

SEPTEMBER

26, 2021

GMT 12:30 – 18:10

V-Renewable2021

Oomman K Varghese[1]

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Advances in Materials and Technologies for Renewable Fuel Production

The unprecedented changes in the weather patterns recently observed around the world has once again brought anthropogenic carbon dioxide (CO_2) emission and global warming into the limelight. The climate models and related studies point toward a steady increase in the global average temperature and irreversible changes in the environment and ecosystem in the coming decades. The Intergovernmental Panel on Climate Change urges to achieve net zero CO_2 emission before 2050. Replacing fossil fuels with renewable fuels, especially those produced using sunlight, has been widely recognized as an important step toward achieving this goal. Photovoltaic-assisted electrochemical, concentrated solar thermochemical and solar photoelectrochemical technologies are considered the most promising options for water splitting and carbon dioxide reduction processes for fuel generation. Unlike the other two approaches, photoelectrochemical fuel generation does not involve multiple steps or high temperatures. It uses semiconductor materials for sunlight absorption and charge generation to perform redox processes leading to fuel generation. Nonetheless, the technology has not yet become commercially viable. This presentation will give an overview of these three promising technologies. The discussion will be focused on the recent innovations in the materials development for photoelectrochemical fuel generation processes.

Biography

Oomman K. Varghese received Ph.D. from Indian Institute of Technology Delhi (IITD), India. He conducted postdoctoral research in the University of Kentucky and the Pennsylvania State University and then worked as a Process Development Engineer in First Solar, USA. He is currently an Associate Professor of Physics at the University of Houston. In 2011, Thomson Reuters ranked him 9th among 'World's Top 100 Materials Scientists' in the decade 2001-2010. From 2014 to 2016 he was a 'Highly Cited Researcher'. He is among the top 2% of the scientists in the world per the Stanford University Report, 2020.

Anupama B. Kaul

PACCAR Professor of Engineering; Materials Science and Engineering and Electrical Engineering
University of North Texas.

Solar Cells and Optoelectronic Devices with Solution-processed Perovskites and Two-dimensional Layered Materials

Two-dimensional (2D) layered materials range in composition from mono-elemental systems such as graphene and black phosphorus, binary transition-metal dichalcogenides (TMDCs) such as WSe2, as well as multi-component organo-halide perovskites. Despite the varying compositions, their unifying feature arises from the weak van der Waals (vdW) interaction that serves as the glue between adjacent layers. The excitonic and multibody interactions in some semiconducting 2D vdW crystallites, their strain-dependent properties and pristine atomically flat interfaces, coupled with the ability to solution-process these materials, offer a rich playground to unveil fundamental physical mechanisms for exciting and innovative devices. In the first part of this talk, I will discuss our efforts in studying the light-matter interactions in halide-grown monolayer and few-layer 2D semiconducting WSe2 to unveil multibody interactions towards quantum platforms. Heterostructures of 2D-2D semiconductors or 0D-2D ensembles also offer an intriguing prospect to enhance the light matter interactions in these systems to new levels. In the second part of the talk, our efforts in the solution-based synthesis of MoS2, WS2 and black phosphorus, has enabled us to realize a rich plethora of flexible and bendable sensing devices, including for addressing age related macular degeneration toward retinal prosthesis. Finally, our additive manufacturing approaches with organo-halide 2D perovskites, specifically, butylamine methyl-ammonium lead triiodide, opens up possibilities to inkjet print these complex crystallites and their heterostructures for exceptional optical absorbers in photodetectors and photovoltaics applications.

Biography

Dr. Anupama B. Kaul is the PACCAR Professor of Engineering at the University of North Texas (UNT) and serves as Director of the Nanoscale Materials and Devices Laboratory and the PACCAR Technology Institute. Her funded research as PI and/or Co-PI has originated through the support of agencies such as the ONR, AFOSR, ARO, NSF, NRO and NASA, as well as industry. Prior to UNT, Dr. Kaul was Associate Dean for Research and Graduate Studies in the College of Engineering and held the AT&T Distinguished Professorship in ECE at the University of Texas, El Paso. Dr. Kaul has served as a Program Director at NSF in the ECCS Division, where she was on rotation as an IPA from JPL, Caltech. Prof. Kaul serves on the External Advisory Board of Penn State University's Two-dimensional (2D) Crystal Consortium (2DCC) – MIP. She was also Chair and PI of the *NSF US EU Workshop on 2D Layered Materials and Devices* held in 2015 with the European Union (EU) Graphene Flagship Program. Dr. Kaul is the recipient of the NSF's Director's Award for Program Management Excellence, the NASA Service Award, a NASA Team Technical Accomplishment Award, multiple NASA Patent Awards and numerous NASA Technology Brief Awards for her research

Arthur J. Nozik

Department of Chemistry and Renewable & Sustainable Energy Institute (RASEI) University of Colorado, Boulder, CO 80309 and National Renewable Energy Laboratory (NREL) Golden, CO 80401

Advanced Concepts for Ultra- High Conversion Efficiency of Solar Photons into Photovoltaics and Solar Fuels Based on Nanostructures and Molecular Singlet Fission

In order to utilize solar power for the production of solar electricity and solar fuels on a global scale, it will be necessary to develop solar photon conversion systems that have an appropriate combination of high efficiency (delivered watts/m^2) and low capital cost ($/$m^2$). One potential, long-term approach to attain high conversion efficiencies above the well-known Shockley-Queisser thermodynamic limit of 33% is to utilize the unique properties of quantum dot/rod (QD/QR) nanostructures and Singlet Fission (SF) in molecular chromophores, to control the relaxation dynamics of photogenerated hot carriers and excited states in photoexcited molecules to produce either enhanced photocurrent through efficient photogenerated electron-hole pair (ie, exciton) multiplication or enhanced photopotential through hot electron transport and transfer processes. To achieve these desirable effects it is necessary to understand and control the dynamics of SF and hot electron and hole cooling, charge transport, and interfacial charge transfer of the photogenerated carriers. These fundamental dynamics in various bulk and nanoscale semiconductors and SF molecules have been studied for many years using transient absorption, photoluminescence, photocurrent, and THz spectroscopy with fs to ns time resolution. The prediction that the generation of more than one electron-hole pair (which exist as excitons in size-quantized nanostructures and photoexcited molecules) per absorbed photon would be an efficient process in QDs,QRs, and SF molecules has been confirmed over the past years in different classes of materials, molecules, and their architectures. Very efficient and ultrafast multiple exciton generation (MEG), also called Carrier Multiplication (CM), and SF from absorbed single higher energy photons has been reported in many quantized semiconductors, hybrid perovskites, and molecules and associated solar photon conversion devices for solar electricity and solar fuels (e.g. H_2) production. Selected aspects of this work will be summarized and recent advances will be discussed, including the very remarkable and beneficial theoretical effects of combining MEG with solar concentration The analogous MEG effect in SF molecules and its use in molecular-based solar cells will also be discussed.

Biography

Prof. Arthur Nozik is a researcher at the National Renewable Energy Lab (NREL). He is also a professor at the University of Colorado, which is located in Boulder. He researches semiconductor quantum dots at the National Renewable Energy Laboratory, and is a chemistry professor at the University of Colorado. He also does research for the advancement of solar energy, for which he won the Intergovernmental Renewable Energy Organization (IREO) Award for Science and Technology in 2009. Dr. Arthur Nozik received his bachelor's degree in Chemical Engineering from the Cornell University in 1959, and he earned his PhD from Yale University in 1967. In 1967, he discovered a new transparent conductor (Cd2SnO4) Thin-Film Devices, which helped develop new applications for solar energy devices. Then he did research on quantization effects in semiconductor quantum dots, for the Allied Chemical Corporation and the American Cyanamid Corporation. He then worked as a group leader of Photoelectrochemistry from 1974 to 1978. He worked in both these places until 1978, when he joined the National Renewable Energy Laboratory (NREL). He has published a little over 150 research papers related to solar cell, quantum dot, semiconductor, silicon solar cells. He has been an editor of The Journal of Physical Chemistry since 1993 and served as Senior Editor. He has reviewed numerous papers for various scientific magazines.

KEYNOTE FORUM

DAY 3

RENEWABLE AND SUSTAINABLE ENERGY Virtual

SEPTEMBER

26, 2021

GMT 12:30 – 18:10

V-Renewable2021

Hendrik Heinz

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Understanding the Working Mechanisms of Comb-Type Superplasticizers in Cement Hydration and Setting

Cement and concrete are the most widely used building materials and contain comb copolymers such as polycarboxylate ethers (PCEs) as hydration and setting modifiers. The working mechanisms of these additives have remained uncertain and play a role in designing cement materials with lower CO_2 footprint and to reduce the amount of concrete needed in construction projects. We identified correlations between PCE copolymer structure, adsorption, and cement setting properties along with insight into the mechanisms from the molecular scale using state-of-the-art experiments and all-atom molecular dynamics simulations. PCE adsorption onto cement particles involves migration of calcium ions in the acrylate backbone onto the calcium silicate hydrate surface, or calcium hydroxide surfaces, followed by ion pairing of the anionic polymer backbone with the positively charged mineral surface. We discovered two distinct sets of property correlations. (1) The carboxylate content of the PCEs in the backbone correlates with the adsorbed amount onto cement pastes, the conductivity of the cement paste, and the retardation of the acceleration period of cement hydration. (2) A combination of this ionic character of the polymer backbone and the length of nonionic polyethylene glycol (PEG) side chains correlate with the water-to-cement-ratio necessary for processing, zeta potentials, and fluidity of the cement pastes in mini-slump tests. Best fluidity and water reduction are achieved using an optimum ratio of the volume of PEG side chains to the volume of the anionic backbone. We discuss the application of

Biography

Hendrik Heinz obtained an M.S. degree in chemistry and a Ph.D. degree in Materials Science and Engineering from ETH Zurich in 2003. He worked at the Air Force Research Laboratory and as a faculty member at the University of Akron, Ohio, and at the University of Colorado Boulder. His research focuses on the simulation of biomaterials and nanomaterials from atoms to the microscale, including catalysts, inorganic/polymer hybrid materials, biomineralization, and hydrogels. He develops the Interface force field and a surface model database for the simulation of compounds across the periodic table in unprecedented accuracy. He received numerous awards and editorships.

Yohannes Haile

Sam and Irene Black School of Business and School of Engineering, Erie, PA, E-mail id: yxh313@psu.edu

Systemic Implications of Renewable Energy (RE)

We have investigated the multi-dimensional attributes of RE business outcomes and its wider implications in developing, emerging and developed economies, which are important parts of the energy mix to meet increasing energy demand and ameliorate the environmental implications of high carbon-based energy resources. Our research findings indicate the importance of the differentiated multilevel interactions among business model and technology innovations, ecological modernizations, and innovative management practices that are emergent and embedded in complex environments of these social systems. The key findings suggest well developed and deployed ecocommunal management practice is the best way to translate value propositions into sustainable value. Additionally, the level of managerial authority bifurcates the translation of RE strategic objectives into sustainable value in the context of emerging economies. However, this phenomenon is absent in developed economies. This difference may be attributed to the variance in power distance and the underlying cultural context of management and authority. Transition engagement has significant relationships in emerging economies, but it did not have significant impact in developed economies. This disparity may be associated with the stickiness of culture and large sunk capital of energy businesses in developed economies, which have created active inertia to system wide change. Furthermore, our research findings support the articulation that the energy and communication construct shape the trajectory of civilization impinging on the mental model we create about our surroundings, and the language we use in our day-to-day activities, indicating differentiated pathways and tensions for sustainable development and socio-technological paradigm shifts across these economies.

Biography

Yohannes Haile holds a Ph.D. from Case Western Reserve University, USA and teaches Management and Engineering at The Pennsylvania State University- Behrend College. His areas of research interests include sustainable systems design, renewable energy, busines & technology innovations, and advanced manufacturing systems.

Victor Veliadis

PowerAmerica, Raleigh, North Carolina, USA, and Electrical and Computer Engineering, North Carolina State University, Raleigh, North Carolina, USA. E-mail id: jvveliad@ncsu.edu

SiC Based Clean Energy Applications: Status and Opportunities

In an increasingly electrified technology driven world, power electronics is central to the entire clean energy manufacturing economy. Silicon (Si) power devices have dominated power electronics due to their low cost volume production, excellent starting material quality, ease of fabrication, and proven reliability. Alth-Although Si power devices continue to make significant progress, they are approaching their operational limits primarily due to their relatively low bandgap and critical electric field that result in high conduction and switching losses, and poor high temperature performance.

In this talk, the favorable material properties of Silicon Carbide (SiC), which allow for highly efficient power electronics with reduced form-factor and cooling requirements, will be outlined. The design of SiC MOSFETs that are presently being inserted in the majority of SiC based power electronic systems will be briefly discussed. High impact application opportunities, where SiC devices are displacing their incumbent Si counterparts, will be presented. These include automotive and rail power electronics with reduced losses and reduced cooling requirements; novel data center topologies with reduced cooling loads and higher efficiencies; variable frequency drives for efficient high power electric motors at reduced overall system cost; more efficient, flexible, and reliable grid applications with reduced system footprint; and “more electric aerospace” with weight, volume, and cooling system reductions contributing to energy savings. Barriers to SiC mass application commercialization will be identified and detailed. These include the higher than silicon device cost, reliability and ruggedness concerns, and the need for a trained workforce to skillfully insert SiC into power electronics systems.

Biography

Dr. Victor Veliadis completed his PhD at John Hopkins University USA in 1995 and is Executive Director and CTO of PowerAmerica, which is a WBG power electronics Manufacturing USA Institute. He manages an annual budget in excess of $30 million that he strategically allocates to accelerate WBG manufacturing, workforce development, job creation, and energy savings. He is an ECE Professor at NCSU, and an IEEE Fellow and Distinguished Lecturer. He has 27 issued U.S. patents, 6 book chapters, and over 120 peer-reviewed publications. Prior to taking an executive position at PowerAmerica in 2016, Victor spent 21 years in the semiconductor industry.

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RENEWABLE AND SUSTAINABLE ENERGY Virtual

SEPTEMBER

26, 2021

GMT 12:30 – 18:10

V-Renewable2021

Neha Arora

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Leveraging algal omics to accelerate cost-competitive biofuels and bioproducts

Algae is the answer to solving major sustainability and climate issues including reduction of green-house gasses emissions, replacing the fossil fuels with renewable energy and mitigation of wastewaters as well as supplements for nutrition and as aquaculture feed. However, in order to accelerate the development of sustainable and cost-competitive algal based biofuels and bioproducts, tapping the potential of algal omics approaches is imperative. Numerous algal species cultivated in different abiotic stresses and cultivation systems have been investigated to augment lipid and/or carbohydrate accumulation in microalgae. However, the precise mechanisms underlying such high accumulation of storage molecules are yet to be known. Utilization of algal-omics techniques can shed light on the dynamics of biomolecule synthesis, its regulation and interplay with other cellular pathways. In this contribution, the use of different multi-omics techniques and tools available is discussed for disentangling the complex pathways regulating the biosynthesis/degradation of metabolic precursors, intermediates and target biomolecules. A case of understanding the halotolerant mechanism of a novel microalgae is presented using integrated physiological and multi-omics (proteomics and metabolomics) technologies. This knowledge can then be leveraged for tailoring microalgae for improving the phenotypes/genotypes of potential strains for enhancing the biomass and bioproduct productivity.

Biography

Dr. Neha Arora has completed her PhD from Indian Institute of Technology Roorkee, India and currently perusing postdoctoral studies from University of South Florida (USF), USA. She is the lab manager of Biofuels and Bioproducts lab, USF. Her current research theme embraces integrated algal omics and engineering algae for enhanced lipid production. Her research focuses on algal based biofuels, bioremediation, platform and chemicals and value-added products (such as nutraceuticals). She has published more than 35 papers in reputed journals and 09 book chapters.

S. D. Rojas[1,2], N. Espinoza-Villalobos[1,2], R. Salazar[3], R. Navarrete[4], G. Rafaela[1] and L. Barrientos[1,2]

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Photocatalytic conversion of lignin model compounds using g-C3N4 photocatalyst

Valorization of lignin as a renewable source of high value chemicals is a critical challenge in the replacement of fossil fuel economy. In this work, we perform the photocatalytic oxidation under visible light of three lignin model compounds (phenol, anisole and guaiacol) using a metal free g-C3N4 photocatalyst. Analyte conversion and intermediary compounds where measured using liquid chromatography. A high conversion rate was achieved after 6 h irradiation, and high selectivity to p-benzoquinone was observed. Exploration of the photocatalytic oxidation mechanism was explored by EPR operando mode and addition of radical scavenger. A possible reaction pathway was proposed, in which the ·OH radical plays an important role.

Biography

Susana Rojas has completed her PhD from Instituto de Física, Pontificia Universidad Católica de Chile, Chile in 2017 and postdoctoral fellowship from Millenium Nuclei NCS, Chile (2019), Universidad de Santiago, Chile (2020) and Facultad de Química y de Farmacia, Pontificia Universidad Católica de Chile, Chile (2012). Currently, is a half time academic at Instituto de Física, Pontificia Universidad Católica de Chile, Chile. She has published 18 papers in WoS journals.

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SEM Critiques of Sri Lankan Vein Graphite for Some Specific Water Pollution Control Aspects

Graphite is one of an abundant allotrope of carbon which is also found in different occurrence modes such as vein graphite and flake graphite.Sri Lanka is a prominent country in the world regarding the availability of graphite deposits since a few of graphite mining sites are being progressed while processing such graphite for various industrial purposes such as refractory materials, lubricants and battery components. In the existing research it was expected to microscopically characterize a selected vein graphite type and to compare the characteristics of that graphite type with the necessary characteristics of water treatment processes. The vein graphite samples were collected from "Kahatagaha" graphite mining site nearby Maduragoda region in North Western Province of Sri Lanka. A few of powdered representative graphite samples were analyzed using Scanning Electron Microscope (SEM). According to the observed results, it seems that some smooth layered surfaces with relatively higher surface area which are much important characteristics in the process of adsorption, less pores though it can be increased the porosity using expanding method by either chemical or electrochemical intercalation method and less impurities contents. Based upon such observations, it is possible to recommend such vein graphite variety for the applications in waste water treatments namely as the removals of different oil species, removals of some dissolved dyes in water, removal of organic pollutants including pesticides and removal of heavy metals from waste water due to the adsorption capacity of graphite which can be enhanced through some specific alterations such as the expansion.

Biography

Suresh Aluvihara has completed his first degree in the year 2017 in Mineral and Earth Resources and Technology from a recognized government university in Sri Lanka and currently he is completing his postgraduate research works under the disciplines of Environmental and Pollution Engineering. According to his research interests, he is having an outstanding list of publications including abstracts and conference papers in conference proceedings, full papers in high indexed reputed journals and he has participated in a large number of worldwide research conferences as a keynote speaker, invited speaker and featured speaker. Apart from that he has gained some experiences in the reviewing of research papers and as an editorial board member.