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ABSTRACT BOOK

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Advanced Materials Engineering for Next-generation Solid-State Energy Storage Technology

Alla White Smirnova [1]*, Sanjeev Mukerjee[2], Fan Zheng[1], Quinn Qiao[3] and Marius Ellingsen[4]

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Abstract:

Environmental and energy sustainability are key factors for the future economic growth of our society. In this regard, next-generation energy storage is critical in minimizing fossil fuel consumption in support of electric vehicles and smart electric power grids. However, the qualitative and quantitative transition to efficient and safe energy storage has significant challenges. Among them are materials design and materials manufacturing. The focus of this presentation is on the most recent achievements in the area of solid-state lithium- and sodium-ion batteries with emphasis on diffusion limitations and ionic transport at solid-state interfaces. Specifically, a few groups of solid-state superionic conductors are compared as well as the market-disruptive cathode and anode materials for high-energy and high-power density solid-state batteries. The time it'll take to transition these innovative materials from laboratory to the market defines the future of sustainable energy in the U.S. Besides materials, the latest achievements in large-scale solid-state battery manufacturing are reviewed regarding the emerging cold spray technology. This effort could be successful only considering collaboration efforts in fundamental and pre-competitive research between academia, industry, and national laboratories. The authors are grateful for substantial support from the NSF IUCRC Center for Solid-State Energy Storage (Awards #2052631, #2052796, and #2052611) and the South Dakota Governor's Research Center for Electrochemical Energy Storage (2021-2026).

Biography:

Smirnova is a tenured Professor at the South Dakota School of Mines and Technology. She serves as the Director of the NSF IUCRC Center for Solid State Electric Power Storage (www.GreenCEPS.com). and the Director of the South Dakota Governor's Research Center for Electrochemical Energy Storage. Dr. Smirnova co-authored over 100 peer-reviewed articles, 10 patents or patent disclosures, and 17 book chapters. She co-edited two books, one of them is focused on solid oxide fuel cell technology (ISBN:1- 4020-3496-2) and the second one - on solid-state battery technology "Next-generation solid-state energy storage technology-a path to environmental sustainability" (ISBN: 978-0-323-90635-7).

Harmonic Frequency Cascade: Oil Refining to Water Purification

Richard Coffin[1]*, Mark Law[2], Hussain Abdulla[1], Kevin Stickney[3]

[1]Texas A&M University – Corpus Christi, Corpus Christi, TX, USA

[2]TMS, Houston, Texas, USA,

[3]Carbontrase llc Corpus Christi, TX, USA

Abstract:

Harmonic Frequency Cascade (HFC) with counter rotating interfaces is developed for novel environmentally clean fuel refining and water purification effort technology. For oil refining initial effort for proof of concept is sulfur extraction from hydrocarbons. In contract further development focuses on local contaminated pond water purification. Focus for this technology development is application of HFC introduction of fuel cavitation resulting in oxygen free radical formation. We present new technology for oil refining that: 1) provides lower costs in the production of fuel or water purification, 2) reduces atmospheric emissions of nitrogen, sulfur and carbon compounds, 3) can be applied to removal of sulfur from fuels, 4) produces specific fuel designs, and 5) is capable of transport to remote locations for industrial and military operations.

The HFC system consists of a cylindrical housing containing two, counter rotating, separately driven, multistage cylinders. This will provide multiple interfaces that will produce the required fluid shear. The main device and intake manifold will be mounted on a framework of square tubing and angle iron that have dimensions of about 3 feet square and six feet in height. The controls consist of appropriate, explosion proof actuators and sensors to allow for precise operation of the unit in hazardous and or extreme conditions. Piping and other support vessels meet industry standards and codes and are mounted to provide the smallest footprint possible. We will present thorough evaluation of changes in the oil or water with specific compound analysis and carbon analysis to provide operation efficiency assessment.

Biography:

Coffin is geochemist with a focus on evaluation of geochemical field data and seismic profiles related to; gas hydrate and oil exploration, carbon sequestration, environmental restoration and climate change. Experience includes lead and co-lead field and laboratory development and operations on all continents with colleagues from over 15 countries since 1989 from basic science to industrial focuses. Currently, he serves as Full Professor and Chair of the Department of Physical and Environmental Sciences at Texas A&M University Corpus Christi. Previously, USA. He earned a doctoral degree in oceanography from the University of Delaware, Lewes, Delaware, USA.

Analysis of Thermodynamic Irreversibility Levels and Distribution for Enhancing Efficiency in Power Cycles with Application to SCO_2 Systems

John P. O'Connell[1]*, Duoli Chen[2] and Warren Seider[2]

[1]University of Virginia, USA

[2]University of Pennsylvania, USA

Abstract:

An advanced Second-law analysis is presented for evaluating irreversibilities in chemical and energy processes. The relationship between the process unit thermodynamic efficiencies and process synthesis, based on lost work, is systematically established, and applied to reveal where

efficiency improvements could be most effective. The presentation will describe the fundamentals of the approach and application will be made to several different open (Allam) and closed (Brayton) sCO_2 power cycles, including comparisons with current electrical generation systems. The results show that sCO_2 cycles are more efficient than steam cycles and detail where and how this arises. In addition, the calculated process section and unit efficiencies expose components causing the greatest work losses in power cycles: combustion for heat generation and transfer of that heat to the working fluid. These elements should be the focus of process improvements.

Biography:

John P. O'Connell is Professor Emeritus of Chemical Engineering. He has published over 200 articles and books on thermodynamics and on process design and simulation.

Spectral Modulated Solar Harvesting via Transparent Nano Hybrids for Synergistic Photothermal-thermoelectric-photovoltaic Energy Generation

Donglu Shi,[1]* Mengyao Lyu,[1] Jou Lin,[1] Yuxin Wang,[1] and John Krupczak[2]

[1]University of Cincinnati, USA

[2]Hope College, USA

Abstract:

In solar applications, the PV efficiencies have been limited by nonideal spectral responses; while the high energy photons contribute to thermalization, the IR portion is responsible for PV heating. We have developed transparent photothermal spectral modulator (TPSM) composed of $Fe_3O4@Cu_{2-X}S$ and chlorophyllin compounds, both exhibits pronounced absorptions in the UV and IR regions. Novel hybrids between the porphyrin and iron oxide compounds are also developed for photonically wavelength-modulating photons from UV to IR in a solar energy module that can synergistically generate energy via PT, TE, and PV. The solar energy module is capable of proportionally distributing photon energies to respective PT, TE, and PV under simulated solar light in the following fashion: 1) photothermally generating thermal energy by TPSM to heat up the hot end of TE for generating electricity; 2) TPSM also functions as a wavelength segregator that removes the IR portion of the light, therefore reducing the PV surface heating, and 3) the PT, TE, and PV are structurally architectured in the solar energy module to fully utilize solar spectrum and produce electricity synergistically. The system efficiency of the novel solar energy module has been found to exceed their commercial PV and TE counterparts. The mechanism of spectral modulation through TPSM is identified based on the photonic behaviors of chlorophyllin, $Fe_3O4@Cu_{2-X}S$, and their hybrids.

Biography:

Donglu Shi is currently the Chair of the Materials Science and Engineering Program at the University of Cincinnati. Dr. Shi's research encompasses a wide range of fields, including nanoscience, energy materials, nano medicine, and condensed matter physics, resulting in more than 300 peer-reviewed journal publications including ones in Nature, Physical Review Letters, Advanced Materials, and ACS Nano. He is currently the Editor-in-Chief of Nano LIFE, Editorial Board of Biomaterials Advances, and Associate Editor of J. of Nanomaterials. He has received 2023 Rieveschl Award for Distinguished Scientific Research, SIGMA XI Research Recognition Award, and Neil Wandmecher Teaching Award. Donglu Shi is a Fellow of ASM International.

Numerical Simulation of Swelling Behavior of Elastomers in Oil and Gas Wells

Sayyad Zahid Qamar

Sultan Qaboos University, Oman

Abstract:

In Solid Expandable Tubular (SET) technology, a tapered mandrel is pushed through a petroleum tubular to enlarge it to the desired size. SET applications in oil and gas wells, such as water control and zonal isolation, utilize swellable elastomers as a sealing material. These innovative polymers possess the unique ability of expanding when exposed to fluids like water, oil, or acid. When the tubular is expanded against the rock formation, the elastomer elements compress against the formation, providing the necessary sealing. This compression can also be achieved by exposing the elastomer to water (say), causing it to swell against the formation. A combination of both events, tubular expansion and elastomer swelling, usually occurs. Prior to deploying SET-based swell packers into wells, it is crucial to evaluate their potential behavior under specific field conditions.

This paper is part of the research conducted at Sultan Qaboos University, Muscat, focusing on expandable tubulars and swellable elastomers. Large number of numerical simulations were conducted to examine the impact of various field conditions on the contact pressure or sealing performance between the elastomer element and the rock formation. These parameters are elastomer seal material, expansion ratio of the SET, compression ratio of the elastomer, type of formation, length and thickness of the seal, and boundary conditions of the SET. The outcomes of this study can be valuable to field engineers, application developers, and researchers for the appropriate selection and enhancement of SET and swelling elastomer applications.

Keywords: Expandable tubulars; swellable elastomers; numerical simulation; contact pressure; water control; zonal isolation; rock formation; expansion ratio; compression ratio

Short Biography:

Sayyad Zahid Qamar is a Professor at the Mechanical Engineering Department, Sultan Qaboos University (SQU), Muscat, Oman. He has over 30 years of academic and research experience in different international universities. He has also worked as a professional mechanical engineer in the field for over 6 years in the heavy engineering and fabrication industry (Manager Research and Development; Deputy Manager Design; Production Engineer; Quality Control Engineer).

The Fastest Energy Change in History

Andrew Blakers*

Australian National University, Australia

Abstract:

This paper explores the solar (and wind) revolution. More new solar generation capacity is being built than everything else combined. This is compelling evidence that solar energy is the cheapest energy today. Solar is growing much faster than any other energy technology in history. It is fast enough to completely displace fossil fuels from the global economy before 2050.The rise and rise of cheap solar is the best hope for rapidly mitigating climate change. However, we need to get to zero fossil fuel use faster than 2050 to reduce the extent of climate damage.

Global solar capacity passed 1 Terawatt in 2022. At current growth rates, this will increase to 6 Terawatts around 2031, which is larger than the combined total of coal, gas, nuclear and hydro. Solar is causing the fastest energy change in history. Relatively few new fossil-fuelled power stations

are being built. This means that the global fleet is aging, and most will retire by mid-century. The world will naturally move to a solar/wind energy system provided that we stop buying fossil fuel machines. There are practically no constraints on vast deployment of solar. Solar is cheap and getting cheaper. Storage is a solved problem via batteries and pumped hydro.

Biography:

Andrew Blakers is Professor of Engineering at the Australian National University. In the 1980s and 1990s he co-produce silicon solar cells with world record efficiencies. He was a lead developer of the PERC silicon solar cell, for which he was joint winner of the prestigious 2023 Queen Elizabeth Prize for Engineering. PERC has 80% of the global solar market, comprises half of all solar panels ever made, has cumulative panel sales of US$150 billion, and is mitigating 2% of global greenhouse gas emissions through displacement of coal. Prof Blakers engages in analysis of energy systems with 80-100% penetration by wind and solar photovoltaics supported by storage for which he was joint winner of the 2018 Eureka Prize for Environmental Research. His team developed a comprehensive global atlas of a million off-river pumped hydro energy storage sites which is highly influential in the renewable energy storage industry.

Transforming Energy Demands: AI and Optimization Tools

Panos M. Pardalos

University of Florida, Gainesville, FL

Abstract:

Not Available

Hybrid Solar PV, CSP and Thermal Energy Storage for Baseload Power, Industrial Process Heat and Solar Fuels

Yogi Goswami

University of South Florida, Tampa, FL

Abstract:

Not Available

Jump Starting Hydrogen Economy with Seven Hubs Awarded

David Blekhman

Technical Director - Hydrogen Research and Fueling Facility, California State University, Los Angeles, CA

Abstract:

Not Available

Benefits and Challenges of California Offshore Wind Electricity

Adam Zachary Rose

University of Southern California, Los Angeles, CA

Abstract:

Not Available

A Novel System for Transportable Green Hydrogen Production Utilizing Waste Heat in a Thermochemical CuCl Cycle

Kamiel Gabriel

Ontario Tech University, Canada

Abstract:

Not Available

Salt Hydrate-based Thermochemical Energy Storage in Buildings

Yao Yu*, Xuelei Xiao, Xiaoou Hu, Shishir Kumar Das and Adam Gladen

North Dakota State University, USA

Abstract:

Thermochemical energy storage utilizing salt hydrates is a novel method to harness renewable and low-grade thermal energy. In this study, a hybrid heating system was developed, which combines the benefits of thermochemical energy storage (using SrCl2) and renewable energy (solar power) for space heating. Specifically, the system utilizes solar thermal collectors to capture thermal energy and then transfers the heat collected to a tank filled with salt, which acts as the thermochemical energy storage element in the system. During periods of abundant sunlight, this system absorbs and stores heat in the tank, which can be used later during nights. This study demonstrates the superiority of using salt for heat storage to systems employing water as the storage medium. Water-based storage requires a larger tank volume to achieve the same heat storage capability, compared with salt-based storage. The developed system plays a pivotal role in curbing energy consumption for heating, potentially leading to considerable long-term cost savings. Consequently, it contributes to sustainable building operations and fosters a greener future by reducing carbon footprint.

Biography:

Yao Yu earned his two Master degrees and one Ph.D. in Architectural Engineering, Civil Engineering, and Computational Science and Engineering in 2008, 2012, and 2014, respectively. After graduation, Dr. Yu worked in industry as an energy engineer to perform building energy modeling and simulation. He is a LEED Accredited Professional and an ASHRAE Building Energy Modeling Professional (BEMP). Currently, Dr. Yu is working as an assistant professor in the Department of Civil, Construction and Environmental Engineering at North Dakota State University.

H-Mat: Polymeric Materials for Hydrogen Technologies

Wenbin Kuang* and Kevin L. Simmons

Pacific Northwest National Laboratory, USA

Abstract:

Hydrogen currently plays a crucial function in our economy, not only as an industrial feedstock but as a versatile tool for decarbonization. A reliable and robust hydrogen infrastructure is key to widespread adoption and deployment of hydrogen technologies, and hydrogen materials compatibility is essential for such a hydrogen infrastructure. The H-Mat program is funded by US Department of Energy's Hydrogen and Fuel Cell Technologies Office, to understand the effects of hydrogen gas interactions in materials and to explore similitude between laboratory/computational studies and real-world applications to enable science-based decision-making for the design optimization of hydrogen technologies. This presentation will cover several significant findings from this program on polymeric materials interaction with high-pressure hydrogen gas as

well as computational methods developed to help elucidate the damage mechanism of hydrogen in polymeric materials.

Biography:

Dr. Kuang is a Senior Materials Scientist at Pacific Northwest National Laboratory (PNNL) since 2018. He has a broad background in materials science and chemical engineering with a research focus on polymers and polymeric composites. He earned his Ph.D. in Chemical Engineering at Syracuse University in 2017 with a focus on shape memory polymer and composite. Current area of his research at PNNL covers fundamental studies of polymeric materials used in hydrogen services, tribological studies of polymeric materials in extreme conditions, joining of dissimilar materials, malleable composite materials (e.g., vitrimer) for lightweight composites, and plastic waste recycling.

Thermal desorption of Hydrogen from Water-soaked lithium-cobalt oxides at Room Temperature

Bun Tsuchiya[1]*, Ryosuke Terasawa[1], Keisuke Kataoka[1], Kohtaku Suzuki[2] and Tomoko Sasaki[3]

[1]Meijo University, Japan,

[2]The Wakasa-wan Energy Research Center, Japan

[3]Tohoku University, Japan

Abstract:

The production of hydrogen molecules (H_2) by splitting water (H_2O), which is a renewable resource, using electrolysis, photo-catalysis, solar energy, and other such methods, is one of the most attractive processes, involving zero emission of carbon dioxide (CO_2). It is important to split H_2O at low temperatures and electric powers and, in addition, to store and release significant amounts of the produced H_2 by spending minimal energy in order to reduce the cost of this H_2 production process.

The aim of this work was to investigate the H absorption and desorption characteristics of $LiCoO_2$ materials soaked in H_2O at room temperature. Thus, the H concentration of $LiCoO_2$ materials exhibiting H_2O-uptake was investigated in air using weight gain (WG) measurement and ion beam surface analysis, which was combined with high-energy elastic recoil detection (ERD) with 5.1 MeV He^{2+} ion-probe beams. In addition, the release of hydrogen molecules (H_2) and the dissociation temperature were characterized using gas chromatography (GC). In addition, first-principles calculations performed using a density functional theory (DFT) code were also examined to elucidate the most stable sites for trapping H in $LiCoO_2$ after H_2O uptake.

In the present study, the results by WG, ERD, GC, and DFT revealed that the release of H_2 was clearly confirmed by heating the H_2O-soaked $LiCoO_2$ up to the lower temperatures less than 523 K and, in addition, the production of H_2 might occur owing to the desorption of H atoms from the Li substitutional sites and the recombination of activated H atoms.

Biography:

Bun Tsuchiya is a professor at Meijo University. He belongs to Japan. He completed his doctor's degree in materials science from Nagoya University, Nagoya city. He joined the Institute for Materials Research in Tohoku University as assistant professor in April 1998 and the Faculty of Science and Technology in Meijo University as associate professor in April 2010 and as professor in April 2017. He has many international research contributions on the energy materials related to nuclear fusion, fuel cell, and lithium ion battery.

Effect of current collector thickness on contact resistance and performance of a cylindrical PEMFC

Sunil Kumar Sethy and Amit C Bhosale

Indian Institute of Technology Roorkee, India

Abstract:

High volumetric and gravimetric power densities make the cylindrically structured proton exchange membrane fuel cells a promising energy conversion device for portable and transportation applications. This study investigates the effect of current collector thickness and gas pressure on contact resistance and cell performance for two clamping systems viz. strap and spring mechanisms. The cell is modelled structurally for understanding the contact pressure distribution at the interface of bipolar plate and gas diffusion layer on either side of membrane electrode assembly. A significant decrease in contact resistance and increase in performance with respect to current density in spring clamping mechanism is observed due to uniform and higher average contact pressure distribution. The average contact pressure is found to increase with the increase in current collector thickness (0.25-1.5 mm) and clamping pressure (0.5-2.5 MPa), thereby reducing the contact resistance. Deformation along the length is also found to be minimum with spring clamping compared to the strap clamping because of uniform clamping. At a current collector thickness of 0.50 mm, 1.5 MPa clamping pressure, and 100 kPa gas pressure, the contact resistance in strap clamping (34.30 Ω cm2) is reduced by 26.95 % in spring clamping. This research identifies an optimum current collector thickness for better cell performance and reduced contact resistance at a particular clamping pressure.

Biography:

Amit C. Bhosale is an Assistant Professor in the Department of Hydro and Renewable Energy, Indian Institute of Technology Roorkee. He pursued PhD from the Department of Energy Science and Engineering, Indian Institute of Technology Bombay. His area of research interests includes Fuel cells, electrolyzers, contact resistance management, and cylindrical fuel cells. Sunil Kumar Sethy is a research scholar at Green Hydrogen Lab, Department of Hydro and Renewable Energy, Indian Institute of Technology Roorkee. Development of cylindrical PEM fuel cells along with investigation of contact resistance in the cells are his few research interests.

Advancements in Temperature Estimation for Conventional Lithium-Ion Batteries and All-Solid-State Batteries

Shu-Xia Tang*, Patryck Ferreira

Texas Tech University, USA Presenter Contact Details.

Abstract:

This presentation highlights recent advancements in temperature estimation for both conventional lithium-ion batteries (LiB) and all-solid-state batteries (ASSB). The thermal model for ASSB involves a quintuple system of five Ordinary Differential Equations (ODEs) governing the temperature of the cathode surface, cathode, electrolyte, anode, and anode surface. Conversely, the thermal model for cylindrical LiB comprises ten ODEs covering all battery components in a simplified assembly

with eight parts rolled up on a central mandrel and gaps filled with liquid electrolyte. The thermal models consider thermal power generated within the batteries as one input, derived from the electrochemical Single Particle Model (SPM) model. The LiB electrochemical model, neglecting dynamics in liquid electrolyte, consists of two Partial Differential Equations (PDEs) for cathode and anode dynamics. Similarly, by neglecting lithium metal anode dynamics, the ASSB electrochemical model governs lithium-ion concentration in the cathode and electrolyte through two PDEs. To estimate temperature profiles based on the aforementioned cascaded electrochemical-thermal models, a model reduction employs the 5th-order Padé approximation method for transcendental transfer functions of the PDE systems. Temperature profiles are then estimated using the Kalman filter and Luenberger observer, with discussions on feasible sensor placement strategies ensuring observability. Simulation results validate the models' accuracy and demonstrate temperature consistency of the Kalman filter and Luenberger observer compared with the thermal model.

Biography:

Shu-Xia Tang received her Ph.D. in Mechanical Engineering in 2016 from the Department of Mechanical & Aerospace Engineering, University of California, San Diego, USA. She is currently an assistant professor at the Department of Mechanical Engineering, Texas Tech University, USA. She is an IEEE senior member and serves on IEEE CSS (Control Systems Society) Technical Committee on Distributed Parameter Systems (DPS), IFAC Technical Committee on DPS, and ASME Technical Committee on Energy Systems. She serves as Senior Associate Editor for the ASME DSCC (Dynamic Systems and Control Division) Newsletter and as an Editorial Board Member of IEEE CSS and ASME DSCD. Her main research interests are stability analysis, estimation and control design of DPS.

A Trivalent Indium Metal as A High-Capacity, High-Efficiency, Low-Polarization, and Long-Cycling Anode for Aqueous Batteries

Xianyong Wu[1]*, Songyang Chang[1], Jose Fernando Florez Gomez[2], Swati Katiyar[1], and Gerardo Morell[2]

[1] Department of Chemistry, University of Puerto Rico-Rio Piedras Campus, San Juan, USA;

[2] Department of Physics, University of Puerto Rico-Rio Piedras Campus, San Juan, PR, USA

Abstract:

Aqueous batteries using multivalent metals hold great promise for energy storage, due to their low cost, high energy, and high safety. Presently, divalent metals (zinc, iron, nickel, and manganese) prevail as the leading choice, which, however, suffer from low Coulombic efficiency or dendrite growth. In stark contrast, trivalent metals have received rare attention, despite their capability to unlock unique redox reactions. Herein, we investigate trivalent indium as an innovative and high-performance metal anode for aqueous batteries. The three-electron In^{3+}/In redox endows a high capacity of ~700 mAh g^{-1}, on par with the Zn metal. Besides, indium exhibits a suitable redox potential (-0.34 V *vs.* Standard Hydrogen Electrode) and dendrite-free plating process, which renders ultra-high Coulombic efficiency of 99.3-99.8%. More surprisingly, it features exceedingly low polarization of 1 mV in symmetrical cells, which is 1-2 orders of magnitude lower than any reported metals. The In-MnO_2 full cell also delivers impressive performance, with a cell voltage of ~1.2 V, a high capacity of ~330 mAh g^{-1}, and long cycling of 680 cycles. Our work exemplifies the efficacy of exploiting trivalent metals as an excel-lent metal anode, which opens an exciting direction for building high-performance aqueous batteries.

Biography:

Xianyong Wu is an assistant professor in the chemistry department at the University of Puerto

Rico, Rio Piedras Campus. Prior to that, he worked as a postdoctoral researcher at the University of Washington and Oregon State University from 2016 to 2021. His major research interest is to develop aqueous batteries with new ionic charge carriers. To date, he has published 52 peer-reviewed papers on high-impact journals, including Nat. Energy, J. Am. Chem. Soc., Angew. Chem. Int. Ed., and Adv. Mater., *etc*. His citation is 6881, and the H index is 33 (as of 11/02/2023).

Experiment and Modeling of Ice Energy Storage for Grid-interactive Efficient Buildings (GEB)

Hailei Wang

Utah State University, Logan, UT

Abstract:

(Not Available)

Efficient Strategies to Accelerate Anodic Reactions in Electrolysis Systems for Hydrogen Production

Rong He[1,2]* and Meng Zhou[1]

[1]New Mexico State University, USA.

[2]National Renewable Energy Laboratory, USA

Abstract:

Electrochemical water splitting is an economical and green approach to producing clean hydrogen, a promising technology to alleviate the energy crisis. A high operating cell voltage is needed to achieve the desired current density due to the sluggish kinetics of oxygen evolution reaction (OER). Herein, we demonstrated two strategies to improve the OER activity of the cobalt-nickel sulfides on Ni foam (CoS/Ni3S2@NF): adding glycerol and increasing the temperature. A current density of 20 mA cm-2 could be reached at a low potential of 1.35 V (vs. RHE) by adding 0.1 M glycerol to the alkaline electrolyte, indicating glycerol oxidation reaction (GOR) is a possible anodic reaction to replace the sluggish OER. The estimated activation energy of Co-S/Ni3S2@NF for OER is higher than that for GOR, indicating the OER process with high kinetic energy barriers. By adding glycerol and increasing the temperature, the anodic current density at ~1.6 V was observed to increase tenfold, providing solutions to improve electrolysis efficiency. These findings provide valuable clues to overcoming the sluggish kinetics of the anodic reaction process and improving electrolysis efficiency.

Biography:

Rong He received her Ph.D. degree in Chemical Engineering from New Mexico State University in 2023. Currently, she is a postdoctoral researcher in the materials chemical science group at the National Renewable Energy Laboratory (NREL). Her research interests include water electrolysis and lithium-ion batteries. Her work primarily focuses on the synthesis of transition metal-based materials for various applications and the characterization of electrochemical processes occurring at different interfaces.

Valorization of animal manures and plastic wastes through wet and dry pyrolysis

Kyoung S Ro

USDA Agricultural Research Service, Florence, SC, USA

Abstract:

For the last decade, production agriculture has become more intensive, and the number of concentrated animal feeding operation (CAFOs) has increased dramatically. As a result, large quantities of animal manures are produced exceeding the capacity of land nearby to assimilate the nutrients in manures. Without proper disposal of the surplus animal manure, these surplus animal manure will cause eutrophication problems in soil and water. In addition, use of plastic mulch and the increased use of disposable face masks due to COVID-19 resulted in a surge of plastic wastes. We investigated both wet and dry pyrolysis technologies to convert these plastic wastes and surplus animal manures into renewable energy and value-added products. Biochar, hydrochar, and plastichar are carbonaceous materials made from pyrolyzing these feedstocks. These were evaluated for their potential in agro-environmental and energy applications. Short introduction and summaries of each application will be presented at the meeting.

Biography:

Ro is a research environmental engineer for the US Department of Agriculture at the Coastal Plains Soil, Water & Plant Research Center, Florence, SC. He provides leadership and expertise in developing innovative waste-to-energy and value-added product technologies. His current research areas are air quality and value-added carbonaceous material production from various wastes using pyrolysis and hydrothermal carbonization processes.

Forging a Path to Sustainable Bioproducts: Innovations in Microbial Engineering and Carbon Capture

Nawa Raj Baral[1,2]* and Corinne D. Scown[1,2]

[1]Joint BioEnergy Institute, Lawrence Berkeley National Laboratory, Berkeley, California 94720, United States.

[2]Biological Systems and Engineering Division, Lawrence Berkeley National Laboratory, Berkeley, California 94720, United States.

[3]Energy Analysis and Environmental Impacts Division, Lawrence Berkeley National Laboratory, Berkeley, California 94720, United States.

[4]Energy & Biosciences Institute, University of California, Berkeley, California 94720, United States.

Abstract:

The global green bioeconomy demands an urgent focus on the production of scalable, economically viable, carbon-neutral, or carbon-negative biobased fuels, chemicals, and materials. Assessing the progress towards achieving this goal over the last decade reveals a substantial need for improvement in the bioconversion stage. The challenge lies in engineering host microbes to maximize the titer, rate, and yield of bioproducts.

When microbes are inefficient at converting carbon sources into products, most experimental studies report near 100% utilization of carbon sources, meaning that the remaining portion ends up as cell mass and CO2. Both CO2 and cell mass play crucial roles and offer opportunities to reduce the cost and carbon footprint of the main bioproduct when appropriately utilized.

In our approach, we combined Techno-Economic Analysis (TEA) and Life Cycle Assessment (LCA) models with a metabolic engineering model to evaluate the optimal combination of bioproducts, cell mass, and CO2. This evaluation was carried out with a focus on bisabolene, a sesquiterpene and a representative precursor for renewable transportation fuels and chemicals, production in *Rhodosporidium toruloides*. We achieve the optimal combination by converting cell mass into hydrocarbon fuels and CO2 into butanol, leveraging moderately engineered host microbes for the production of economically viable low-carbon biofuels and biochemicals in the near term. This approach identifies process bottlenecks, optimization opportunities, and threshold points, indicating where future research should best allocate time and effort.

Our work offers a novel approach to host microbe engineering and provides actionable guidance for prioritizing future research.

Biography:

Nawa Baral is a Research Scientist at The Joint Bioenergy Institute, Lawrence Berkeley National Laboratory, California, United States, specializing in process modeling, technoeconomic analysis, and lifecycle assessment. His research interests encompass a wide range of topics, including the design and analysis of terrestrial and aquatic biomass feedstock supply systems, biomass-to-transportation fuels production system analysis. Dr. Baral holds the position of Associate Editor at Bioenergy and Biofuels, a specialty section of Frontiers in Energy Research, showcasing his commitment to advancing the field. He earned his Ph.D. in Food, Agricultural, and Biological Engineering from The Ohio State University, United States.

Integration of layered unstacking graphene for high energy density Li-ion Batteries (LIB)

Tereza M. Paronyan

HeXalayer LLC, Louisville, KY, USA

Abstract:

The rapidly growing market for Li-ion batteries (LIB) is driven by the demand for many applications including electric vehicles, Unmanned Aerial Systems (UAS), connected and IoT-based devices, and many other mobile electronic devices. Besides the many advances of current LiB such as high voltage, long-term cycling, and safety, those batteries are still lacking in terms of high energy density and high power for a long lifetime of safe cycling.

HeXalayer develops an innovative graphene technology that demonstrates up to six-fold (~1,800 mA.h/g) specific capacity than the capacity of currently using graphite anode. The unique electronic structure of this layered graphene initiates a weakened interlayer interaction inside of structure that provides a larger amount of Lithium intercalation reversibly. The established kinetics provides long-term cycling with over 98% retained capacity. We discuss the implementation and challenges of this graphenic anode into the full battery technology chemistry with NMC, and LFP cathodes.

HeXalayer's technology offers a new class of advanced and safer LIB technology with only carbon-based beneficial other competitive high-energy density LIB battery technologies that promise to deliver 500Wh/kg and even higher energy density LIBs with longer cycling time.

Biography:

Tereza Paronyan is the Chief Scientist and Founder of HeXalayer LLC. She is also a Professor of Physics at Bellarmine University, KY, USA. Dr. Paronyan earned her Doctorate in Applied Physics in 2003 and has many years of experience working on nanomaterials for energy storage, sensors, supercapacitors, and other applications. Her current focus is developing and transferring innovative graphene technology as an advanced material for LI-ion and other rechargeable batteries. Her research and innovations have been published in high-impact journals such as Science, and Nature, Encyclopedias, and handbooks.

Renewable Liquid Fuels from Woody Biomass

Hemant Pendse

University of Maine, Orono ME USA

Abstract:

Maine has significant quantities of unmerchantable low-grade woody biomass due in part to many pulp-mill closures and a very limited market for a few remaining biomass power plants to generate electricity. UMaine's Forest Bioproducts Research Institute (FBRI) has developed processes to produce renewable diesel and jet fuel from woody biomass. Our wood to jet fuel project is based on FBRI's patented thermal deoxygenation process, which yields jet fuel that meets key specifications for Sustainable Aviation Fuel (SAF). We operate two pilot plants. The Biomass to Bioproducts Pilot Plant (B2P2) is designed to convert one dry metric ton of biomass into organic acids and biochar. The intermediate process stream containing mixed organic acids is then converted to crude oil in the BioCrude Oil Pilot Plant (BioCOPP) designed for a crude oil production rate of 100 kg/day. The conversion technologies have been tested in several 100-hour continuous operation campaigns. This presentation tells the story of discovery, innovation, and the proof-of-concept at commercially relevant scale. Plans for demonstrating the technology at a small commercial facility in Maine are underway. Discussions with an oil refinery show promising options to blend the wood derived UMaine jet fuel with conventional jet fuel for the commercial aviation market as SAF.

Biography:

Pendse, Professor Emeritus of Chemical Engineering and Director Emeritus of FBRI has led research in the conversion of woody biomass to bioproducts including fuels, chemicals and advanced materials since 2006. Dr. Pendse led the establishment of a new Technology Research Center (TRC) for floor-scale processing of biomass at a 40,000 sq. ft. high-bay facility. TRC operates the Biomass to Bioproducts Pilot Plant (B2P2) and the BioCrude Oil Pilot Plant (BioCOPP), for its "Wood to Jet Fuel" program. As an internationally recognized leader in forest bioproducts, Pendse was named the University of Maine's 2021 Distinguished Maine Professor (DMP).

Develop an efficient and cost-effective novel anaerobic digestion system producing high-purity of methane

Liang Yu*, Do-Gyun Kim, Meghana C Mendon, Sarah Witherrite and Shulin Chen

Washington State University, Pullman, WA, USA

Abstract:

Dairy manure, abundant in the United States at approximately 100 pounds per day per cow, serves as a significant biofuel source. Anaerobic digestion (AD) of this manure effectively produces bio-methane, addressing environmental concerns related to greenhouse gas emissions. Financial incentives for renewable natural gas (RNG) further make AD attractive. However, cost remains a barrier to widespread adoption.

To overcome this, an Intensified Versatile Anaerobic Digestion (IVAD) System for RNG production has been developed. This technology addresses low reaction rates, feedstock limitations, and low methane content in biogas. It incorporates a hyperthermophilic anaerobic acidification reactor (AAR), pressurized thermophilic and mesophilic anaerobic methanogenesis reactors (TAMR and MAMR), and a hydrothermal treatment (HTT) unit.

Bench-scale experiments, including a heat recovery strategy, were conducted. The pilot-scale system is currently in the construction phase. Techno-economic analysis (TEA) evaluated the IVAD technology, with a case study on a dairy farm revealing its advantages over current mesophilic AD technology. The LCOE and EROI for mesophilic AD were $18.05/MMTBTU and 1.71, respectively, compared to IVAD's $9.72/MMTBTU and 2.59. Sensitivity analysis emphasized methane production rate and equipment size as significant parameters.

Further research is crucial to enhance methane production rates and reduce equipment size, unlocking additional cost reductions in IVAD technology.

Biography:

Liang Yu, an assistant professor at Washington State University (WSU) in the Department of Biological System Engineering, is a Licensed Professional Engineer in Washington. Dr. Yu's research primarily revolves around the development of anaerobic digestion-based biorefinery, industrial symbiosis and circular economy. To achieve this goal, he employs hands-on experimental validation and multi-scale mathematical modeling techniques, including molecular simulation, computational fluid dynamics, bioprocess simulation, optimization, integration, techno-economic analysis, life cycle assessment, and machine learning. Dr. Yu's research, supported by the Department of Energy and the Department of Agriculture, spans over 60 publications in peer-reviewed journals, accompanied by five granted patents.

Performance Evaluation of a Clean Hydrogen Production System

Ehsan Hosseini

Arkansas Tech University, Russellville, AR

Abstract:

This presentation evaluates the performance of a gas turbine (GT) system coupled with a flameless boiler for steam generation for hydrogen production in a solid oxide steam electrolyzer (SOSE). In this design, the GT exhaust gases are directed to the flameless boiler, in which diluted and preheated exhaust gases are applied as an oxidizer. Using a small amount of fuel in the flameless boiler enables the hybrid system to produce the required steam for the SOSE process. The whole generated electrical power by GT is employed in SOSE and produces hydrogen. The effects of fuel flow rate, turbine inlet temperature (TIT), steam temperature, and electrode characteristics on the hybrid system's performance are assessed. The results indicate that at the constant electrical power in the GT system, when steam temperature increases, the overall SOSE potential decreases. Consequently, the current of the SOSE is enhanced, resulting in the enhancement of the overall hydrogen production in high steam temperatures. The presented analysis in this research can perform more analyses to achieve an insightful understanding of green hydrogen production using hybrid systems.

Biography:

Hosseini is an Associate Professor in the Department of Mechanical Engineering at Arkansas Tech University (ATU). He established the Combustion and Sustainable Energy Laboratory (ComSEL) at ATU, working on several energy-related projects. Dr. Hosseini has published two books and more than 100 scientific papers, and his research has been funded by NASA and the Department of Transportation (DoT). In 2020, 2021, and 2022, Dr. Hosseini was on the Elsevier Stanford list of 2% of most cited scientists globally. Before joining Arkansas Tech University, Dr. Hosseini was a postdoctoral research fellow in the Combustion and Solar Energy Laboratory with the Department of Mechanical Engineering at San Diego State University, working on a hybrid solar thermal energy generation system funded by the Department of Energy (DOE).

Potential strains of cyanobacteria in biotechnology: advances and applications in biofuels

Bolatkan Zayadan*, Ardak Kakimova, Kenzhegul Bolatkhan and Sandybayeva Sandugash

Al-Farabi Kazakh National University, Kazakhstan

Cyanobacteria present promising prospects for sustainable biofuel production and biotechnology applications, given their rapid reproduction, robust photosynthetic capabilities, and minimal nutritional requirements. In response to contemporary freshwater and energy shortages, the exploration of the potential of living organisms in bioenergy and waste recycling technologies becomes imperative. Cyanobacteria have garnered attention for their diverse applications in various industries, serving as reservoirs of biologically active compounds.

Total lipids were quantified gravimetrically, and fatty acid composition analysis was conducted using capillary gas chromatography following established procedures (Zayadan et al., 2019). Molecular hydrogen was measured using a gas chromatograph (Kossalbayev et al., 2022).

In comparison with isolated and collection strains, *Anabaena variabilis* A-1 showed superiority in hydrogen yield production, demonstrating exceptional dark hydrogen evolution, reaching 8.67 µmol H_2/mg Chl/h.

The *Desertifilum* IPPAS B-1200 strain exhibited outstanding fatty acid composition (16:1(Δ7) and 16:2(Δ7,10)), suitable for biodiesel. Additionally, it displayed significant potential in wastewater treatment, achieving 68–95% purification of organic contaminants. The *Cyanobacterium* sp. IPPAS B-1200 strain showcased versatile characteristics, with lipid content ranging from 15% to 22% of dry weight, providing valuable insights for biofuel production. These findings underscore the multifaceted applications of *Anabaena, Cyanobacterium*, and *Desertifilum* strains in biotechnology, bioenergy, and environmental technologies.

Biography:

Bolatkhan Zayadan was born on February 8, 1961. He entered in 1979 the Faculty of Natural Sciences with a degree in Biophysics and Biology at Mongolian National University in Ulan Bator.1984-1989 Researcher in Institut of Biotechnology, Academy of Sciences, Mongolia. 1989-1990 Researcher in Laboratory of algology, of the Timiriyazev Institute of Plant Physiology Moscow, Russia. 1992-1997 Post-graduate degree of genetics and breeding of the St. Petersburg University. From 2006 - Doctor of Biological Sciences, 2020 - Academician of the National Academy of Sciences of RK. From 2007 - present time Professor of the Biotechnology Department, al-Farabi Kazakh National University.

Decarbonizing hydrogen supply chain via electrifying endothermic production processes

Ram R. Ratnakar*

Shell International Exploration & Production Inc, Houston, TX, USA

Abstract:

Continuously increasing global emissions of CO_2 and other greenhouse gases in the atmosphere pose great challenge due to their adverse ecological, health and economical effects on to our society. One of the primary sources of CO2 emissions are chemical and manufacturing industries, where energy is supplied by burning fossil fuels. While several renewable pathways are being on development, enabling these resources for manufacturing industries while improving thermal efficiency are still major gap. In this work, we describe the electrified reactor configurations that can enable the integration of renewable power with manufacturing processes where endothermic heat is required. Hydrogen production is considered as a case example that could include not only the decarbonized heating pathways but also for production of carbon-free fuel. The proposed reactor configurations are shown to have technical feasibility for various endothermic processes including ethane cracking, steam reforming and dry reforming of methane, and can easily be extended for other endothermic processes.

Keywords: Process Intensification; Process Electrification; Net carbon zero, Hydrogen production

Biography:

Ram R. Ratnakar is a Sr. Researcher, a subject matter expert (SME), Technical authority (TA) 2, and PT-BMS auditor in Shell International Exploration & Production Inc., Houston, USA. He received his B.Tech. in Chemical Engineering from the Indian Institute of Technology, Delhi, India and Ph.D. in Chemical Engineering from University of Houston, USA. He has 17+ years of work experience, holds 60+ technical articles and 6 patents, coauthored a graduate textbook, and contributed significantly to the areas of multiscale modeling, reactive-transport, PVT, Data analytics, and new energy technologies such as hydrogen, dense energy careers, carbon capture and utilization, and electrification.

Performance Evaluation of a Novel Loop Heat Pipe-Based BTMS Systems: An Experimental Investigation

Vipul M. Patel*, Milan Vachhani, Kalpak R. Sagar and Hemantkumar B. Mehta

Sardar Vallabhbhai National Institute of Technology Surat, Gujarat, India

Abstract:

In the present work, a novel battery thermal management system (BTMS) based on a loop heat pipe is designed and developed for electric vehicles. The BTMS consists of an evaporator, vapor line, condenser section, liquid line, and compensation chamber. Distilled water is considered as the working fluid, and a filling ratio of 50% is maintained for all investigations. The performance of the proposed BTMS is evaluated at different charging and discharging rates (1 C, 1.5 C, and 2 C) under an ambient temperature of 45°C, representing Indian summer conditions. A battery module comprising 12 Li-ion cells in a 4P3S configuration is assembled to assess the performance of the proposed BTMS. An aluminum holder is specially fabricated to accommodate the battery module, allowing for the installation of multiple evaporators as per requirements. The aim of this study is to provide a detailed comparison between a single evaporator-based BTMS and a double evaporator-based BTMS under the aforementioned operating and ambient conditions. The study defines successful BTMS performance as maintaining a maximum temperature below 60°C and a maximum temperature gradient within the module of less than 5°C. Experimental investigations reveal that the BTMS with a single evaporator performs effectively up to discharge C-rates of 1.5C. However, at higher discharge rates of 2C, it reaches the maximum allowable temperature of 60°C when the state of charge (SOC) is at 32%. In contrast, the double evaporator-based BTMS outperforms the single evaporator BTMS by achieving an SOC of 20% at an ambient temperature of 45°C.

Biography:

Vipul M. Patel, assistant professor in the Dept. of Mechanical Engineering at Sardar Vallabhbhai National Institute of Technology, Surat, India. Prior to joining this institute, He was a postdoctoral fellow (2018-2019) in the Dept. of Mechanical Engineering at Indian Institute of Technology Bombay, India. He did my M.Tech. (2009-2011) and Ph.D. (2013-2018) from Indian Institute of Technology Delhi, India. He completed B.E. in Mechanical Engineering from Sardar Patel University, India. My areas of interest are battery thermal management systems, radiation heat transfer, transport phenomena in porous media, bio-heat transfer, radiation therapy, and computational modeling.

Renewable Energy Deployment in the Europe: Identifying Driving Factors and Bridging the Performance Gap

Giacomo Di Foggia*, Massimo Beccarello and Ugo Arrigo

Department of Business and Law, University of Milano – Bicocca, Milan, Italy

Abstract:

The European Union has established ambitious renewable energy targets as a cornerstone of its decarbonization strategy. However, there exists a substantial variation in the progress of EU

member states towards achieving these goals. This research delves into the factors influencing renewable energy deployment and examines the potential for emulation of best-performing nations, aiming to accelerate the transition towards a sustainable energy system. Our analysis identifies key determinants of RE deployment, including the strength of electricity grid infrastructure, the adoption of innovative technologies, diversification in the energy mix, and the promotion of sustainable transportation. A simulation scenario where all countries emulate the best-performing paths suggests a potential reduction in the gap between actual and projected renewable energy deployment by 1.7% by 2030, with associated societal benefits. This finding highlights the importance of aligning national policies with the strategies of leading RE nations. This study provides valuable insights for policymakers and utilities to inform the design of effective policies and investment strategies, ultimately accelerating the EU's transition to a sustainable energy future.

Biography:

Asst. professor of Applied Economics at University of Milano-Bicocca. General Secretary at CESISP - Research Center in Economics and Regulation of Services, Industry, and Public Sector. He received his Ph.D. in Business and Economics from LIUC University. He has served as technical and economic advisor for both public entities such as the City of Milan, The Metropolitan Agency for Sustainability and the Lombardy Region as well as for corporations. He has served as scientific consultant of the National Energy Research System on energy efficiency and policy

Additive Manufacturing for Advanced Thermal Management for Aerospace Propulsion Systems

Zekai Hong

University of Ottawa, Canada

ABSTRACT:

As the aerospace industry is striving to meet ever tightening environmental regulation standards and to aggressively reduce greenhouse gas emissions, new technology injections facilitate the evolution and/or revolution of aircraft propulsion systems. Several competing technical pathways have been identified as potential candidate in achieving low- or zero- carbon emissions, including more efficient gas turbines using Sustainable Aviation Fuel (SAF) or hydrogen, hybrid electric propulsion integrating battery packs and gas turbines, and pure electric propulsion systems with either battery or hydrogen fuel cell as energy sources. However, no matter which technical paths the industry takes, advanced thermal management has been identified as one of the limiting factors in deciding the ceilings of power/energy density and efficiency of next-generation propulsion systems. The recent advancements in additive manufacturing enable functional components featuring unique lattice structures at the core of aviation propulsion systems to be manufactured to achieve advanced thermal management.

Two proposed thermal management solutions that are made possible by additively manufacturing lattice structures for aerospace propulsion systems are presented in this report: 1) revolutionize gas turbine combustor cooling by adopting additively manufactured triply periodic minimal surface (TPMS) lattice structures to realize transpiration cooling by replacing the start-of-the-art effusion cooling; and 2) additively manufactured Hillbert lattice structures as the building blocks of the core of electrical motor rotors.

The first proposed approach is intended for improving the efficiency of gas turbines by reducing cooling air consumption. Cooling is a prominent constrain that limits further efficiency gains in

modern gas turbines. The TPMS lattice structure could be engineered as hot-gas path components that could effectively reject heat by featuring large internal surface areas. In addition, the uniform distribution of cooling air in transpiration cooling featuring TPMS structure create a 4X more effective cooling films. The design and optimization of such functional parts take advantages of improved understanding of transpiration cooling from our recent studies.

The second proposed thermal management solution is intended for electrical motors, because additively manufactured lattice structure has the potential to address the bottleneck thermal management challenges in meeting the power density needs by greatly facilitating waste heat rejections while reducing waste heat generation by suppressing eddy current. Our recent studies investigated the couplings between micro-scale geometry, material properties, macro-scale transport and flow characteristics of Hillbert lattice structures applied in changing electrical fields, as a potential solution for achieving optimal cooling designs for electrical motors.

BIOGRAPHY:

Zekai Hong received his Ph.D. in Mechanical Engineering from Stanford University in 2010 with a focus on power and propulsion systems. Upon graduation, he joined GE Global Research Centre at Niskayuna, New York as a combustion research engineer working on GE's new product line of ultra-efficient, low-emission turbofan engines, including GE9X, LeapX, and GEnx engines. In 2017, Dr. Hong was appointed as a Senior Research Officer at National Research Council Canada's Aerospace Research Centre in Ottawa, Canada. Currently he also serves as an Adjunct Professor of Mechanical Engineering at the University of Ottawa.

Integral Ecology Approach to Life Cycle Assessment: A Case Study on Energy and Building Systems Upgrades at a Benedictine Monastery

Charles E. Sprouse III*

Benedictine College, USA

Abstract:

Among the most salient questions building owners (and engineers) face in the presence of aging building systems is, "what human and environmental benefits can be realized through a systematic upgrade project?" In a way, this question points towards the essence of integral ecology and the indispensable value of life cycle assessments. Unfortunately, the nascent enforcement of the US Act banning the import of materials from the Xinjiang Uyghur Autonomous Region of the People's Republic of China and the lack of a US Product Environmental Footprint (PEF) law mirroring the European Union makes it extremely difficult and time consuming (if not impossible) to examine the entire chain of custody of materials in commercial energy and HVAC products in the US. Even the most ardent supporters of corporate transparency and environmental responsibility, such as First Solar, merely publish policy statements and select numerical findings of proprietary environmental accounting studies. Within this context, this presentation offers a case study of the efforts of St. Benedict's Abbey in Atchison, Kansas, USA, to responsibly generate power and condition the ~150,000 ft^2 facility. In particular, the adoption of solar, geothermal, and dedicated outdoor air systems is shown to significantly improve energy efficiency and air quality, preventing pollution and achieving stability for the monastic community. By transparently reporting on the project's life cycle assessment, engineers and business owners have access to what is likely the first case study aimed towards living an integral ecology.

Biography:

Charles Sprouse III is an Associate Professor of Engineering in the Benedictine College School of

Engineering. Before joining the academy, he worked in consulting engineering and automotive research. Specializing in power generation and emissions abatement strategies, as well as green building systems, he advances environmental stewardship through computational modeling and analysis of thermofluid systems.

Optimizing Solar Policy Support

Andy Hira

Simon Fraser University, Burnaby, BC, Canada

Abstract:

-Solar prices have come down remarkably over the last 15 years, by 90% according to some estimates. Solar has developed along three fronts: industrial, commercial and residential. This paper examines the pros and cons of policy support for each. Should policymakers support large industrial solar installations? Such installations have serious drawbacks, including land use, but may be more economical and reduce the challenges of intermittency. Should policy support instead commercial solar usage? Larger enterprises can better support the costs of battery storage and thus maintain stable electricity provision, but exclude the public benefits of solar. Residential solar is clearly the least efficient from a policy perspective and may threaten utility business models, but support provides the possibilities for customization to individual needs, and the possibility of more rapid diffusion of solar technology. The paper will examine the technical, economic/financial and social/political advantages of each form of solar development.

Biography:

Anil (Andy) Hira-is Professor and Chair of the Dept. of Political Science at Simon Fraser University in Vancouver, Canada. He is also the Director of the Clean Energy Research Group (https://www.sfu.ca/politics/CERG.html), which produces research and policy working papers about climate change and clean energy, as well as hosting a network of researchers who share insights. Hira is the author of numerous books and articles about climate change and clean energy. His most recent book is *The Smoke and Mirrors Game of CSR Reporting* (2023, Anthem Press) that examines the challenges with ESG reporting

The High Price U.S. Green Economy: A Specific Factors Modeling

Osei Yeboah[1]* and Nicholas Mensah Amoah[2]

North Carolina A & T State University, United States[1], L. C. Cooper, Jr. International Trade Center, United States[2]

Abstract:

The high price of energy due to green energy policy will cause adjustments across the U.S. economy is predicted in the present computable general equilibrium with specific factors model. This includes energy input, especially electricity with capital and labor to produce manufacturing and service goods. 2022 labor, energy, and sector-specific capital input data on U.S. manufacturing, service, and agricultural sectors is applied to specific factors of computable general equilibrium model. The model, which assumes constant returns, full employment, competitive pricing, and perfect labor mobility across industries hypothesizes a range of price changes to project potential adjustments in factor prices and outputs. The U.S manufacturing sector is revealed to have a higher degree of noncompetitive pricing followed service while the policy has almost no effect on the agricultural sector. The high price due to green energy will cause an inelastic decrease

in all energy inputs, but electricity. The output from energy-intensive manufacturing rises both in the short and long runs while service and agriculture falls. Manufacturing wages, especially for production workers and managers, rise while the sector's returns to capital remain barely unchanged given the weak substitution of capital relative to the price of energy. Returns to capital and wages in the service sector except production workers, all rises. Thus, the clear winners of the green energy policy are labor in both manufacturing and service, and capital owners in the service sector. These results are consistent with literature that the green energy policy can create high paying jobs in. the U.S.

Biography:

A member of the NC A&T faculty for the past 21 years, Yeboah's scientific interests began at the KNUST in his native Ghana, where he earned his BS in Agricultural Science. He earned an MS in Production Economics from NCA&T in 1993, and Doctorate in Agricultural Economics (Resource Economics) at University of Nebraska-Lincoln in 1998 and served as a postdoctoral research fellow at same institution from 1998 to 2000. He has since 2014 been a Professor and Director at NC A&T. He has earned several awards including the University's Senior Researcher Award in 2013. Research focus includes Environmental and Energy Economics.

Energy saving during washing due to ultrasound

Tobias Kimmel

University of Applied Sciences Niederrhein, Germany

Abstract:

Laundry washing is an established process that is mostly fully automated in households, especially in industrialized countries. Due to the frequency and energy intensity of the process, large amounts of energy are consumed. Therefore, the search for new technologies to reduce energy consumption is a high priority.

In the EU, the water for washing is mainly heated in the appliance itself, so the energy can be easily identified as electrical energy. Washing accounted for about 6.4% of household electricity consumption in the EU. In the U.S., consumption patterns are somewhat different, as hot water is more often heated separately through the domestic water system.

Conventional efforts to reduce energy consumption focus mainly on increasing the duration of the wash cycle. But long process times, i.e. 3 hours or more, are not acceptable to most consumers. A promising new technology is washing with ultrasound. The possibilities and limitations of this process will be presented in this lecture.

Ultrasound causes cavitation, which leads to small vapor bubbles that implode at high speed and generate water jets and locally a high temperature. Both have a high cleaning effect on nearby surfaces. The main problem in using ultrasound is the introduction of ultrasound into the washing process and the distribution of ultrasound over the laundry in the washing machine. Concepts are presented on how ultrasound can best be used to achieve a good cleaning effect while maintaining a low energy profile.

Biography:

Professor for Cleaning Technology at the University of Applied Sciences Niederrhein, Germany since 2012. Current research topics: Ultrasound for cleaning applications, microplastic formation in laundry washing, studies on the dosing behavior of consumers of detergents, application of surfactants containing chemically bonded CO_2 for cleaning products. Research projects are most often carried out directly with companies without using public funds. 2005 - 2012 employed at Miele & Cie., 2000 - 2005 assistant and PhD student at the Technical University of Berlin.

Patented Snow/Icemelting System with Solar Vacuum Tube

Zuhal Er*

ISTANBUL TECHNICAL University, Turkey

Abstract:

This study which will be from my invention; It is a snow/ice melting system; It is characterized as an environmentally friendly design, in which hot "special working material" is obtained from the vacuum tube panel with solar energy, , IoT designed and which reduces the costs such as equipment, materials, personnel, energy. The solvent which is described as the special working material for snow removal, contains special solvent components that help dissolve snow and ice. The snow cleaning special working material can be used in snow and ice removal processes, as well as providing a suitable solution for many different situations (such as disinfection). The invention is unique in that it has a large data recorder that gives measurements on the surface to the electronic device, and it has new technology advantages as it is solar powered and uses waste. The work to be presented in this study has received a Patent Certificate from the Turkish Patent Institute with the number TR201710264B. I would like to thank ITU-Nova for their support in the patent procedures. Vacuum tubes operate with an efficiency of 65-70% in winter (70-750C hot fluid production) and 80-85% in summer compared to other hot water producing panels. Due to the tangential component of the cylindrical structure, the sun's rays are perpendicular at all hours of the day, and this makes it possible to produce hot fluid even under snow. The algorithm of solar energy design in the storage of this liquid will be presented in this study.

Biography:

Zuhal Er was born in Turkey. She started her academic career with a bachelor's degree in physics from YTU. Her master's and doctorate degrees are from Istanbul Technical University-ITU. In her career, she works as an Associate Professor at the Maritime Faculty, and also teaches in the Department of Physics Engineering at ITU. In 2001, she became a visiting professor in Australia with an IMO scholarship. She has done research in areas such as solar energy applications, energy efficiency, ship electronics and has published articles in many journals. She has also been the patent number TR 2017 10264 B holder.

Photovoltaic penetration in the Island of Ikaria, Greece

Maria Fotopoulou[1], Dimitrios Rakopoulos[1]*, Niki Skopetou[1], Kyriaki-Nefeli Malamaki[2], Nikos Andriopoulos[2], Georgios Lampsidis[3] and Konstantinos Kaousias[3]

[1]Centre for Research and Technology Hellas (CERTH), Greece

[2]Independent Power Transmission Operator (IPTO), Greece

[3]Hellenic Electricity Distribution Network Operator (HEDNO), Greece

Abstract:

The operation of Distribution Networks (DNs) has been affected by the ongoing energy transition, gradually incorporating more Distributed Energy Resources (DERs), mainly Renewable Energy

Sources (RES), as well as Energy Storage Systems (ESS) sustainably enhancing DN's flexibility. In the case of the non-interconnected island of Ikaria, Greece, with high solar and wind potential, the DN includes conventional generators, Photovoltaic systems (PVs), wind farms and a hydro-pumped ESS. Scope of this study is to assess the possible impact of the PV system expansion considering either: i) fixed, ii) 1-axis or iii) 2-axis tracking panels. For this purpose, CERTH's in-house INTEMA.grid platform is used. Tracking mechanism's effectiveness is studied considering that the expansion doubles or triples the rated power of the existing, fixed 0.4 MW PVs, following the directions of the Distribution System Operator (DSO). Additionally, a monthly analysis is presented, because Ikaria is an island with extremely higher load during summer months due to tourism. According to the results, if the current PV capacity is doubled or tripled, a 2-axis expansion yields 16.0% or 21.3% yearly production increase compared to fixed panels, respectively, with the 1-axis effect though being much higher (14% or 18.7%, respectively) than the incremental effect of the second axis (further comparative 1.8% or 2.3%, respectively). The effectiveness of tracking mechanisms is highlighted during summer months and particularly early in the morning or late in the afternoon. Finally, the effect of the PV generation on the island's DN is presented through power flow analysis of selected cases.

Biography:

Dimitrios Rakopoulos holds Diploma (2002) and Ph.D. degree (2007) in Mechanical Engineering from the National Technical University of Athens (NTUA), Greece, and is currently a Senior Researcher with the Chemical Process & Energy Resources Institute (CPERI) of Centre for Research & Technology Hellas (CERTH), Greece. Research interests: Diesel engines; power plants; Smart Grids; RES, storage and novel energy systems. Scientific record: 105 papers, >8000 citations and H-index=44 according to Scopus; Top 1% Highly Cited Researcher for 6 consecutive years (2015 – 2020) by Thomson-Reuters; Top 0.5% Highly Cited Researcher (career) for the last 4 consecutive years (2020 – 2023) by Elsevier-Scopus.

Two-Sided Electricity Auction Mechanism Incorporating X2G

Christopher J. Sepka

University of California, Berkeley, USA

Abstract:

Presented is a two-sided market system for the commerce of electricity resources between connected Energy Storage Systems (ESS). In the proposed system, both the buyer (G2X) and sellers (X2G) submit private bids in second-price auctions. Bids from buyers come dynamically over time while sellers do not. The task of creating the optimal matching between buyers and sellers which maximizes both Social Welfare and Revenue in any given scenario is unfeasible both due to the heavy use of computation and also lack of knowledge of the future bids. Therefore, we present a several greedy algorithms which are practical, working in real-time, and provide approximate solutions to the Online Scheduling and Pricing (OSAP) problem. After running experiments, with stochastically generated bids from buyers and sellers, it was determined that MOSAP-II and MOSAP-III exhibited the highest comparative performances in our auction setup.

Biography:

Christopher is a dedicated undergraduate student at UC Berkeley majoring in Electrical Engineering and Computer Sciences. He plans on earning his Bachelor of Science by May 2025 and later pursuing a Master's degree. His primary research focuses are on Electric Vehicles, Auction Mechanisms, and Vehicle-to-Grid Technology.

Economic pre-feasibility of Metarhizium anisopliae production by solid-state fermentation from agroindustrial residues in a novel tray bioreactor

Cristian Orlando Avila[1], Taís Lima Sousa[2], Sebastián Ospina-Corral[3], Fernanda Perpétua Casciatori[4], Carlos Eduardo Orrego-Alzate[5] and Lina María Grajales[2]*

[1]Federal University of Tocantins (UFT), Graduate Program of Regional Development, Brazil and Universidad Nacional Abierta y a Distancia (UNAD), Administrative, Accounting and Business Sciences School, Bogota, Colombia;

[2]Federal University of Tocantins (UFT), Graduate Program of Digital Agroenergy, Brazil;

[3]Universidad de Zaragoza-CITA, Departamento de Producción Animal y Ciencia de los Alimentos, Tecnología de los Alimentos, Facultad de Veterinaria, Instituto Agroalimentario de Aragón Zaragoza, Spain;

[4]Federal University of São Carlos (UFSCar), Graduate Program of Chemical Engineering, Brazil;

[5]Universidad Nacional de Colombia, Instituto de Biotecnología y Agroindustria, Manizales, Colombia.

Abstract:

The main alternative to fossil fuel in Brazil is sugarcane ethanol. Sugarcane crops are biologically controlled by *Metarhizium anisopliae*, a fungus that requires several manual steps for its production. This leads to high contamination, low productivity and health risks for workers. Moreover, manual production limits the scalability of the process. Therefore, a bioreactor that integrates upstream operations and fermentation in one piece of equipment is proposed to intensify the process. Additionally, *M. anisopliae* is typically grown on type I (high quality) rice, which poses a threat to food security. Therefore, alternative substrates are desirable. Both, new equipment and alternative substrates can reduce the production costs of *M. anisopliae*. The objective of this work was to conduct an economic pre-feasibility analysis of *M. anisopliae* production by solid-state fermentation from agroindustrial residues in a novel pilot-scale tray bioreactor. The fungus was produced using broken rice, wheat bran and soy bran as substrates in a tray bioreactor designed by the Bioreactor Engineering Research Group. Production costs were calculated for each batch and the data obtained were used to feed a model created in the Superpro Designer 10 software to simulate annual production. Results indicated that the fermentation technique and equipment employed maintained the operating conditions stable and controlled throughout the process. Simulations estimated the fungus production costs as US$ 89.14 each 500g per year. The current average market price of *M. anisopliae* is US$ 96.77/500g.

Biography:

Chemical Engineer, graduated from the National University of Colombia, UNAL. She holds a Master's and Doctoral degree in Engineering and Food Science from São Paulo State University, UNESP. She has a postdoctoral internship in Chemical Engineering at UNAL. She is a professor at the Federal University of Tocantins, UFT, in the undergraduate program of Food Engineering and in the graduate program of Digital Agroenergy. She is coordinator of the Support Group for Foreign Students. She coordinates the Bioreactor Engineering Research Group. Her area of expertise is the development of rotary drum and fixed bed bioreactors for solid-state fermentation aimed at biofuel production.

Reinforcement Learning for Optimizing Energy Efficiency of Industrial Systems

Metin Turkay

Koc University, Turkey

Abstract:

Not Available

Designing Metal Oxide-Based thermochemical Redox Materials and Processes: Solar Fuels and Energy Storage

Ellen B. Stechel, Ivan Ermanoski, and James E. Miller

Arizona State University, ASU LightWorks, USA

Abstract:

In this presentation, we unveil cutting-edge developments in metal oxide-based thermochemical redox materials and processes1, applicable to solar fuels and energy storage. We start by exploring how the high-temperature endothermic reduction of redox-active metal oxides, capable of releasing oxygen under realistic operating conditions, effectively converts thermal energy into stored chemical energy. A subsequent re-oxidation step then either recovers this energy as heat or drives further chemical reactions. The ability to indefinitely repeat these two steps opens the door to sustainable energy cycles. Here we will focus on two interrelated processes: reversible re-oxidation with oxygen and bond-breaking re-oxidation with CO2 and/or water. We will also highlight the groundbreaking design of a novel perovskite metal oxide material, Ca2/3Ce1/3Ti1/3Mn2/3O3 (CCTM2112), specifically engineered for enhanced thermochemical hydrogen production. This material, predicted solely from theoretical considerations and validated experimentally, showcases a unique cation redox chemistry. Utilizing quantum-based modeling2, we reveal how the deliberate manipulation of cation composition on both A and B sub-lattices leads to a material with optimal oxygen vacancy formation energies and superior redox dynamics to facilitate splitting of water and carbon dioxide. This presentation will delve into the intricacies of CCTM2112's thermodynamics, demonstrating its potential. Our findings not only introduce a high-performing material but also open new avenues in the design of redox-active materials through a deep understanding of their electronic characteristics. [1] de la Calle, et al International Journal of Hydrogen Energy, vol. 47, no. 19, 2022. [2] Wexler, et al, Energy & Environmental Science, vol. 16, no. 6, 2023.

Biography:

Ellen B Stechel is Executive Director, Center for an Arizona Carbon-Neutral Economy (AzCaNE), Co-Director, ASU LightWorks® (campus wide initiative in energy and sustainability); Professor of Practice, School of Molecular Sciences, School of Arts and Sciences); and Senior Global Futures Scientist, Julie Ann Wrigley Global Futures Lab, at Arizona State University (ASU.) Her diverse career has afforded her opportunities to build and/or coordinate research programs at a national laboratory, industry, a U.S. government agency, and now in higher education at ASU; in both basic and applied research; policy and commercialization of emerging technologies; and in multi-disciplinary R&D strategy and management.

High efficiency C2ZnSn(S,Se)4 solar cells via Ag and Li co-alloying

Edgardo Saucedo[1,2]*, Alex Jiménez-Arguijo[1,2], Sergio Giraldo[1,2], Joaquim Puigdollers[1,2] and Yuancai Gong[1,2]

[1] Universitat Politècnica de Catalunya (UPC), Photovoltaic Lab – Micro and Nano Technologies Group (MNT), Electronic Engineering Department, EEBE, Barcelona, 08019, Catalonia, Spain;

[2] Universitat Politècnica de Catalunya (UPC), Barcelona Center for Multiscale Science & Engineering, Barcelona, Catalonia, 08019, Spain

Abstract:

After several years unbeaten, recent progress on molecular inks methodology for the synthesis of kesterite, has allowed to increase the solar cell conversion efficiency of this technology up to 14.9%. Main improvements are related to the precise control of the molecular inks formulation, the fine tuning of the selenization process, and the use of alloying elements, which directly impact in the phase purity and crystalline quality of the material. In this work, we present a complete analysis of the selenization and sulfurization processes of molecular inks based Cu2ZnSnS4 precursors, and the co-alloying with Ag and Li, to better understand the relationship between precursor/absorber in both type of chalcogenization. We demonstrate that the chalcogen vapor pressure and annealing temperature are key for the reproducibility of the processes. We tune these parameters in a wide range of values, performing a complete characterization of the morphology, composition, phase purity and optic properties of the absorbers. By adapting our chalcogenization process in a semi-closed system and including Ag and Li co-alloying, we report 13.5% efficiency for Cu2ZnSn(S,Se)4 based solar cells, and almost 11% efficiency for Cu2ZnSnS4 ones, both values among the highest reported ever. The effect of Ag and Li will be discussed, and future strategies for further improve the conversion efficiency will be also presented.

Biography:

Edgardo Saucedo received his PhD in Materials Physic at the Universidad Autónoma de Madrid in 2007. He holds 5 patents and has co-authored more than 260 papers (H-factor = 49). He has been involved in more than 50 Founded Projects and coordinated 5 European projects. In 2019 he was granted with an ERC-Consolidator (SENSATE), for the development of low dimensional materials for solar harvesting applications. He has supervised 13 PhD Thesis. In 2020 he has been awarded with the ASEVA-Toyota Award for his contribution to the development of sustainable photovoltaic technologies and the ICREA Academia Award in 2021.

Oilseeds and Products – Emerging Oil Processing Techniques, Current Trends and Contribution towards Renewable Energy Efficiency

Abraham Kabutey*, David Herák and Čestmír Mizera

Czech University of Life Sciences Prague, Czech Republic

Abstract:

Globally, oilseed crops are one of the largest commodity products produced, traded and consumed. Vegetable oils are generally produced from oil-bearing plants/crops. During the last few years, the worldwide production of vegetable oils has exceeded 200 million metric tons/year. Indonesia and Malaysia account for more than one-third of the world's vegetable oil production. The most consumed vegetable oils are palm, soybean and rapeseed. India is the number one importer of vegetable oil and the world's second-largest consumer after China followed by the

USA. Indonesia is the main driver for the increasing use of vegetable oil as feedstock for biodiesel in the world. The use of vegetable oil as feedstock for biodiesel depends on the policy setting and the relative price development of vegetable oil and crude oil. Agroindustrial by-products especially residual oilseed cakes and meals from vegetable oil extraction are available in large quantities and are explored as alternative protein sources or feed ingredients. In the vegetable oil extraction industry, emerging and green extraction technologies have been developed and are being designed to reduce the environmental impact by waste minimization, to decrease energy consumption and processing time and to avoid health hazards by substituting toxic and unsafe solvents with green solvents. Vegetable oils are one of the biomasses used as a source of energy. It can reduce GHG emissions in the transportation section which account for more than a fifth of GHG emissions in Europe. Minisingle screw pressing of selected oilseeds will be discussed in addition to the above information.

Biography:

Abraham Kabutey is an Associate Professor of Technique and Mechanization in Agriculture at the Department of Mechanical Engineering, Faculty of Engineering, Czech University of Life Sciences Prague, Prague, Czech Republic. Dr Kabutey's research is focused primarily on the Post-Harvest Processing of agricultural materials and products (investigation of the mechanical and rheological properties, oil extraction processes and energy requirement) useful for designing and developing energy-efficient processing systems. Dr Kabutey has a keen interest in global energy efficiency strategies (renewable energy sources) against climate change mitigation. Dr Kabutey has published considerable publications indexed in both Web of Science and Scopus.

Advanced Robust Control of Dynamic Virtual Power Plants for Renewables Contribution to Grid Ancillary Services

Bogdan Marinescu

Ecole Centrale de Nantes –LS2N

Abstract:

The concept of Virtual Power Plant (VPP) has arisen over a decade ago from the relatively low competitiveness of the back then emerging non-dispatchable Renewable Energy Sources (RES). A set of smaller generators imitates the behavior of large synchronous generators. So far, static aspects such as generation or slow dynamics have been of interest, as it is the case for the zonal secondary frequency control scheme in Spain, which can be viewed as a VPP. However, considering dynamic aspects is of high importance, especially to further increase the current penetration level of RES. For that, we have proposed a new concept called Dynamic VPP (DVPP) which fully integrates the dynamic aspects at all levels: locally (for each RES generator), globally (for grid ancillary services and interaction with other close-by elements of the grid) and economically (for internal optimal dispatch and participation in electricity markets). A DVPP is a set of dispatchable and non-dispatchable RES along with a set of common control and operation procedures. Original control architectures are proposed to ensure both local and grid voltage and frequency objectives. Solutions for centralized vs decentralized control synthesis and implementation as a trade-off between performances and resilience (no need of reconfiguration of controls in case of failure of one/some DVPP generators, plug-and-play facilities,...) are discussed. Validations and comparative studies have been done both in real-time simulation and hardware in the loop.This new DVPP concept is now under development in the H2020 POSYTYF project (https://posytyf-h2020.eu/).

Biography:

Bogdan Marinescu was born in 1969 in Bucharest, Romania. He received the Engineering degree from the Polytechnical Institute of Bucharest in 1992, the PhD from Université Paris Sud-Orsay, France in 1997 and the "Habilitation à diriger des recherches" from Ecole Normale Supérieure de Cachan, France in 2010.

He is currently a Professor in Ecole Centrale Nantes and LS2N laboratory where he is the Head of the chair "Analysis and control of power grids" - http://chairerte.ec-nantes.fr/home/ - (2014-2024) and the Coordinator of the POSYTYF H2020 RIA project - https://posytyf-h2020.eu/ - (2020-2023) and DREAM Erasmus Mundus Master - https://master-dream.ec-nantes.fr/ - (2021-2027). In the first part of his carrier, he was active in R&D divisions of industry (EDF and RTE) and as a part-time professor (especially from 2006 to 2012 in Ecole Normale Supérieure de Cachan). His main fields of interest are the theory and applications of linear systems, robust control and power systems engineering.

Effectiveness of the energy efficiency regulations on electricity saving and CO_2 emission reduction in the household sector: An ARDL model with time-varying coefficients and synergistic effects

Ching-Yu Li[1], Shin-Hang Lo[1], and Chung-Huang Huang[2*]

[1] Researchers at the Green Energy and Environment Research Laboratories (GEL), Industrial Technology Research Institute (ITRI), Taiwan

[2] President of the Greater China Financial and Economic Development Association, and Advisor of Taiwan Research Institute, Taiwan

Abstract:

The main objectives of this paper are twofold. Firstly, we critically reviewed the relevant literature and addressed the misleading results caused by spurious regression. Specific examples are as follow: (1) Empirical contribution of MEPS and ELS to electricity saving is counterfactual; (2) Estimate of price elasticity of electricity is time invariant and varies substantially across studies, ranging from 0 to -2.6; (3) The household's choice and use of appliances and equipment are not adequately modeled, leading to unjustifiable empirical results. Secondly, we developed a new model based on a household production function and characteristics demand theory that allows us to estimate both the demand for electricity and the demand for electricity services. Accordingly, an autoregressive distributed lag (ARDL) model was estimated that is characterized by time-varying coefficients and synergic effects among the key variables accounting for the growth of residential electricity consumption (REC). The empirical results exhibit robust estimates that allow us to evaluate the long-run equilibrium effects as well as the short-run dynamic impacts of key variables on REC.

Biography:

Huang received his Ph.D. in 1986 from the Department of Applied Economics at University of Minnesota, and then started his career as a professor at National Tsing Hua University (NTHU) in Taiwan. Immediately after his early retirement from NTHU in 2010, he joined Taiwan Research Institute as the Vice President in 2011, acted as the President of Taiwan Association of Environmental and Resource Economics in 2016, and now the President of the Greater China Financial and Economic Development Association.

Urban Heat Island and Pollutant Correlations in Bangalore, India using Geospatial Techniques

Aneesh Mathew[1]* and K.S. Arunab[2]

[1,2]Department of Civil Engineering, National Institute of Technology, Tamil Nadu, India

Abstract:

The interaction between Urban Heat Island (UHI) effects and urban air pollution significantly impacts urban ecology, climate dynamics, and inhabitants' well-being. This study delves into the relationship between UHI effects and various pollutants (CO, HCHO, aerosols, NO_2, O_3, and SO_2) across Bangalore from 2019 to 2022, exploring their spatial and thermal connections. Findings reveal notably higher pollutant concentrations in urban versus rural areas. The study establishes a positive correlation between UHI indicator and CO, HCHO, aerosols, NO_2, and O_3 in urban-rural settings. Conversely, a negative correlation is observed between UHI indicator and SO_2 in these settings, necessitating comprehensive analysis of the UHI-pollutant nexus. High-risk zones (HRZs) exhibit substantially higher annual average concentrations of NO_2 (by 66.614%), aerosols (by 13.610%), HCHO (by 8.816%), and CO (by 2.028%) compared to low-risk zones (LRZs). Ozone concentrations remain relatively comparable between HRZs and LRZs. Conversely, LRZs exhibit a higher annual average concentration of SO_2 (by 7.562%) compared to HRZs. Moreover, HRZs experience a higher Land Surface Temperature (LST) by 2.198 °C compared to LRZs. These observations provide critical insights for urban planning and policy formulation, offering a comprehensive understanding of UHI-pollution dynamics. By elucidating these dynamics, this research contributes to informed decision-making in mitigating the impact of UHI and pollution in urban environments.

Biography

Aneesh Mathew, an academician at NIT Tiruchirappalli, holds a B. Tech. in Civil Engineering from Mahatma Gandhi University (2011), an M. Tech. with a gold medal in Water Resources Engineering (2014), and a Ph.D. in Civil Engineering (2018) from Malaviya National Institute of Technology, Jaipur. As an Assistant Professor, his expertise spans water resources engineering, digital elevation models, remote sensing, GIS applications in water resources and climate change, urban planning modeling, urban heat island studies, and climate change. His dedication to research and teaching aligns with a fervent commitment to advancing sustainable solutions in civil engineering, encapsulating over a decade of diverse academic accomplishments.

Global Monitoring of Gas Flaring Using VIIRS Nightfire Satellite Remote Sensing

Tamara Sparks[1]*, Chris Elvidge[1], Mikhail Zhizhin[1], Tilottama Ghosh[1], Stephen Pon[1] and Feng Chi Hsu[1]

[1]Earth Observation Group, Payne Institute for Public Policy, Colorado School of Mines, USA

Abstract:

The National Oceanic and Atmospheric Administration (NOAA) Visible Infrared Imaging Radiometer

Suite (VIIRS) is unique in collecting five low-light imaging spectral bands at night. The most well-known of these is the day / night band (DNB), designed to image clouds at night based on moonlight. The other four low-light bands are in the near and shortwave infrared. With sunlight eliminated, infrared emitters can be readily detected. We developed the VIIRS Nightfire (VNF) algorithm to detect infrared emitters and fit Planck curves to calculate their temperatures, source sizes, and radiant heat worldwide. Three VIIRS instruments are in orbit, each observing nearly the entire globe nightly around 1:30am local time, and records go back to 2012, providing extensive global and temporal coverage for study. One application of VNF is global mapping and monitoring of gas flares. Flared volumes are calculated using a calibration between radiant heat and reported flaring volumes from multiple flares. A catalog of persistent IR emitters active between 2012-2021 was developed and contains around 15,000 gas flares. Detection count thresholds were employed to exclude transient IR emissions such as biomass burning, and temperature thresholds along with visual identification of satellite imagery were used to separate gas flares from other industrial sites. Temporal profiles of all sites on nightly, monthly, and annual time scales were developed to monitor changes in flaring activity since 2012. With a global push to eliminate routine flaring, VNF can be used to identify high flaring locations and is an independent check against reported flaring volumes.

Biography:

Tamara received a Ph.D. in Physical Chemistry from the University of California, Berkeley, where she specialized in studying urban air quality, investigating the effect of nitrogen oxide chemistry on air pollution. After graduating, she spent two years at the California Department of Public Health studying the composition of particulate matter in wildfire smoke and modeling the spread of SARS-CoV-2 via exhaled droplets. In 2021, she joined the Earth Observation Group at Colorado School of Mines to work on the VIIRS Nightfire (VNF) product, studying gas flares and other IR emitters with satellite remote sensing.

Combustion Modeling of Hydrotreated Vegetable Oil (HVO) in a Compression Ignition Engine

Samy Alkhayat[1]*, Manan Trivedi[2] and Naeim Henein[3]

Wayne State University, Detroit, MI, USA

Abstract:

Renewable diesel, also known as Hydrotreated Vegetable Oil (HVO), received more attention from the research community in the recent years. The developed surrogates in a previous investigation were shortlisted to a binary HVO surrogate that was chosen for further investigation. In this research, we introduce a combustion model in the CFD space incorporating the detailed chemistry solver (SAGE). The skeletal mechanism of the binary surrogate is optimized from the CRECK modeling detailed mechanism using the DRGEP reduction method. For validation, we designed a test matrix that sweeps a wide range of engine loads, at constant speed, with the relevant conditions of injection strategy and intake conditions. We used the production Engine Control Module of a GenSet diesel engine to run the experiments for validation of the combustion model, in which we replicated the exact conditions of the experimental tests. The model shows high fidelity at low loads and high loads as quantified by ignition delay and indicated mean effective pressure.

Biography:

My name is Samy Alkhayat, and I received my MSc and Ph.D. degrees from Wayne State University. Specialization in Diesel combustion, developing and modeling of surrogate fuels and optimizing their skeletal kinetic mechanisms. I joined Cummins Inc. as Aftertreatment Integration Technical Specialist in 2021. My research interests include investigating renewable diesel combustion and optimization of its kinetics to use in CFD simulation.

Enhanced electrocatalytic hydrogenation of biomass-derived organics at solid/liquid interface

Mal-Soon Lee[1,2]

[1]Pacific Northwest National Laboratory, USA; [2]TU München, Germany

Abstract:

A major challenge in today's energy industry is to eliminate the carbon and environmental footprint associated with the use of petroleum while meeting the growing demand for fuels, power and chemical products. Electrocatalytic conversion of biomass-derived feedstocks is one of the most promising approaches to effectively recycle carbon from renewable energy resources. To maintain the economic viability of this target technology, the rational design of electrocatalysts with high activity and selectivity for the production of fuels and fine chemicals is required. In order to improve electrocatalytic conversion, it is crucial to understand and control the aqueous phase catalytic hydrogenation of organic compounds on metals. In contrast to gas-phase hydrogenation, the solid/liquid interface plays a critical role in catalysis in the presence of water. Although electrocatalysis has been extensively studied, mechanistic investigation and molecular understanding of the electrochemical conversion of organic compounds specific to biomass feedstocks is lacking. In this talk, we will address the effect of solvent and the charged metal electrode on the reaction pathways and their ability to undergo reduction/hydrogenation. Results of molecular-scale structural/electronic properties near the electrochemical interface and reaction energetics of target organic compounds obtained from density functional theory (DFT) based ab initio molecular dynamics (AIMD) simulations will be presented. The conclusions will be used for the postulation of design criteria for the electrocatalytic conversion of organic compounds from an experimental and theoretical perspective.

Biography:

Mal-Soon Lee is a senior scientist at Pacific Northwest National Laboratory, USA. She has been working in the field of computational physics/chemistry with an emphasis on studying dynamics and reactions at complex interfaces, confined systems, and liquid phases. Her areas of application include catalysis, thermo-/electro-catalysis, battery materials, surface science, and polymer upcycling. To understand the reactivity of homo- and hetero-phase materials, large-scale high-performance computing techniques such as ab initio molecular dynamics combined with enhanced sampling techniques are employed. With obtained data, various statistical mechanics techniques are applied to calculate reaction enthalpies/entropies, spectroscopies, which can be directly compared with experimental observations.

FEED Study of CarbonCapture Inc. DAC and CarbonCure Utilization Technologies Using United States Steel's Gary Works Plant Waste Heat

Leslie Gioja[1] *, Bajio Varghese Kaleeckal[1] , Kevin Obrien[1,2,3], Patricia Loria[5] , Meghan Kenny[5], Alberto Baumeister[6] , Kevin Cail[7] , Ryan Cialdella[8] , Brenda J. Petrilena[9]

[1] University of Illinois at Urbana Champaign – Illinois Sustainable Technology Center, USA;

[2] Illinois State Water Survey, USA;

[3] Nuclear Plasma and Radiological Engineering - UIUC, USA;

[5] CarbonCapture Inc., USA;

[6] Ecotek, USA;

[7] CarbonCure Technologies, USA;

[8] Ozinga, USA;

[9] US Steel Corp., USA

Abstract:

The University of Illinois Urbana-Champaign (UIUC) is spearheading a front-end engineering design (FEED) study of a Direct Air Capture and Utilization System (DACUS) that can remove 5,000 tonnes/yr net CO2 from ambient air, utilizing it in the production of concrete. The designed system, if built, would be larger than any currently existing DAC collector. Such carbon negative technologies are critical to meeting the goals of the DOE's program to accelerate climate-critical technology. DAC is a promising new technology for reducing the greenhouse gas in the atmosphere but is expensive, partly due to the energy required to capture and then release CO2 during the process. By integrating CarbonCapture Technologies Inc. DAC collector at United States Steel's Gary Works and utilizing steel plant's waste heat, energy, and location so energy & transportation costs can be minimized. CarbonCapture has developed an innovative DAC system using novel adsorbents to costeffectively capture CO2. The captured, liquified CO2 will be trucked to ready-mix concrete plants across Illinois, Indiana, & Wisconsin, where CarbonCure will inject it into concrete during the mixing process. The carbon dioxide reacts with concrete, mineralizing into calcium carbonate (CaCO3), sequestering the CO2 into the concrete, and reducing the amount of cement, the manufacturing of which is among the major sources of CO2 emissions. This FEED study demonstrates a full CO2 value chain for DACUS from industrial facilities. It also provided an opportunity to assess the impact of this holistic approach on job creation, regional economic impact, and environmental justice.

Flash Chemistry Guided by Flow Microreactor Research

Aiichiro Nagaki

Hokkaido University, Japan

Abstract:

Many successful applications reported in the literature speak well for the power of the flow-microreactor method in chemical synthesis. The reaction time in a flow microreactor is defined as the residence time between a reagent inlet and the quencher inlet, which can be controlled precisely and reduced to millisecond order by adjusting the length between these positions and the flow speed. Such a feature of flow microreactors enables the use of short-lived highly reactive intermediates for synthesis. Various chemical reactions using highly reactive short-lived organolithium species that are difficult or even impossible to perform in batch processes can be accomplished in flow microreactors using space integration of reactions. In this presentation, we slow our recent results to various synthetic reactions mediated by organolithium reagents based on flash chemistry conducted in flow reactors, especially utilizing space-integration of the flow reactions.

Biography:

Aiichiro Nagaki, now is a professor of department of chemistry, faculty of science, hokkaido university. Aiichiro Nagaki graduated from Doshisha University in 2000. He received his PhD in

2005 from Kyoto University under the supervision of Professor Junichi Yoshida. He worked with Professor Hiroaki Suga, Tokyo University, from 2005 as a postdoctoral fellow. In 2006, he became an assistant professor of Kyoto University. He was promoted to a junior associate professor in 2013, an associate professor in 2018 and became a full professor of Hokkaido University in 2022. He His current research interests are organic synthesis and microreactor synthesis. Awards: Takeda Pharmaceutical Co., Ltd. Award in Synthetic Organic Chemistry, Japan (2012), Incentive Award in Synthetic Organic Chemistry, Japan (2012), and Young Innovator Award on Chemistry, Micro-Nano Systems (2013), ESPEC Prize for the Encouragement of Environmental Studies (2013), Flow Chemistry India 2014 Distinguished Presentation Award (2014), and SSOCJ Tosoh Award for Environment and Energy (2022).

Production of Zeolites by Conversion of Kaolin for Application in the Process of Catalytic Cracking in Fluidized Bed

TERESA MATOSO M. VICTOR* **and OSÓRIA MOURISCA D. DE CARVALHO**

ISPTEC, Luanda, Angola

Abstract:

The Fluidized Catalytic Cracking (FCC) process of petroleum is employed in the petrochemical industry to transform the heavy fractions of distillation residues into light products with higher demand and added value, such as gasoline and LPG. The FCC process employs zeolite catalysts to promote molecular cleavage reactions and is therefore a heterogeneous catalytic process. The main zeolite used in the process, type Y, has a crystalline structure and well-defined pores. Therefore, this work has as main objective the production of Y zeolites by adaptation of the standard method IZA. Given the different and main forms of zeolites production, such as the Hydrogel process and conversion of kaolin tailings, the second option was chosen due to the fact that it presents greater product stability and efficiency. In view of the elaboration of the block diagram involving the mass balance, it was necessary to define a nominal capacity resulting in 1225 ton/day of zeolite Y. The economic viability analysis showed that the company will have an annual revenue of 6,706,875,000 USD/year and the indicators (VPL, TIR, TL and Payback) proved that the implementation of the factory in Angola is possible and feasible.

Keywords: Heterogeneous catalyst, FCC process, zeolite y, kaolin.

Biography:

Teresa Matoso M. Victor, studied Chemistry with Chemical Engineering at Northumbria University, United Kingdom 2001 and graduated 2004 with MSc in Sustainable Chemical Engineering, University of Newcastle upon Tyne, United Kingdom. She then joined research group of Prof. Galip Akay and Prof. Alan Ward, School of Chemical Engineering and Advanced Materials for her PhD, during her studies, invented a micro-porous inert material. She obtained PhD in Chemical Engineering, with a multidisciplinary project encompassing the areas of Chemical Engineering and Biotechnology, defended thesis 2008. Currently associate professor and Researcher at the Higher Polytechnic Institute of Technologies and Sciences, Luanda, Angola.

Long-term impact of the extraction of fossil energy sources on the surface environment

Andre Vervoort*

KU Leuven, Belgium

Abstract:

The extraction of all fossil energy sources leads to a redistribution of stresses in the earth's layers and thus to deformation of the rock. The environmental impact differs depending on the type of raw material and the extraction conditions. The relevance of the impact is significantly influenced by the surface conditions, e.g., inhabited or uninhabited area. One aspect of this impact is the downward surface movement or subsidence. It is usually believed to be limited in time, i.e., during the extraction and for a short period afterwards. The analysis of satellite remote sensing data (InSAR) makes it possible to study surface movements over several decades and to quantify the long-term environmental impact. This finding is highly relevant for proper sustainable management of resources.

In this study, the focus is on the surface movements above old coal mines in Europe, which were flooded after the closure of the underground access (around 1990). The satellite data shows that (i) residual subsidence is observed during several decades after mining (average rates of about 10 mm/year) and (ii) the surface starts to rise after the flooding of the underground infrastructure and rock mass (similar rates as for the residual subsidence). The upward movement is not a simple rebound of part of the previous subsidence. The critical zones for damage to buildings and infrastructure can as a result differ. An analytical model was developed, allowing a correct interpretation and understanding of the observations.

Biography:

André Vervoort studied mining engineering (KU Leuven, Belgium) and obtained his PhD summa cum laude from FPMs, Belgium in 1987. His doctoral research dealt with a ground control problem of deep coal mines in Europe. From 1988 to 1992 he worked for the COMRO research center, South Africa. Since 1992 he has been a professor at the University of Leuven, Belgium. He teaches courses on rock mechanics, mining methods and aspects of sustainable development. His research focuses on ground control issues and their impact on safety and sustainable development. André Vervoort published more than 250 articles.

Development of Off Grid Charging Stations for Electric Vehicles

Matthew Smith[1*], Mobin Naderi[1], Diane Palmer[1], Daniel Gladwin[1], David Stone[1], Ewan Fraser[2], Andrew Cruden[2]

[1]University of Sheffield, UK; [2]University of Southampton, UK

Abstract:

Decarbonising road transport by switching to electric vehicles is a critical component to limiting the effects of climate change. By transitioning from internal-combustion powered vehicles to electric alternatives the use of fossil fuels and the environmentally damaging emissions caused by their consumption can be significantly reduced. Whilst there has been much progress in the development of EVs, to the point where many auto manufacturers are now mass producing fully electric vehicles, and public adoption is increasing rapidly, charging, and the infrastructure to support charging remain a challenge.

Charging EVs places significant demands on the electricity supply grid that were not envisioned

when originally installed. Further, the need for national networks of charging stations to service the increasing fleet of EVs means that huge amounts of the electricity supply infrastructure nationwide will need to be upgraded to meet the increased demand now being placed on them by EV charging. To overcome these challenges in a timely manner fully off grid charging stations will be required.

Through a new five-year Programme Grant the FEVER (Future Electric Vehicle Energy networks supporting Renewables) project aims to design, develop and demonstrate at scale an off grid charging station using fully renewable generation sources. This presentation will provide an overview of the project and discuss the challenges and design considerations surrounding such a system. Initial modelling of the projected renewable generation and EV load demand will be presented along with an analysis of the energy storage options available to bridge the gap between supply and demand.

Biography:

Matthew Smith is a Research Associate in the Centre for Research into Electrical Energy Storage & Applications Group of the Electrical & Electronic Engineering Department at The University of Sheffield, UK. He graduated from the University of Sheffield with a Master's Degree in Digital Electronics in 2014 and obtained his PhD from the University of Sheffield in 2018. His research interests include Power Electronics, Electrical Energy Storage & Management and Battery Performance. Specifically, his work examines factors affecting the lifetime and performance of batteries within energy storage and automotive applications and battery testing methodologies and procedures.

A combined application of solar and wind energy towards decarbonization in the Philippines

Ruth Anne Gonocruz[1*], Yoshikuni Yoshida[2], Nathanael Silava[3], Rodolfo A. Aguirre, Jr.[3], Edward Joseph H. Maguindayao[3], Akito Ozawa[1], Jairo Vazquez[1]

[1]National Institute of Advanced Industrial Science and Technology (AIST), Japan;

[2]Department of Engineering, The University of Tokyo, Japan;

[3]Department of Electrical Engineering, College of Engineering and Agro-Industrial Technology, University of the Philippines Los Baños (UPLB)

Abstract:

With an emphasis on decarbonizing electric power systems, increasing renewables has drawn much interest in raising the percentage of renewable energy in the Philippines. Instead of building transmission lines, the usage of batteries was taken into consideration due to the Philippines' archipelagic geological position. The optimization of the power generating mix model employs linear programming with a temporal resolution of 8760 hours per year, taking into account the capacity of each generator and transmission line in each region of the Philippines. According to the simulation, solar, wind and/or battery power generation integrated simultaneously yields a greater impact on the grid. Increasing the utilization of renewables such as solar and wind up to a 15-fold increase can lead to a 28% share of the energy mix. Consequently, carbon emissions may be reduced which is in line with the country's declared plan to reduce coal consumption. This research could present a picture of the combined integration of solar and wind into the Philippine electricity industry that is theoretically viable.

Biography:

Ruth Anne Gonocruz is a researcher at the National Institute of Advanced Industrial Science and Technology in Tsukuba, Japan. Her research experiences involved power grid modeling of a large-scale integration of renewable energies, particularly photovoltaics and wind energy, in Japan and the Philippines, emphasizing its possible economic and environmental impacts. She is keen on practicing energy management principles, monitoring and analyzing energy processes and flow mapping, and identifying factors influencing the power grid to minimize energy costs, energy consumption, and efficiency.

Techno-economic feasibility assessment of lipases production by solid-state fermentation from agroindustrial residues in a pilot tray bioreactor

Itamar Souza Reges[1], Cilene Reges Mendes[1], Lucas Cunha Borges[1], Dante Ijarma Martins de Moraes[1],Cristian Orlando Avila[2], Fernanda Perpétua Casciatori[3], Lina María Grajales[4*]

[1]Federal University of Tocantins (UFT), Food Engineering Course, Brazil;

[2]Federal University of Tocantins (UFT), Graduate Program of Regional Development, Brazil and Universidad Nacional Abierta y a Distancia (UNAD), Administrative, Accounting and Business Sciences School, Bogota, Colombia;

[3]Federal University of São Carlos (UFSCar), Graduate Program of Chemical Engineering, Brazil;

[4]Federal University of Tocantins (UFT), Graduate Program of Digital Agroenergy, Brazil.

Abstract

Lipases are used as biocatalysts for the biodiesel production. However, lipases production is still an expensive process. According to the literature, the filamentous fungus *Metarhizium anisopliae* is a good lipases producer by solid-state fermentation (SSF). Considering the region where this work was carried out, babassu agro-industry is nowadays prominent. However, its potential remains unexploited due to the lack of scale and production structure. In this study, the *M. anisopliae*-babassu bagasse microorganism-substrate binomial is considered a promising lipase-producing system. The objective of this work was to conduct an economic pre-feasibility analysis of extracellular lipases from the fungus *M. anisopliae* by SSF using babassu coconut bagasse as substrate in a pilot-scale tray bioreactor. To achieve this goal, the research was divided into two stages. In the first stage, lipases were produced in the pilot scale tray bioreactor. In the second one, previously gathered information was used to calculate the tray-biorreactor lipases production monthly. The estimated monthly production was then used to analyze the costs based on Milton Friedman's price theory. Results showed that, under the operating conditions analyzed, the production cost of the lipase was $ 52.2 for a 500mL unit. In contrast, the current commercial price for the lipases enzymatic extracts is $ 157.24 per 500mL unit. As it can be concluded, the technology used for the lipolytic enzymes production may be promising. Nevertheless, a market analysis on the real competitive price must be carried out.

Biography:

Chemical Engineer, graduated from the National University of Colombia, UNAL. She holds a Master's and Doctoral degree in Engineering and Food Science from São Paulo State University, UNESP. She has a postdoctoral internship in Chemical Engineering at UNAL. She is a professor at the Federal University of Tocantins, UFT, in the undergraduate program of Food Engineering and in the graduate program of Digital Agroenergy. She is coordinator of the Support Group for Foreign Students. She coordinates the Bioreactor Engineering Research Group. Her area of expertise is the development of rotary drum and fixed bed bioreactors for solid-state fermentation aimed at biofuel production.

Temperature derived Fe dissolution of a LiFePO4/graphite cell under fast charging condition

R. Prakash

Centre for Automotive Energy Materials, International Advanced Research Centre for Powder Metallurgy and New Materials (ARCI), India

Abstract:

Lithium ion batteries have seen striking growth in the last few years due to the booming of electric vehicle market share. Lithium-ion batteries are dominated by transition metal oxides, phosphates and spinel cathodes, which are known to undergo rapid capacity fade due to the synergistic effect of transition metal dissolution and lithium plating, especially at higher operating voltages and at elevated temperatures. However, solutions to mitigate these issues are unavailable largely due to the incomplete understanding of the complexity of the capacity fade mechanism at high state-of-charge and fast charging rates. Herein, we provide a comprehensive experimental evidence linking to the high cell temperature as the main origin of Fe dissolution in the LiFePO4/graphite cell. After 400 complete charge-discharge cycles at 4C, Fe dissolution is accelerated and is shortly followed by deposition of Fe on graphite anode, and subsequent formation of Fe-catalyzed solid electrolyte interface layer at the anode. The dissolution-deposition process accounts nearly 17% of the capacity loss against the initial capacity as evidenced by the experimental results. These details will be discussed during the presentation.

Biography:

Prakash obtained his PhD (Chemistry) in 1999 at Central Salt and Marine Chemicals Research Institute, Bhavnagar, India. He completed his PostDoc (1999-2003) and Research Scientist (2003-2006) positions at University of Erlangen-Nuernberg, Germany. From 2007 to 2011 he worked as Senior Research Scientist at Karlsruhe Institute of Technology, Germany. In Jan-2012, he joined as Senior Scientist at International Advanced Research Centre for Powder Metallurgy and New Materials (ARCI), Chennai. Currently he is Scientist-F and Head of the Centre for Automotive Energy Materials at ARCI Chennai. His research interest is the development of lithium ion batteries for electric vehicles and ESS. He developed 4 technologies, got 10 international patents, published >50 research articles, 2 book chapters, and delivered over 40 invited talks and presented 75 conference papers.

Hydrogen Technology for Supply Chain Sustainability: The Mexican Transportation Impacts on Society

Marisol Rico Cortez

Jonkoping University, Sweden

Abstract:

Not Available

Bioelectrodes and light-activated devices based on [FeFe] hydrogenases

Francesca Valetti*

University of Torino, Italy

Abstract:

Recent progress in the recombinant synthesis of [FeFe]-hydrogenases has significantly advanced their utilization in H_2 production for the purpose of clean energy storage. [FeFe]-hydrogenases have demonstrated remarkable catalytic abilities in diverse in vitro devices. These devices can directly generate hydrogen from water, employing methods such as water electrolysis or light-driven mechanisms. Consequently, this allows the direct storage of solar energy in the form of hydrogen. The optimization of integrating [FeFe]-hydrogenase with electroactive materials, including carbon-based substances, metals, or semiconductors, holds crucial importance for leveraging this biocatalyst in hydrogen production. This optimization aims to establish effective coupling with other sustainable sources of electrons and protons, contributing to the overall efficiency and viability of the process. TiO2-based electrodes have been successfully demonstrated to adsorb [FeFe]-hydrogenases efficiently, resulting in the formation of stable bio-electrodes through potential electrostatic interactions. Experiments were conducted in our lab using anatase nanostructured electrodes with variations in particle size and layer thickness. The application of a polymer film of Nafion, known for its effective proton exchange properties, contributed to enhancing protein stability, limiting desorption, and maintaining a current density of approximately 0.1 mA/cm2. Further advancements were achieved by testing new and more efficient [FeFe]-hydrogenases. This resulted in improved performance in H2 evolution for TiO2–enzyme hybrid systems, yielding bio-electrodes with exceptionally high Faradaic efficiency (98%) and enhanced stability over time. Further experiments included photo-activation of doped-TiO2 interfaced [FeFe]-hydrogenases. An overview will be presented [1].

[1] Morra, Valetti, Gilardi*[FeFe]-hydrogenases as biocatalysts in bio-hydrogen production (2017) Rendiconti Lincei, 28, 183-194

Biography:

Associate Professor of Biochemistry at University of Torino, PhD in protein Chemistry. Research: [FeFe]hydrogenases discovery and engineering. Biohydrogen production from waste. Biocatalysts for biofuels, CO_2 capture, green processes and bioremediation. Scientific track record: Author of 41 indexed publications, 1 patent. H-index:18, i10-index:24, 775 citations (source: Scopus), https://orcid.org/0000-0002-8380-595X, Invited speaker at 6 congresses and 2 residential PhD Schools. Associate Editor of Biotechnology and Applied Biochemistry (Ed. Wiley), Guest Editor of Special Issue "Biofuels Production from Renewable Resources" Biotechnology and Applied Biochemistry (2020) Volume: 67. Guest editor for Frontiers in Microbiology 2021-2022 (Special issue: "Hydrogenase: structure, function, maturation, and application").

Facile synthesis of a binder-free 3D Ni/NiO microwire network for Li-ion batteries

Mikhail Morozov

Kazan National Research Technical University named after A.N. Tupolev-KAI, Russia

Abstract:

The increasing demand for advanced electric vehicles and efficient energy storage requires a major improvement of the rechargeable battery technology in terms of energy and power densities, safety and reliability. One of the ways to face this grand challenge is the possibility to apply metal oxides

instead of graphite, with the final goal to provide better safety, and significantly increase capacity of the Li-ion battery. In contrast to the broadly researched titanium dioxide polymorphs, nickel (II) oxide (NiO) has a higher theoretical capacity (718 mAh/g). It is shown that nickel microwires can be as effective scaffolds for anodes of li-ion batteries. Binder free Ni/NiO microwire hybrid network with a nanostructured surface is synthesized by employing a facile and low-cost method, involving one-pot synthesis of Ni microwires, followed by their partial oxidation in air atmosphere. A combination of imaging, diffraction, thermodynamic and electrochemical methods has been applied to reveal the impact of the synthesis conditions on the energy storage performance of the Ni/NiO microwire networks. The performed electrochemical characterisation of the materials has shown that setting a low temperature for the synthesis enables high reversible capacity and better cycling stability of the binder free materials. When the Ni/NiO network structures are deposited by a conventional slurry-based technology, involving polymer binder and conductive additive, the high capacity and cycling stability of the anodes are preserved. The presented approach may have wide applications in electrochemistry, especially for creation of electrodes for next-generation rechargeable batteries and for electrocatalysis.

Biography:

Mikhail Morozov is an Associate Professor in Chair of Nanotechnologies in Electronics at Kazan National Research Technical University named after A.N. Tupolev-KAI (KNRTU-KAI), Kazan, Russia. He has 14 years of research experience and his areas of interest includes materials science, synthesis of nickel-based nanostructured microwires for next generation rechargeable batteries and electrocatalysts. He has established his research group and research laboratory. He was a visiting researcher in several prestigious German universities.

Geologic Energy Storage – Past Present and Future

Avinoam Rabinovich

Tel Aviv University, Tel Aviv, Israel

Abstract:

Reaching global net zero CO2 emissions requires a transition to renewable energies, among other technologies. The intermittency of renewables must be overcome by implementing energy storage methods such as compressed air, CO2, hydrogen and other gas energy storage techniques. Geological formations such as saline aquifers or depleted gas reservoirs have a large storage capacity and have been used historically for storage of natural gas, making them possible candidates for storage sites. This presentation will lay out the history of geologic energy storage, current standpoint and the future prospects. The importance of modeling the gas distribution in the subsurface will be emphasized and discussed. Recent work on modeling of coreflooding experiments of CO2-brine from cores extracted from candidate sites will be presented.

Biography:

Avinoam Rabinovich obtained a B.Sc. in Geophysics and Mathematics (2007), an M.Sc. in Geophysics (2010) and a Ph.D. in Mechanical Engineering (2014) from Tel-Aviv University. He then became a postdoctoral researcher in the department of Energy Resources Engineering at Stanford University. Since 2016 he is a faculty member at the School of Mechanical Engineering, Tel Aviv University and the head of the Subsurface Reservoir Flow Research Group. Dr. Rabinovich is interested in subsurface flows pertaining to groundwater, CO2 sequestration, and other environmental applications.

Smart Grids as enabler of the Energy Transition: Future trends

Andrés Llombart Estopiñán* and Samuel Borroy Vicente*, Aníbal Prada Hurtado*, Noemí Galán Hermández*

*Fundacion CIRCE, Parque Empresarial Dinamiza, Avenida Ranillas 3-D, Spain

Abstract:

The relentless penetration of renewable energies is challenging traditional electrical grids in several ways. Besides the bidirectional flow of electricity, the intermittent nature of renewables and the different dynamic behavior against short-circuits induce frequency and voltage instability, leading to malfunctions in conventional protection schemes. Furthermore, certain nodes within the grid experience saturation due to high renewable integration, resulting in curtailment, thus reducing the effective utilization of clean energy resources.

Smart Grids, equipped with advanced digitalization, novel protection systems, and energy storage solutions, present a promising avenue to overcome these challenges. The digital transformation of electrical networks enhances real-time monitoring and control, ensuring stability despite the intermittent renewable inputs. New protection schemes are pivotal to prevent malfunctions and ensure system reliability amidst the fluctuating nature of renewable generation. Energy storage systems act as a buffer, absorbing excess generation and supplying during demand peaks or low generation intervals, thereby significantly reducing curtailment instances.

Moreover, the virtualization of control and protection systems, alongside innovative planning tools capable of performing precise curtailment calculations due to grid saturation, are integral for optimizing grid operations. These advancements facilitate a more seamless integration of renewables, thus fostering a sustainable energy transition.

This paper elucidates the potential of Smart Grids in addressing the identified challenges, exploring how these contemporary solutions enable a robust, efficient, and more sustainable energy infrastructure capable of accommodating the evolving energy landscape.

Biography:

Llombart, Industrial Engineer (1994) and PhD in Industrial Engineering (2000) University of Zaragoza. He is the CEO of Fundacion CIRCE since April 2016 and former Executive Director since January 2011. He was also a lecturer of the Electrical Engineering Department at University of Zaragoza since June 2003 to May 2018.

He has participated in more than 35 R&D+i projects. Author of 15 articles in indexed journals and more than 50 contributions in international conferences.

Fault diagnosis of PV systems based on percentage scatter plot by standard neural network

Cherifa KARA MOSTEFA KHELIL[1]*, Badia AMROUCHE[2] , Kamel KARA[3]

[1]Technology department, Djillali Bounaama, Khemis Miliana University, BP 44225, Ain Defla, Algeria

[2]Renewable Energies Department, Blida 1 University, BP 270 Blida, Algeria

[3]SET Laboratory, Electronics Department, Blida 1 University, BP 270, Blida, Algeria

Abstract:

Fault detection and diagnosis of grid-connected PV systems is becoming today's hot topic, with the aim of ensuring the stability, reliability and quality of PV systems. To this end, many researchers around the world approach this topic carefully using different methods, some of them are based on the output measurement data of the setup, others are focused on the output I_V curves and P_V, while for modern approaches are based on the different methods of Artificial Intelligence. The present approach is based on one type of Artificial Intelligence which is the fault diagnosis of grid-connected PV systems based on the standard neural network. The developed model requires four input data: solar irradiation, temperature of the PV module, current and voltage of the PV generator. The faults treated in this approach are the classification between healthy cases, short-circuit case and open-circuit case. The validation of the proposed model used real data from the experimental setup of a small gridconnected PV generator (PVG). The first step of this approach took into consideration the performance of the smart output by the comparison with real measured output data from the setup using the residual criteria RMSE, MAPE and R2, the second step is to diagnose the PV system by the employment of the linear percentage scatterplot based on a standard neural network. The obtained results showed an extraordinary output diagnosis with high accuracy in a short response time.

Biography:

Cherifa KARA MOSTEFA KHELIL, I am Algerian, I am teacher at Khemis Miliana University in Algeria and researcher at Blida 1 University in SET Laboratory, I have a Phd degree, the theme of my research is Diagnosis of Photovoltaic systems. I have two publication's article in Elsevier under the title "New Intelligent Fault Diagnosis (IFD) approach for grid-connected photovoltaic systems " and " The impact of the ANN's choice on PV systems diagnosis quality" and two other publication's article, in addition to different International Conferences that you can find in research gate.

In-silico prediction of the organic solar cells' performances

Alessandro Landi* [1], Daniele Padula[2], Andrea Peluso[1]

[1]Dipartimento di Chimica e Biologia, Università degli studi di Salerno, Fisciano (SA), Italy;

[2]Dipartimento di Biotecnologie, Chimica e Farmacia, Università di Siena, Siena, SI, Italy

Abstract:

Organic solar cells (OSCs) offer significant advantages over silicon devices, because of their lower costs, easier processability, improved mechanical properties, and chemically-tuneable electronic properties. The identification of novel donors and acceptors boosted up the power conversion efficiency (PCE) up to 18% for bulk heterojunction (BHJ) OSC; however, this value is still lower than their inorganic counterparts, thus hindering their commercialization. Theoretical studies have the potential to play a key role in the quest for higher PCE, since determining structure-property relations can lead to the identifications and possibly the complete in-silico design of new materials with improved properties. Since the overall OSC efficiency depends on the rates of several elementary charge transfer processes which can take place at the donor/acceptor (D/A) interface (e.g. photoinduced hole and electron transfer, excitation energy transfer, and charge recombination), reliable and fast protocols for evaluating such rates from first principles are needed. In this respect, we have developed a protocol where Fermi's Golden Rule rates for the processes occurring at the interface are computed on a reliable morphology obtained through molecular dynamics simulations. We have applied this protocol over four D/A blends, representative of different ranges of efficiency and featuring different donors and either fullerene or non-fullerene acceptors, providing a simple rationalisation of the different PCE: the slower charge recombination for D/A blends with higher PCE leads to a higher ratio between charge dissociation and charge recombination rate.

Biography:

Alessandro Landi co-authored more than 40 peer-reviewed papers (h-index 14; citations > 450; Ph.D. in Chemistry awarded in 2019). His main research interests are: (i) the theoretical modelling of charge transfer in organic semiconductors, aiming at the development of new strategies to shorten the computational time without affecting the accuracy of the results; (ii) the combination of quantum and classical models to study organic materials coupling electronic and ionic charge transport; (iii) the prediction of the absorption band-shapes of organic dyes and (iv) the kinetics of non-radiative processes occurring in bulk or in solution.

Keg wine, a sustainable innovation

Stephanie Pougnet Rozan*

EHL Hospitality Business School, HES-SO, University of Applied Sciences and Arts Western Switzerland

Abstract:

So far, the wine industry has continuously relied on heavyweight glass packaging, which has a considerable carbon footprint due to water and energy demand. Yet, growing concerns about the impact of environmental challenges on wine production, distribution and consumption are pushing the wine industry to search for sustainable solutions. To make the wine industry more sustainable, how about a plastic reusable keg? Our research shows that on top of wine quality preservation, the plastic reusable keg with an airtight pouch inside that we developed and tested reduces storage volume and weight, resources consumption and wine waste. To assess the benefits of keg wine, an LCA has been done comparing wine distributed in reusable kegs or in glass bottles. Primary data were collected from the keg designer and retailer. Six indicators of the ILCD 2011 Midpoint+ method were considered as relevant for this study : Climate change, Acidification, Marine eutrophication, Freshwater ecotoxicity, Water resource depletion and Mineral, fossil & renewable resources depletion. The results show an environmental benefit of the reusable keg over the glass bottle overall. A shift from aluminum multilayer to plastic multilayer pouch and from single use to washable pouch head could improve these results. Market study results and oenological research results are also in favor of keg wine. Therefore, in order to comply with a triple economic, ecologic and social purpose, a sustainable wine industry should consider keg wine as a mean to incorporate management of product quality economics, waste and carbon footprint, and human resources.

Biography:

Pougnet is Associate Dean of Undergraduate School and Teacher in People Management at EHL Hospitality Business School, HES-SO, University of Applied Sciences and Arts Western Switzerland. She has management, start-up creation and consulting experience in retailing, energy, and restaurant industries in Europe, America and Asia. Her research focuses on innovative processes impacting employee performance. Her keg wine research included market studies that she led, oenological tests done by Changins School of Viticulture and Oenology, an LCA conducted by the French Wine and Vine Institute (IFV), and the contribution of Bibarium and CGS-Ecofass, respectively a wine distributor and a keg-maker.

Leveraging IoT Technology for Enhanced Microgrid Control: A General Analysis

Jianchuan Tan

Pacific Northwest National Laboratory, USA

Abstract:

This presentation will discuss the transformative impact of Internet of Things (IoT) technology on microgrid control systems. Microgrids, being decentralized energy networks, face challenges in maintaining stability and efficiency. The integration of IoT offers a solution by enabling real-time monitoring, communication, and data analytics. Through interconnected devices and sensors, IoT facilitates dynamic control of distributed energy resources, allowing for optimal energy management within the microgrid. This presentation explores the role of IoT in improving microgrid controls, emphasizing its ability to enhance responsiveness, reliability, and adaptability in the face of evolving energy landscapes. The findings underscore the potential of IoT technology to revolutionize microgrid operations, contributing to greater sustainability and resilience in the broader energy infrastructure.

This presentation will review IoT implementations and applications in the microgrids, including:

- The DOE roadmap of microgrid improvements.
- The status of microgrid control strategies.
- Typical platforms and application layers, as well as mainstream implementation schemes.
- IoT use cases resulting in enhanced microgrid performances and energy resilience.
- Current knowledge gaps.

Biography:

Jianchuan Tan (JT) joined PNNL as a Systems Engineer in 2021 and works in the Building Science Group. He is a Ph.D. from Rensselaer Polytechnic Institute, with areas of expertise in Lighting and Architectural Science. He is a PMP, LC, WELL AP, and Microsoft Power BI data analyst. His works are mainly on lighting research, human factor studies, building energy upgrades, microgrid improvements, online tool developments, and germicidal UV studies. He has strong background in control systems and strong interest in implementations of energy-efficient systems on the IoT platforms.

Hydrogen production and value-added chemical recovery from the photo-reforming process using waste plastics

Huiyao Wang*, E.M.N. Thiloka Edirisooriya , Punhasa S. Senanayake and Pei Xu

New Mexico State University, USA

Abstract:

Photo-reforming is a novel and promising green H_2 production method with enhanced catalytic efficiency via optimizing the oxidation reaction by introducing an organic compound as the sacrificial agent. This study focuses on the degradation of different plastic wastes, such as polyethylene terephthalate (PET), low-density polyethylene (LDPE), and polystyrene (PS) as sacrificial agents in the photo-reforming process for H_2 production. The process was optimized by evaluating H_2 production under different plastic pretreatment methods and the polymer-to-catalyst ratio. Disodium terephthalate (Na_2TP) and terephthalic acid (TPA) were identified as byproducts after the

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alkaline pretreatment of PET, and these extracted products were re-applied in the photo- reforming process and tested for their applicability in H_2 generation. The degradation of plastics and their respective pretreatment byproducts were characterized using attenuated total reflectance-Fourier transform infrared spectroscopy (ATR-FTIR) and thermogravimetric analysis (TGA). PET was the best sacrificial agent in H_2 production under almost all conditions whereas 4026 µmol/g_{cat}/gPET was produced under ethanol-induced pretreatment at 40 °C. This combined analysis indicates H_2 can be successfully generated from LDPE, PET, PS, and degradation byproducts. Further, TPA and Na_2TP can be extracted from the reaction mixture for reuse. This study revealed the mechanisms of using plastics as sacrificial agents and the intermediate byproducts in the photo-reforming process on H_2 evolution efficiency. It provides the opportunity for green H_2 generation while degrading plastic waste by solving multiple environmental issues with revenue generation.

Biography:

Huiyao Wang studied Physics at the Lanzhou University, Lanzhou, China and graduated as MS in 1993. He then joined the research group of Prof. Tianmin Wang in the Department of Material Science at the Lanzhou University. He received his PhD degree in 1998 at the same University. After two years postdoctoral fellowship and several research associate works, he obtained the position of an Associate Professor at the New Mexico State University. He has published more than 60 research articles in SCI journals.

Advanced Sodium Ion Batteries for E-mobility & Energy Storage

Darren H. S. Tan and Erik A. Wu

UNIGRID Inc (UNIGRID Battery), San Diego, CA

Abstract:

Advanced sodium ion batteries can lower costs and overcome supply chain challenges of lithium ion batteries. Through a breakthrough alloy anode innovation, the energy densities of sodium ion batteries can be increased by a factor of 2x and eliminate battery safety hazards, offering competitive advantages in e-mobility and energy storage markets. This session will cover the state-of-the-art in commercial sodium ion batteries, going beyond laboratory scale research and showcase unprecedented energy densities, performance (high rate, low temperature, long cycle life) and safety testing results of U.S. made advanced sodium ion batteries. The working mechanism behind this enabling technology will be discussed along with recent trends in the sodium battery markets and how the sodium supply chain can alleviate today's critical material bottlenecks faced by the industry. This session will appeal to both academic and industry audiences interested in exploring non-lithium chemistries that lower costs, improve safety and overcome supply chain challenges of battery materials.

Biography:

Darren H. S. Tan is the CEO & co-founder of UNIGRID Battery, a spin-out startup from the Sustainable Power & Energy Center at University of California, San Diego. He is currently leading the UNIGRID team in commercializing next generation advanced sodium ion batteries for the emerging energy storage markets.

Nuclear Magnetic Resonance Studies of Structure and Ion Transport in Novel Battery Electrolytes

Steven G. Greenbaum*

Hunter College of the City University of New York, New York, NY

Abstract:

A significant bottleneck in the development of large-scale, safe, and sustainable batteries is the slow progress in electrolyte materials research. In the lithium ion battery (LIB) realm, electrolytes based on flammable alkyl carbonate solvents have seen few changes in the last quarter century and are unsuitable for lithium metal batteries. For larger scale grid storage, redox flow batteries (RFBs) which require thousands of gallons of electrolyte (catholyte and anolyte), present formulations are too costly for widespread adoption. We present here several novel electrolyte development efforts led by collaborators at the University of Maryland and Case Western University. Nuclear magnetic resonance (NMR) is a unique method of probing local structure and dynamics in a wide variety of materials owing to the short range nature of most of the interactions that produce spectral features and govern dynamic behavior. Among its advantages are elemental (nuclear) specificity and its reliably quantitative nature in that the integrated intensity of a particular spectral component is directly proportional to the number of nuclei in the corresponding material phase. Modern day NMR has grown into an enormously diverse array of sophisticated experimental techniques in studies ranging from complex biochemical systems in the solution phase to a wide selection of solid-state compounds, with often negligible overlap in methodology. As a counterexample of the increasing divergence between the liquids and solids NMR communities, we present here several ongoing NMR investigations of structure and ion transport in novel electrolytes, utilizing both liquid state and solid state NMR.

Biography:

Steve Greenbaum is CUNY Distinguished Professor of Physics at Hunter College and the CUNY Graduate Center, and a Fellow of the American Physical Society. He is also senior science advisor at Ionic Materials, Inc. in Woburn, MA. He earned his Ph.D. in Physics from Brown University. His main research interest involves studies of materials for electrochemical energy storage and conversion by magnetic resonance methods. He has co-authored over 320 peer-reviewed publications and was one of eleven Jefferson Science Fellows who served as Senior Science and Technology advisors to the U.S. Secretary of State during the 2014-15 academic year.

Decarbonization of Urban Water, Energy and Solids Management with Hydrogen Technologies

Vladimir Novotny

Northeastern University (Emeritus) Boston, USA

Abstract:

Recent United Nations Environmental Programme (2023) report found 2030 greenhouse gas emissions still are rising and must fall which will require decarbonization and moving to attaining negative GHG emissions to reverse these catastrophes an include implementation of negative GHG emissions and conversion to hydrogen as a source of energy Decarbonization requires switching from fossil energy to green, blue, and turquoise hydrogen with net zero or negative CO_2 emissions. bn. The known processes of producing hydrogen presented and proposed for urban water, used water, waste solids and energy management include: *Green hydrogen by Electrolysis* of water.

Blue hydrogen produced by natural (fossil) gas steam methane reforming *Gasifying (thermolysis or pyrolysis)* of combustible organic constituents originally y from organic biomass (sludge, combustible municipal solid waste, woodchips) and organic materials (plastics, tires) into syngas and converting syngas into hydrogen and carbon dioxide. *Cracking methane by pyrolysis* with electricity or high solar energy sources into solid carbon and *turquoise hydrogen. By microorganisms* in the fermentation of sludge, and other biodegradable organic waste to hydrogen and acetates. *By partial oxidation (burning)* of fossil fuels (coal, wood, biomass, fossil gas) with limited air oxidation makes syngas (hydrogen and carbon monoxide). Conversion of emitted concentrated CO_2 into methane, and acetates followed by turquoise hydrogen production is possible. Fugitive losses and flaring of methane at the extraction site are eliminated. The hydrogen technologies that achieve these goals with negative CO_2 emissions are presented and combined with the three-line system of urban integrated water, energy, and solid wastes management with a power generating fuel cell.

Deciphering the solar extreme overirradiance events

Marco A Zamalloa Jara*

Universidad Nacional de San Antonio Abad del Cusco, Peru

Abstract:

The solar irradiance on the Earth’s surface can be higher than expected for clear sky conditions and even higher than the extraterrestrial solar irradiance; these events are known as overirradiance (OI) and extreme overirradiance (EOI), respectively. The standard conditions to compare and evaluate the performance of photovoltaic (PV) solar panels for terrestrial use are 1000 W/m2 for irradiance and 25 °C for temperature. These standard conditions are easily exceeded in OI conditions, negatively affecting the performance and useful life of the PV panel. In addition, some publications show that PV systems are susceptible to malfunctioning in the presence of OI conditions, leading to some electronic components melting if the system is not correctly sized, leading to economic losses for PV plants. Overirradiance becomes even more relevant when we understand that these events are more frequent than expected, mainly in regions with fragmented clouds. This work is an attempt to understand the physics behind OI events, so we show the effect of OI conditions on the spectral distribution, the qualitative correlation between irradiance and the cloud optical depth under OI, and the irradiance variations in the ultraviolet, visible, and infrared. The data comes from a spectroradiometer in Lima, Peru, and the geostationary satellite GOES-16. The spectral change, the presence of optically thick clouds, and the significant irradiance increase in the infrared region allow us to conclude that the OI events are due to reflections at the edges of the clouds, causing an enhancement of the direct irradiance.

Biography:

Physics Doctor candidate from the Pontificia Universidad Católica del Peru (PUCP), Master in Physics from PUCP, and Graduate in Physics Mathematics from the Universidad Nacional de San Antonio Abad del Cusco (UNSAAC). Qualified as a Researcher by the National Council of Science, Technology and Technological Innovation of Peru (CONCYTEC) and appointed Research Professor at the UNSAAC. Areas of interest: Non-destructive optical spectroscopies, Astrophysics, and Computational Physics. Research lines developed: optical metrology, cosmic rays, qualitative analysis of materials, archaeometry, and currently oriented to the understanding of solar extreme overirradiance events detected at the level of the Earth’s surface.

Towards 26% efficient solar cells in mass production with doped poly-silicon passivating contacts

Daniel Macdonald[1]* Peiting Zheng[2], Sieu Pheng Phang[1], Jie Yang[2], Zhao Wang[2], Rabin Basnet[1], Di Kang[1], Xinyu Zhang[2] and Hao Jin[2]

[1]Australian National University, Canberra, Australia

[2]Jinko Solar, Haining, China

Abstract:

Doped poly-silicon passivating contacts have emerged as a key technology for the next generation of industrial crystalline silicon solar cells beyond the current industry-standard p-type PERC cells. Their outstanding surface passivation and low contact resistance have enabled very high efficiencies in the laboratory, whilst their high compatibility with existing production technologies has led to many PV manufacturers trialing this technology in pilot lines, with several already moving to mass production.

To date, the industrialization of poly-silicon contacts has been limited to the original "TOPCon" cell design – n-type cells with a full-area n+ doped poly-Si contact on the rear, and a boron-diffused p+ junction on the front. Large-area TOPCon cells fabricated in industrial R&D laboratories have achieved multiple efficiency records over the past few years, with the most recent mark of 26.4% being set by Jinko Solar in December 2022. Despite this rapid progress, identifying the best architecture and processes to achieve above 26% in mass production with poly-silicon contacts remains an open challenge, and may require alternatives to the standard n-type TOPCon structure. In this work we will review recent progress in the industrialization of poly-silicon contacted cells, and consider possible future directions, including alternative architectures with p+ poly-silicon contacts, rear-junction cells, and interdigitated back contact cells.

Biography:

Daniel Macdonald completed his PhD in silicon solar cells at ANU in 2001 and has over 20 years' experience in silicon solar cell research, spanning materials, device design and fabrication, and advanced characterization. He currently leads a team of 25 postdoctoral fellows and research students, has published over 400 papers in the field, and has led projects valued at over AU$20 million, including large industry-supported projects. He has held three prestigious ARC Fellowships and is a leading expert in n-type silicon solar cells and their commercialization, including poly-silicon contacted solar cells.

Synthesis, Characterization, Conformational Switching and Photophysical Properties of BODIPY-Fullerene Resorcin[4]arene Cavitand

Selina X. Yao[1], Yuguang Suib[2], and Hai Xub[2]*

[1]Rivian Automotives, San Jose, CA, United Stated

[2]Central South Univeristiy, Changsha, Hunan, China

Abstract:

Chlorophyll is a temperature- and pH-sensitive pigment responsible for the absorption of light in photosynthesis, which ultimately provides energy for the process. The inhibition of photosynthesis and energy transfer can occur due to a decrease in temperature or pH levels. To imitate this process, two new donor-acceptor dyads, **R-BF-Cl** and **R-BF**, with bridging the donor BODIPY and

the acceptor fullerene by resorcin[4]arene cavitand, were synthesized and characterized for light harvesting in artificial photosynthesis. Steady-state absorption spectra showed no interaction between BODIPY and C_{60} in **R-BF-Cl** or **R-BF** under ground state. However, steady and transient state fluorescence emission spectra showed singlet-singlet energy transfer occurring from BODIPY to C_{60} in **R-BF-Cl** or **R-BF** with the *vase* conformation, with calculated rate constants and efficiencies of 7.39×10^{7} s^{-1} and 13.05%, 6.39×10^{7} s^{-1} and 11.48%, respectively. **R-BF-Cl** undergoes conformational switching from the *vase* to the *kite* under pH induction in $CHCl_3$ or $CHCl_3/CS_2$, not CD_3COCD_3/CS_2, and the singlet-singlet energy transfer rate constant and efficiency of the *kite* conformation **R-BF-Cl** are calculated to be 4.3×10^{7} s^{-1} and 13.24%, respectively. However, no photo-induced energy transfer occurred in **R-BF-*kite***. This study successfully developed two stable donor-acceptor dyads, **R-BF-Cl** and **R-BF**, for light harvesting in artificial photosynthesis. The findings illustrate the impact of resorcin[4]arene cavitands as bridges on the interaction between the donor and acceptor moieties of artificial photosynthetic reaction centers and demonstrate the energy transfer dynamics through molecular conformations of **R-BF-Cl** and **R-BF**, respectively.

Biography:

Selina X. Yao, a Sr. reliabilty engineer in Rivian Automotives. I have get my PhD in 2020 from Mechanical Engineering Department at University of Vermont. During these years I have conducted tramondous research on polymers processing and characterization. After graduation I joined multiple companies for polymer application studies including TE connectivity, Meta, and my current company Rivian Automotives. Working for the industry gives me motivation to do practical acadmical research. From 2021, I collaborated with Central South Univerisity and co-advised students there for BODIPY-Fullerene Resorcin[4]arene Cavitand related research.

A Comprehensive Introduction of the World First Elevated and Conventional Turbine-Generators Layout Design Double-Reheat Coal-Fired Power Unit

Li Li

Shanghai Shenergy Power Technology Co., Ltd, China

Although theoretically double-reheat units are more efficient than single-reheat ones, the practical application results worldwide show that the efficiency improvement of the conventional double-reheat unit is not obvious, and the cost performance is not outstanding. One of the main reasons is the larger pressure loss, heat dissipation loss and related investment cost caused by the excessively long pipeline, especially the second reheat system. The patented double-reheat technology of elevated and conventional turbine-generators layout introduced in this paper solves this problem well in principle. By placing the very- high-pressure and high-pressure turbine cylinders on a high platform very close to the boiler outlet headers, the technology can shorten the associated expensive critical piping by more than 85 percent, which means not only reducing investment, but also eliminating corresponding pressure and heat loss, resulting in higher unit efficiency. At the same time, other patented innovations, such as a series of the Generalized Regeneration technologies, can be combined with double reheats to further reduce energy losses such as losses in the condenser and improve unit efficiency. The R&D and integration of these technologies have been applied in the Pingshan Phase II 1350MW elevated and conventional turbine-generators layout double-reheat unit, a national demonstration project in China. During the design process, the project also encountered challenges such as the stress problem caused by the extremely short steam pipe between the elevated turbine and the boiler header, and the overspeed problem of the elevated turbine-generator, fortunately all of them were well solved through innovative technical means. At the same time, in addition to the world first elevated and conventional layout design, the project also applies a number of pioneering energy-saving

technologies such as primary air Generalized Regeneration technology and generalized frequency adjusting technology. After the project was put into commercial operation, the test results of the third-party test institutes in 2022 shows that the net efficiency of the unit was as high as 49.4% (LHV) under rated conditions, and still as high as 46.8% under 50% load. In addition, the unit achieved safe and environmentally friendly operation in reasonable efficiency under 20% load during commissioning, making it the largest capacity unit to achieve this goal. The unit's state of the art high efficiency and flexibility make it a new benchmark for coal-fired units worldwide.

Production of sustainable aviation fuel through a biorefinery scheme

Araceli Guadalupe Romero-Izquierdo [1], Fernando Israel Gómez Castro [2], Salvador Hernández [2], Claudia Gutiérrez-Antonio [1*]

[1] Autonomous University of Querétaro, México

[2] University of Guanajuato, México

Abstract:

Sustainable aviation fuel (SAF) has been identified as the most promissory alternative for the development of aviation sector. This biofuel can be produced from several raw materials through different processing pathways. Unlike other biofuels, aviation biofuel must fulfill the same technical standards of its fossil counterpart as well as sustainability standards in order to be used in commercial and freight flights. In addition, the price of aviation biofuel must be competitive respect to fossil jet fuel. In this context, the use of waste materials for the production of SAF is attractive due to its low cost and widely availability.

In particular, waste cooking oil is considered as hazard waste in Mexico, since one liter of this oil can contaminate 1000 liters of water. At the moment, there is no a government program to collect and/or revaluate this waste. Therefore, this work presents a biorefinery scheme for the production of sustainable aviation fuel considering waste cooking oil. The biorefinery allows the production of SAF, green diesel, naphtha, light gases, biodiesel, glycerol, fertilizer and also bioenergy. Moreover, results indicated that the SAF price is competitive respect to fossil jet fuel. So, the use of this type of waste, widely generated in Mexico, can be used to produced SAF, transforming a problem into a new energy alternative.

Biography:

Doctor of Science in Chemical Engineering from Technological Institute of Celaya, and Professor-Researcher at Faculty of Engineering of the Autonomous University of Querétaro; her research area is the development of sustainable biofuels production processes. She has published 55 research articles, 25 book chapters, and three books. On the subject of aviation biofuels, she collaborated in the preparation of National Development Plan (2012-2018, 2019-2024). She leads the research group Sustainable Processes for the Production of Bioenergy, which is part of the Ibero-American Network of Biomass Technologies and Rural Bioenergy. Also, she collaborates with the Querétaro Energy Cluster, as part of the Advisory Council.

Novel bioenergy production process from industrial waste through acetic acid fermentation

Harifara Rabemanolontsoa*

Graduate School of Energy Science, Kyoto University, Japan

Abstract:

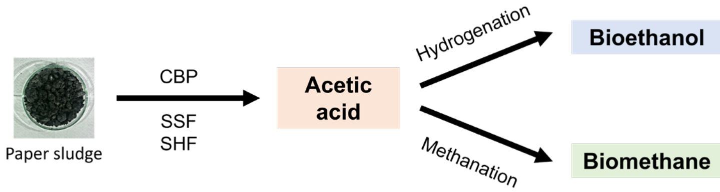

Figure 1. Biofuel production process from paper sludge through acetic acid fermentation.

Addressing global energy and environmental challenges necessitates cost-effective strategies for repurposing industrial wastes like paper sludge into valuable products. Consolidated bioprocessing (CBP) emerges as a promising approach for biofuel production by integrating enzyme production, saccharification, and fermentation in a single step. This streamlined process reduces reactor and enzyme expenses, enabling economical biomass conversion for biofuel generation. To verify the merits of CBP, this study compares it to the traditional Separate Hydrolysis and Fermentation (SHF) and Simultaneous Saccharification and Fermentation (SSF) methods in converting paper sludge to acetic acid using clostridial cultures. The resulting acetic acid serves as a platform chemical that can be further processed into bioethanol through hydrogenation. Additionally, biomethane production via chemical or biochemical methanation of acetic acid is also explored. These findings pave the way for ongoing research into efficient biofuel production through acetic acid fermentation of biomass.

Biography:

Harifara Rabemanolontsoa works at the Graduate School of Energy Science, Kyoto University, Japan. She specializes in developing innovative biomass technologies for fuel, chemical, and material production. She began her career with an NGO working for sustainable development in Madagascar before joining Holcim Ltd. She completed a PhD in Energy Science at Kyoto University and has subsequently worked in industry-government-academia collaborations. She also received training in Energy from the UK Energy Research Center and Vitae at Warwick University. Passionate about advancing women in science and sustainable development, her research focuses on biomass and creating a cleaner future.

Comprehensive evaluation of solar electric power for industrial applications

Guillermo Martinez-Rodriguez[1]*, Amanda L. Fuentes-Silva[1] and Juan-Carlos Baltazar[2]

[1]University of Guanajuato, Mexico;

[2]Texas A & M University, USA.

Abstract:

Currently, most of the energy required in industrial processes is generated from fossil fuels. Electric power generation occurs in large-scale power plants. The global decarbonization goals indicate the need for an energy transition towards sustainable systems. In this research, an economic, environmental and social evaluation of the on-site (decentralized) energy production required by a plant or process using solar thermal energy is carried out. The life cycle analysis was carried out to evaluate the environmental impact associated with the production of energy from conventional sources and from thermosolar sources. The study considered the production of electrical and thermal energy to satisfy the energy demand of a cold room in a period of one

year. Simultaneously, evaluating the life cycle cost allowed determining the design of the energy system that presents the best effective cost. The results obtained show that the solar fraction that maximizes the effective cost of the thermal system and the ORC driven by solar thermal energy is 1.0. The levelized cost of thermal energy for the case with the best effective cost is 0.065 USD/ kWh_{th}, while electrical energy presents a levelized cost of 0.305 USD/kWh_e. These types of studies promote the sustainable transition of the use of solar energy in industrial processes.

Biography:

Guillermo Martínez-Rodríguez is a Chemical Engineer with experience at petrochemical industry, is a Mexican lecturer and researcher with 22 years of experience at University of Guanajuato, the major public higher level institution of Guanajuato state. He is convinced the industry can continue to developing using 100 % renewable energy. He has overseen a Solar Testing University Laboratory since 2006, with more than 50 solar collector trademarks tested and providing consulting. His research interests have focused on the thermal and hydraulic performance of solar collectors for the innovation and integration in industrial and domestic applications; the mathematical modeling of heat transfer phenomena within the solar collectors, and solar thermal dehydration application.

Leveraging Palm Kernel Shells Gasification for Sustainable Decentralized Small-capacity Dual-Fuel Power Generation

Sunu Herwi Pranolo[1]*, Joko Waluyo[1] , Wusana Agung Wibowo[1], Nikmal Kewin Witjaksono[1], Achmad Azizul Alim Maricar[1] , Firman Asto Putro [2] and Sigit Basuki Wibowo[3]

[1] Universitas Sebelas Maret, Indonesia

[2] Universitas Gadjah Mada, Indonesia

Abstract:

Small-capacity diesel genset units up to 40 kW are already operating to supply the electricity needs for some remote regions of Indonesia, scattered near palm oil plantations and far from the national electricity grid. The consumers may include local palm oil farmers, plantation laborers, and palm oil mill workers. A few barriers include fossil fuel availability, maintenance and spare parts, environmental impacts, and operational costs. On the other hand, the areas generate various biomasses due to plantation activities and related derived industries, which are promising for locally sustainable energy sources. Palm oil trunks and midribs are the primary agricultural wastes available in the plantation areas. Palm oil industries produce empty fruit bunches, fibers, and palm kernel shells as main by-products. By leveraging the available biomass resources, it is possible to reduce the dependence on diesel fuel. A 5-kW dual-fuel diesel genset based on palm kernel shell gasification was studied. The system should be operated to maximize energy efficiency and minimize emissions. It provides flexibility by allowing multiple fuels, which can be advantageous when one fuel source becomes expensive, limited, or unavailable. A mathematical model for specific diesel fuel consumption calculation as a function of producer gas flowrate and electricity load was developed based on laboratory experiments and a thermodynamic approach. The proposed model enables optimization and estimation of diesel fuel requirements for the dual-fuel genset, which helps improve the operational efficiency of the genset and facilitates better planning and management of fuel consumption. Sustainable decentralized small-capacity dual-fuel power generation offers a flexible, reliable, and environmentally friendly.

Biography:

Since 2004, the author's research has focused on developing sustainable energy provision based on local biomass resources using thermochemical processes, mainly gasification technology for heat and power. A palm kernel shell gasification unit at a capacity of 45 kg/minute for aggregate heating in an asphalt mixing plant was successfully constructed and has been operational since 2020. Some small power plants up to 100 kW based on palm kernel shell gasification were constructed in some rural areas in Indonesia. Recently, the authors have been working on the environmental impact evaluation of such biomass gasification technology using the life cycle analysis method.

Multifunctional Catalysts for Selective Hydrocracking of Polypropylene to liquid hydrocarbons in jet fuel range under Mild Condition

Gillian Goh[1]* , Jennet Li Ying Ong[1] , Man Fai Ng[2] , Teck Leong Tan[2] , Wei Jie Yap[1] , Xian Jun Loh[1,3] and Lili Zhang[1]

[1] Institute of Sustainability for Chemicals, Energy and Environment (ISCE2), Agency for Science, Technology and Research (A*STAR), Republic of Singapore

[2] Institute of High Performance Computing (IHPC), Agency for Science, Technology and Research (A*STAR), [1] Fusionopolis Way, #16-16 Connexis, Singapore 138632, Republic of Singapore

[3] Institute of Materials Research and Engineering (IMRE), Agency for Science, Technology and Research (A*STAR), A∗STAR, 2 Fusionopolis Way, Singapore 138634, Singapore

Abstract:

The widespread applications of polypropylene (PP) had resulted in a rapid generation of its waste1 which should be addressed to reduce carbon emissions by incineration and to transform PP waste into valuable products in a circular economy. Currently, researchers had focused their efforts on the catalytic depolymerization of plastic waste to generate the value-added hydrocarbons. It is noteworthy that while the reported reaction conditions were mild2-4 , the conversion and selectivity towards liquid hydrocarbons (C8-16) were moderate. Much harsher conditions, either at high pressure and long reaction times or with additives, were required to achieve an improved yield. Therefore, a highly selective and efficient pathway towards saturated hydrocarbons in the range of C8-16 for the use of jet fuel under mild conditions is desirable. Here, we report the multifunctional heterogeneous catalyst system (i.e., XYO3/meso Al-Si) 5-7 that is highly selective towards the production of liquid hydrocarbons (C8-16) through hydrocracking of PP at mild conditions in the absence of solvent to achieve a high yield and selectivity of 78 % and 81%. Several features such as appropriate amount of strong hydrogenating metal X and the strong Brønsted acidity of the XYO3/meso Al-Si catalyst system come together to result in an optimized processive multifunctional catalytic hydrocracking of PP to afford desired C8-16 hydrocarbons in a high yield and selectivity.

Biography:

Gillian Goh is currently a scientist at Agency for Science, Technology and Research (A*STAR), Institute of Sustainability for chemicals, energy, and environment (ISCE2), Catalysis and Green Process Engineering since 2021. She was working as a research fellow at Institute of Chemical and Engineering Sciences (ICES) from 2020-2021. She specializes in low carbon technologies for waste upcycling to carbon neutral fuels contributing to the Zero-waste masterplan and the National CO2 emissions target. She graduated from Nanyang Technological University with a 2 nd Uppers honor (Bachelor), specialization in medicinal chemistry (2016) and a Doctor of Philosophy in Chemistry and Biological Chemistry (2020).

Reduction in limit of detection of Fluorobenzoic acids by methyl esterification using UiO-66-NH2 as heterogeneous catalyst

Anuj Kumar* and Chhaya Sharma

Indian Institute of Technology Roorkee Saharanpur Campus, India

Abstract:

Fluorobenzoic acids (FBAs) are used as chemical tracers in enhanced oil recovery and reduction in their limit of detection is a crucial issue. GC-MS is a versatile tool to detect and quantify FBAs at very low limits of concentration, but they require esterification prior to analysis by GCMS. The present study describes the catalytic methyl esterification of fluorinated aromatic carboxylic acids (FBAs) using methanol as methyl source and UiO-66-NH2 as a heterogeneous catalyst. The reaction time was reduced to 10 hours which is a 58% reduction in time over the traditional BF3-MeOH complex as derivatizing agent. The yield of the esterification reaction was evaluated with respect to the BF3–MeOH complex and determined by GC-EI-MS. The catalytic procedure was optimized by the Taguchi model with a 99.99% fit. Good catalytic performance was observed for 23 different isomers of fluorinated aromatic acids showing a relative conversion yield of up to 169.86%, which reduced the detection limit of FBAs up to 2.60 ng mL−1 .

Biography:

Anuj Kumar is a Prime Minister Research Fellow in Indian Institute of Technology, Roorkee working under the supervision of Prof. Chhaya Sharma. He is currently working on the applications of different materials in extraction and sensing of chemical tracers especially fluorinated aromatic carboxylic acids. He has great expertise in analytical Chemistry, mainly in method development and validation by GC, GC-MS, HPLC, AAS etc. He has published 05 articles in internationally reputed journals.

Role of Energy Efficiency in Energy Transition: A Decomposition Analysis of Energy use

Pooja Sharma *

University of Delhi, India

Abstract:

Not Available

Friction Reducer in Water-Based Mud: A Catalyst for Improved drilling Efficiency in Extended Horizontal Well

Mohamed Metwally*

New Mexico institute of mining and Technology, USA

Abstract:

The significance of drilling horizontal and extended reach wells (ERW) in enhancing well productivity is undeniable. Advancements in horizontal drilling and completion technologies have driven the quest for longer lateral wells to maximize hydrocarbon production. However, achieving this comes with challenges, particularly in addressing the increased circulation rate needed for optimal hole cleaning. This higher circulation rate results in elevated hydraulic pressure loss and equivalent circulation density (ECD), limiting the extension of the lateral horizontal section. This paper proposes an innovative solution to these technical challenges by introducing a water-based mud (WBM) formulated with a friction reducer (FR) for ERW drilling. Utilizing a commercially available FR commonly used in hydraulic fracturing, both experimental and modeling approaches were employed in this study. The developed WBM with FR demonstrated thermal stability, maintaining fluid rheology up to 180°F. Hydraulic flow loop measurements indicated a significant reduction in pressure loss, up to 30%, when 0.5 lb/bbl of FR was added to 9 ppg WBM. The mud hydraulics calculation, employing the Herschel Bulkley rheological model, showed a decrease in ECD similar to oil-based mud (OBM). Furthermore, the hydraulics calculation demonstrated an increase in the

drilling open hole horizontal lateral section when using the formulated WBM with FR. This study introduces a promising WBM alternative to oil-based mud for ERW drilling, offering benefits such as lower ECD and reduced hydraulic pressure losses.

Biography:

I am Mohamed Metwally, a holder of a Ph.D. in petroleum engineering from New Mexico Tech, USA, with a specialization in drilling engineering, particularly in the development of high-performance drilling fluids. My research interests in the oil and gas sector encompass various areas, including environmentally friendly drilling fluid formulations, drilling engineering, extended reach wells, shale inhibition, drilling hydraulics, reservoir characterization, geomechanics, geothermal energy storage, oil production, and artificial intelligence applications in petroleum engineering. Additionally, I focus on addressing challenges related to wellbore instability. I have contributed as a co-author to over 10 patents and research papers. Moreover, my expertise extends to teaching advanced drilling courses tailored for the oil and gas industry.

The Generation of Energy as a Result of Action of Spin Supercurrent

Liudmila Borisovna Boldyreva

Russia

Abstract:

In 1952, Czech researcher K. Drbal was granted a patent for the discovery of the possibility without an auxiliary source of energy, of “maintaining razor blades and straight razors sharp” in a pyramid [1].

In 1977–1987, the area (called “bubble”) that had the property of shielding various fields was discovered near pyramids by J. Parr

In 1891, N. Tesla created energy’s generator using electromagnetic oscillations and providing the efficiency factor greater than 1.

The process, the action of which could be the cause of generation of energy in the considered cases is spin supercurrent [1]. The spin supercurrent is a process transferring angular momentum (angles of deflection or/and angles of precession) between precessing spins. These spins may be the spins of virtual photons created, according to Feynmann, by quantum objects (Figure 1), or spins of photons transferring electromagnetic oscillations.

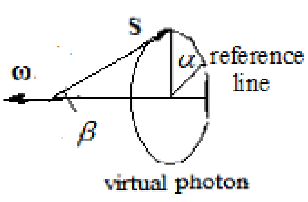

Figure 1. Schema of virtual photon: **ù** is a precession frequency of spin $\mathbf{S}$; α is a precession angle; β is a deflection angle

For example, the energy ΔU obtained at equalizing of deflection angles (respectively, β_1 and m_q) of precessing spins of two virtual photons created by interacting quantum objects with mass m_q is determined [1]: $\Delta U = c^2 m_q \left(\cos^2\beta_1 + \cos^2\beta_2 - 2\cos^2\left(\beta_1/2 + \beta_2/2\right)\right)/2$, where *c* is the light’s speed.

Spin supercurrent is a non-dissipative process and it can be supposed that the generation of energy obtained in the above-mentioned experiments is connected with spins of quantum objects.

Reference

1. Boldyreva, L. (2021) A spin vortices in a physical vacuum consisting of quantum oscillators. Cambridge Scholars Publishing, 250 pp; https://www. cambridgescholars.com/product/978 -1-5275-6455-8.

Biography:

Liudmila Borisovna Boldyreva has graduated from the National Research Nuclear University “MEPHI”, Moscow, Russia. There she has defended a dissertation on processing the results of physical experiments. For 40 years she has been studying the properties of the physical vacuum. The results have been published in 3 books, more than 40 papers in various journals and proceedings of a number of international conferences. Liudmila Borisovna Boldyreva is familiar with the latest achievements in physics and biophysics.

Advancing Lubrication Technologies: Unleashing the Potential of Nanoparticles for Enhanced Tribological Performance and Moisture Detection

Alfonso Fernández González*, Christian Chimeno Trinchet and Rosana Badía Laíño

University of Oviedo, Oviedo Asturias, Spain

Abstract:

In recent years, the incorporation of nanoparticles as additives in lubricants has emerged as a groundbreaking technology with tremendous potential. These tiny particles, typically measuring less than 100 nanometers, offer unique properties that can significantly enhance the performance of lubricating oils. By dispersing these nanoparticles into lubricants, researchers have been able to achieve remarkable improvements in various key aspects, including friction reduction, wear resistance, and thermal stability. The current state of the art in nanoparticle additives for lubricants involves advanced materials such as graphene, carbon nanotubes, and metal oxides, which exhibit exceptional lubricating properties at the nanoscale. This innovative approach not only allows for enhanced efficiency and durability of machinery but also contributes to the reduction of energy consumption and environmental impact.

In this work, we present the results of our studies on the synthesis, characterization, and application of different nanoparticles in sensing and tribology. Our research has focused on the utilization of nanoparticles, both metallic and non-metallic, as additives in lubricants, demonstrating their significant potential. To enhance the stability of metallic nanoparticles, we have developed innovative techniques such as chemically capping metal oxide nanoparticles with hydrocarbon chains. Additionally, we have conducted extensive research on the synthesis of environmentally friendly carbon-based nanoparticles. These advancements have shown remarkable effects on friction reduction, wear resistance, and overall performance enhancement in lubricants. Furthermore, we will share our findings on the design of chemically doped carbon dots as nanosensors for detecting moisture, a critical contaminant in lubrication systems. Notably, these doped nanoparticles not only exhibit excellent moisture detection capabilities but also retain their enhanced tribological properties.

Biography:

Alfonso Fernández-González got his B.Sc and Ph.D from the University of Oviedo in 1997 and 2003 respectively. Afterwards, he worked in the Dresden University of Technology (Germany) for two years with Professor Reiner Salzer under the topics of Surface Plasmon Resonance Imaging. From then, he worked in the Spanish Council for Scientific Research and again in the University of Oviedo, where he works as Assistant Lecturer since 2016. He is author of more than sixty scientific papers, reviews and book chapters. His main research interests are the use of nanoparticles in tribology, fluorescence and luminescence, optical sensors and chemometrics.

Development of a New Type of Glass-ceramic Electrolytes with the Improved Operation Parameters

Hanna Potapenko

Joint Department of Electrochemical Energy Systems NAS of Ukraine

Abstract:

Lithium-ion batteries have achieved great market share since their commercialization by Sony in 1990. Compared with other energy storage devices, lithium-ion batteries have demonstrated a lot of advantages, including high energy density, long cycle life etc.

To thoroughly address the safety issues, use of highly flammable organic liquid electrolytes should be entirely avoided as such all solid-state batteries become a good choice because the organic liquid electrolytes are replaced by inorganic solid electrolytes that have high thermal stability.

Main functions of solid electrolytes are the same as liquid electrolytes and separators that only allow Li-ions to crossover between cathode and anode, and prevent electron conduction and short-circuit. Thus, several basic requirements for solid electrolytes are essential. Electrolytes should:

- possess high ionic conductivity of above 10^{-4} S cm^{-1} at room temperature;
- have negligible electronic conductivity with a high ionic transference number, and
- have wide electrochemical stability windows.

Now my research group at this time is working with Li_2S-P_2S_5 glass-ceramic. We believe that glasses could have higher ionic conductivities than crystals because of larger free volume of glasses due to random and open structures. However, we have found that the different glass-ceramic compositions xLi_2S-yP_2S_5 in accordance with different methods of synthesis demonstrate the ionic conductivity from 10^{-5} S cm^{-1} to 10^{-3} S cm^{-1} at room temperature. Thus, we hope that in the future this class of solid electrolytes will become a cheap and safe replacement for flammable organic electrolytes in new generation lithium-ion batteries.

Biography:

Hanna Potapenko in 2015 have presented the PhD thesis entitled "$Li[Li_xMn_{2-x}]O_4$ and $LiNi_{0.5}Mn_{1.5}O_4$, obtained by the citric acid route, as electrode materials for high-power lithium-ion batteries". Since 2016 I have been approved as the Senior Researcher, have carried out 6 projects from 2015. Then, in 2017 I had the working trip to the Ukrainian-Chinese Joint laboratory of lithium-ion power sources (Institute for Energy Research of Shandong Academy of Sciences, Jinan, China,) and since 2019, I had the cooperation with the best Universities in China: Chengdu University of Electronic Science and Technology and Jiangxi University of Science and Technology.

Strategies for future sustainable energy systems

Louise Ödlund*

Linköping University, Sweden

Abstract:

The ongoing redirection of the Swedish energy systems towards sustainability are urgent and must address challenges as for example energy security and accessibility. The redirection towards sustainability and less use of fossil fuels will lead to a situation with significant increased use of electricity within the coming years. This higher demand for electricity is mainly due to conversion to electricity from other fuels within above all industrial processes, but also due to conversion to more electricity use in the transport sector. To be able to meet the future increased demand for electricity it is vital to consider that the demand for electricity must be met both in a short-term perspective, and in a long-term perspective. To prioritize energy efficiency is always the fastest way to free electricity. This is particularly interesting for the Swedish energy systems, since the use per capita in Sweden is higher compared to other European countries. The need for substantiable more electricity production in Sweden is though most vital to address, and when planning for future electricity production the time-perspective must be taken into consideration. In the same way it is important that all energy sources are included when planning for new electricity production. The aim of the study is to analyze strategies for how new electricity production together with more efficient and flexible use of electricity can meet future higher demand for electricity in Sweden.

Biography:

Louise Ödlund (former Trygg) is Professor in Energy System at Linköping University, Sweden. Her research area concerns regional and municipal energy systems with a special focus on district heating. By using optimization models and in close cooperation with energy utilities, industries, and real estate companies, she studies how combined energy systems of energy users and energy suppliers can shift in the direction of resource effectiveness and sustainability. Louise was engaged by the Swedish Government within the development of the Sweden´s long-term energy agreement and is a frequently engaged invited speaker for conferences and events.

An Innovative Approach to Transform Sour Saudi Natural Gas into Blue Hydrogen and Ammonia through Optimal Process Design, Simulation, and Optimization

Abulhassan Ali* and Aymn Abdulrahman

University of Jeddah, Jeddah, Saudi Arabia

Abstract:

This study presents an innovative technique for converting sour natural gas reserves into ammonia and blue hydrogen. Due to the challenges and environmental concerns involved with the purification process, sour natural gas, which is characterized by high quantities of carbon dioxide (CO_2), hydrogen sulfide (H_2S), and nitrogen (N_2), is often neglected. We suggest a two-step process for the effective use of these reserves. The feedstock used for this study comprises 27% CO_2, 29% N_2, 21%H_2S, and the remaining 23% CH_4. First, a cryogenic purification process is used to retain nitrogen while removing CO_2 and H_2S from the sour gas, converting it into a feedstock suitable for other catalytic operations. The cleaned natural gas, mostly composed of methane and nitrogen, is then transferred into a reactor, which converts methane into hydrogen using a steam reforming reaction. The catalytical reaction is then used to create ammonia from this mixture of hydrogen and nitrogen. The suggested approach offers a practical and sustainable strategy to use

sour gas deposits, minimizing the negative environmental effects of greenhouse gas emissions and assisting the worldwide transition to greener energy and chemicals. It profoundly impacts the energy industry by enabling the effective use of hitherto challenging sour natural gas reserves, thus offering significant potential for the energy transition towards low-carbon fuels and value-added chemicals.

Biography:

Abul Hassan Ali Quddusi is an expert academic with over 15 years of experience in Chemical Engineering. Holding a Ph.D. from Universiti Teknologi PETRONAS, Malaysia, his expertise lies in natural gas purification using cryogenic technology. He has developed a novel cryogenic technology to capture CO_2 from natural gas and published several articles in reputed journals. Quddusi has successfully led impactful research projects and fostered industry partnerships, contributing significantly to the field.

Accelerating Urban Road Transportation Electrification: Planning and Implementation Strategies for Connected Automated Shuttle Services

Ata M. Khan

Carleton University, CANADA

Abstract:

Governments are keen on road vehicle electrification in support of the sustainability goal. Also, there is considerable interest around the world in automation in driving. Among many strategies, the application of electric connected automated vehicle (CAV) shuttles to enhance mobility in urban areas is commonly recognized as an enabler to accelerate the electrification process. Electric CAV shuttles are undergoing slow speed tests around the world. When developed further for use in urban road network at posted speed limits in mixed vehicle traffic networks, these can provide “last mile” services such as connecting a public transit hub station with a medical campus. There are knowledge gaps in such an application that require research. This paper covers planning, technology, economic, and implementation factors in system design of electric CAV shuttle last mile service. Methods are described for treating demand and supply-side uncertainties in system design of electric CAV shuttle “last mile” service between a public transit hub and a medical campus. Also, financial risk in economic factors is covered. Specifically, probability-based macro simulation approach is employed in the development of methods that treat demand and supply-side factors as stochastic within the system design framework and financial risk analysis method is adapted for use in shuttle research. The findings reported here can be used for system design of electric CAV last mile shuttle service to medical campuses as well as other activity centres in other cities.

Biography:

Ata M. Khan is a professor emeritus in Civil and Environmental Engineering at Carleton University, Ottawa, Canada. His research interests focus on intelligent systems, automation in driving, policy and planning, and safe, efficient, and sustainable transportation. He has carried out research/consulting projects for the United Nations; federal, provincial, and municipal governments in Canada; and private sector companies/societies in the USA, Japan, and Canada. The co-author of this presentation material, Bailey Jones, received her B.Eng. (Civil) degree from Carleton University. She is working as an Engineer and also conducting Master’s thesis research on the design and feasibility of electric CAV shuttle service to a medical campus

Evaluation of secondary porosity type in carbonate oil and gas fields using acoustic logging data

Irina Markova*, Mikhail Markov

Instituto Mexicano del Petróleo, México.

It is known that most of the world's hydrocarbon resources are contained in carbonate deposits. Many carbonate oil and gas reservoirs are typically **dual or triple porosity systems containing primary pores,** vugs and fractures. To estimate the volume of hydrocarbonates in carbonate rocks with double porosity, the information about the secondary pore structure is required.

In the present work we have proposed a simple and easy to code methodology of the determination of the secondary porosity type in carbonate sediments with multimineral skeleton. The methodology is based on the analysis of the normalized differences between the measured and the calculated velocities of the compressional and shear waves. To obtain the effective elastic moduli of the multimineral skeleton, we have used the Hill's averaging method and the data obtained by neutron, density and lithographic (PEF) logs. For the calculations, it is supposed that the secondary pores are much larger than the primary ones, but, at the same time, much smaller than the wavelength of the P- and S-waves; thus, it is possible to apply the Hill's averaging.

The methodology was validated by using the data obtained from carbonate reservoirs in Mexico.

The obtained qualitative results can be further improved by the petrophysical inversion of acoustic log data. This inversion is based on the micromechanical model (Effective Medium Approximation) for elastic moduli of double porosity rock calculation. In this case, it is also possible to calculate the petrophysical properties of the secondary pores, such as their concentration and aspect ratio. This information can be used, for example, for prediction of connectivity of secondary pore systems.

Biography:

Irina Markova has completed his PhD in Engineering Science by the National Polytechnic Institute (Instituto Politécnico Nacional, México). She works as a senior researcher at the Mexican Oil Institute (Instituto Mexicano del Petróleo). She has published more than 30 papers in ISI indexed journals. Her research interests include petrophysics, modeling, processing and interpretation of acoustic log data, and rock mechanics.

High-frequency operation of an aqueous nanocapacitor

D. Bratko* and N. Mulpuri

Virginia Commonwealth University, Richmond, VA,

Abstract:

Nanosized capacitors have been a subject of considerable interest for novel energy and microcircuit applications. Experimental challenges accompanying miniaturization invite model predictions of their static and frequency dependent capacitances. In the present study, we use Molecular Dynamics simulations of a water-based nanocapacitor to explore the effect of baseline voltage on the confined dielectric's response to high frequency signals. We show this effect can profoundly modulate the frequency dependent permittivity next to the electrodes leading to asymmetric responses in opposite hydration layers. A strongly nonmonotonic shift of the absorption peak frequency observed in the proximity of negative electrode is discussed in terms of competing orientation-ordering trends in interfacial water.

Biography:

Dusan Bratko is a Professor of Physical Chemistry at the Virginia Commonwealth University. He has previously held positions at the Department of Chemistry, University of Ljubljana, and in the College of Chemistry, University of California at Berkeley. His research concerns statistical mechanics and molecular modeling of ionic solutions, colloids, and interfacial phenomena of interest in nanoscience, energy, and materials engineering.

Developing a data-driven framework for regional emission budgeting

Ling Min Tan* and Vania Sena

University of Sheffield, Sheffield, UK

Abstract:

Monitoring of greenhouse gas emissions against an established baseline is essential in reducing our carbon footprint. Greater monitoring capability leads to a more robust evidence base on which to make more informed decisions on emission reduction measures. This project seeks to address the challenges of assessing regional emissions in order to evaluate the scale of projected impact and the effectiveness of emissions reduction interventions at sub-national levels. To support evidence driven decision making, a Regional Emissions Budgeting Framework (REBF) is proposed as a dynamic planning tool for managing regional emissions audits and monitoring progress towards decarbonisation targets. Here in this study, we demonstrate the development of a framework for managing regional emissions audits and monitoring progress towards decarbonisation. The model development process consists of two key steps: (1) tracking emission data in time series; and (2) predict future emissions pathways. The first step provides a baseline value for regional emissions, which is then used in conjunction with the UK Energy and emissions projections (EEP) data to compare the regional performance against the national averages. A statistical model is also used to generate future emission pathways and predict the impacts of carbon reduction scenarios, which are tailored to be more realistic for the region based on local policies and economic structure. The effectiveness of proposed interventions over time will be evaluated not only based on the depth of interventions, but also the extent to which technology advancement contributes to cutting carbon emissions from each activity, represented by emission conversion factors.

Biography:

Ling Min is a Postdoctoral Research Associate at the South Yorkshire Sustainability Centre. She is working to develop a Regional Emissions Budgeting Framework and inform decision making through data-driven solutions. Ling Min obtained her PhD degree from the University of Sheffield for developing 'An Ecological-Thermodynamic Approach to Urban Metabolism', with scholarship support from the Grantham Centre for Sustainable Futures. Prior to starting her role at the South Yorkshire Sustainability Centre, Ling Min contributed to the development of a data-driven retrofit workflow for large-scale decarbonisation through evaluation of data integration and housing stock modelling approaches for meeting net zero residential emissions.

Optimizing Design and Control in Tandem: Unleashing the Performance Potential of Energy Systems

Himanshu Sharma*, Thiagarajan Ramachandran and Veronica Adetola

Pacific Northwest National Laboratory, Energy and Environment Directorate, USA

Abstract:

The rising complexity of modern energy systems poses significant challenges due to the increased integration of renewable energy sources. Faster dynamic responses introduced by power-electronics-driven assets (e.g., renewables, batteries) and the multifaceted objectives of system-level design and operation further compound these difficulties. While active control is prevalent in energy systems, the traditional practice of tailoring control parameters after design often leads to suboptimal performance. This sequential approach can be effectively bypassed by control co-design (CCD), a transformative methodology that integrates physical and control aspects of system design from the outset. By simultaneously optimizing design and control objectives, CCD unlocks significant performance gains, particularly when system properties are highly coupled (i.e., design decisions significantly influence control strategies, and vice versa). This talk provides a comprehensive introduction to CCD principles and its application in energy systems, highlighting its critical role in ensuring the efficiency, resilience, and sustainability of modern energy infrastructure.

Biography:

Himanshu Sharma is a research scientist in the optimization and controls group at Pacific Northwest National Laboratory, USA (PNNL) where his research focus is on developing advanced modeling, optimization, and data-driven control techniques for energy systems and cyber-physical systems to achieve resiliency, sustainability, and energy efficiency. His broad research interest includes intelligent energy system design, physics informed machine learning , uncertainty quantification, reduced order modeling of dynamical systems, and developing advanced controls of complex physical systems.

Social Impact of Covid-19 Electricity Subsidy on the Lifeline Citizen's Welfare in Ghana: Sharp Regression Discontinuity Design

Mensah Ewurasi Boafowa[1]* and Kaneko Shinji[2]

[1]Master student, International Economic Development Program (IEDP),

[2] Executive Vice President for Global Initiatives for Hiroshima University and Senior Professor

Abstract:

To lessen the pandemic's disastrous effects, the President of Ghana announced on 9th April 2020 a nationwide electricity subsidy (Office of the President GoG, 2020). The Government of Ghana implemented this electricity subsidy nationwide with the aim of making electricity affordable and accessible to the vulnerable and poor in Ghana. Several studies have explored COVID-19 policies in different cases. Some studies have explored the correlation between COVID-19 policies on energy prices and electricity consumption. Most of this literature only explored what happened during the early weeks and months of the pandemic. Most of these studies are only concentrated in developed countries due to their availability to real-time data, whiles little attention is given to developing countries, especially in Sub-Saharan Africa. Also, most studies on the impact of energy subsidies on electricity consumption do not focus on a pandemic period and are not anti-poverty

focused but rather financial and economic recovery. Hence, studies focusing on an electricity subsidy solely for a pandemic period and anti-poverty purposes are scarce. The sole objective of this study is to explore the causal effect of the COVID-19 electricity subsidy policy on monthly electricity consumption of households slightly below the 50kWh cut-off. March 2020 electricity bill consumption was used as a baseline for eligibility of the free electricity units (ECG, 2020). The study used the Sharp Regression Discontinuity Design approach to look at the statistical comparison between the treated households and the control households. A panel dataset from the Electricity Company of Ghana captured 1,476 household electricity monthly consumption and payment observations in Central Region in Ghana from January 2020 to December 2020 was used for the analysis. The findings from the study revealed that the COVID-19 electricity subsidy policy led to sharp discontinuities in monthly electricity consumption at the 50kWh cut-off from May 2020 to March, 2021 due to the significant increase in electricity consumption (LATE) of households below the 50kWh cut-off in March 2020 by 54.57 kWh ($p<0.01$) in the full sample data using the first order. This result provides an econometric logical assessment of the reduction of prices on electricity through a COVID-19 electricity subsidy policy during a crisis for 12 months. The implication of the results revealed that the government expenditure on electricity for poor households slightly below the 50kWh cut-off increased significantly leading to the improvement of their welfare with regard to electricity availability, accessibility and affordability (MOF, 2021).

Biography:

I am Ewurasi Boafowa Mensah from Ghana in west Africa. I am currently a second-year master student of Hiroshima University studying International Economic Development. As a skilled student with a degree in Bsc. Computer Science and Statistics, Commonwealth Executive MBA and previous job experience as a Regional Database Administrator at Electricity Company of Ghana for over a decade.

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