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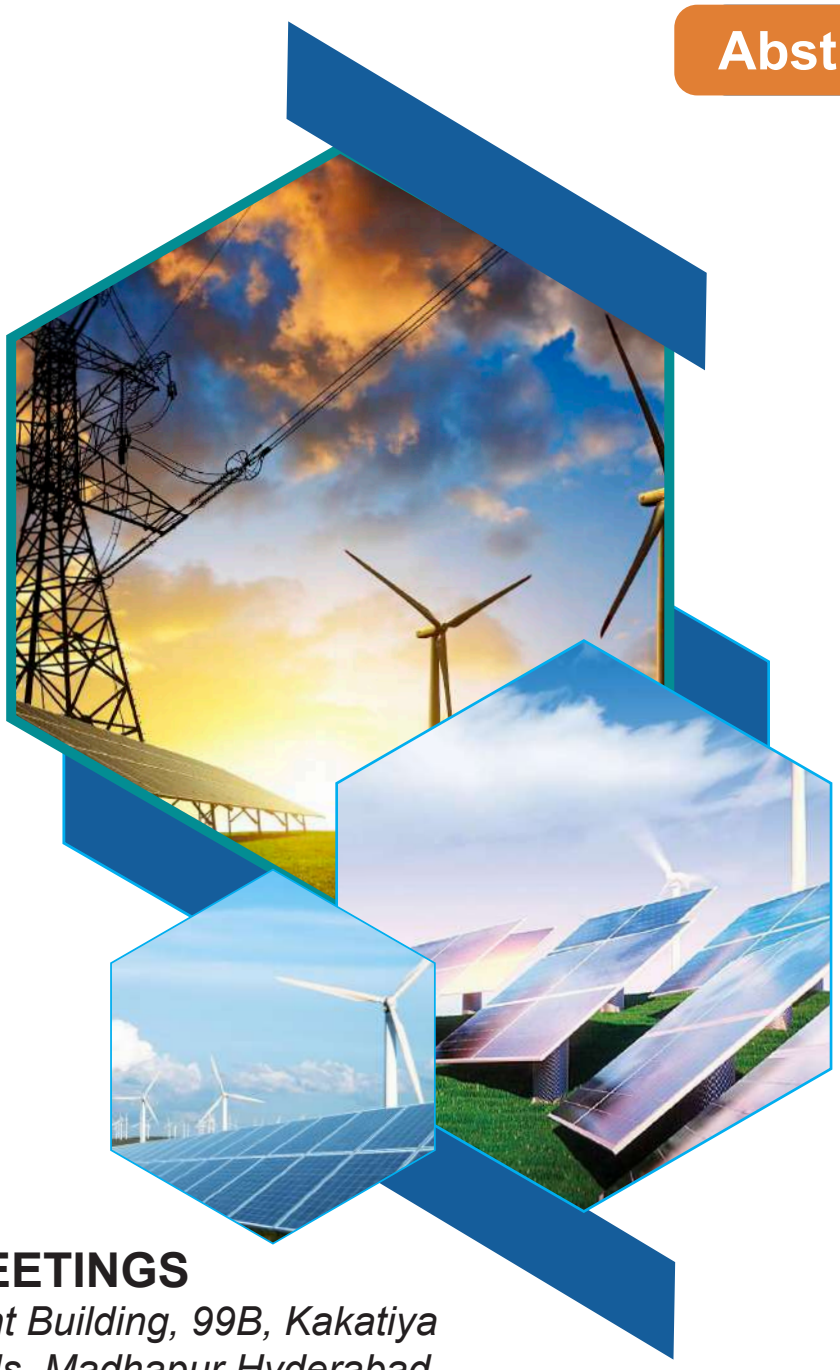
RENEWABLEMEET2023

March 13-15, 2023 | Rome, Italy

Location: *"Sheraton Parco de" Medici Rome Hotel*
Viale Salvatore Rebecchini 39, Rome, Italy

Abstract Book



ALBEDO MEETINGS
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FOREWORD

Dear Colleagues,

It is our pleasure to invite all scientists, academicians, young researchers, business delegates and students from all over the world to attend the International Conference on Renewable and Sustainable energy conference will be held in Rome, Italy during March MARCH 13-15, 2023.

RENEWABLEMEET 2023 Conference provides a platform of international standards where you can discuss and share persuasive key advances in Renewable and Sustainable Energy. In addition to Presentations, Workshops, and Discussions, the conference also offers a unique venue for renewing professional relationships, networking and for remaining up-to-date variations in our challenging and expanding discipline.

RENEWABLEMEET 2023 we have not only increased the number of opportunities for you to network with colleagues from across the world but also introduced more focused sessions that will feature cutting edge presentations, special panel discussions, and livelier interaction with industry leaders and experts.

We’re looking forward to an excellent meeting with scientists from different countries around the world and sharing new and exciting results in Renewable and Sustainable energy.

COMMITTEES

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Why Soft, Solution Processing(=Low-EnergyProduction) of Advanced Nano-Materials is Difficult but Necessary for Sustainable Society?

Masahiro YOSHIMURA

Distinguished Chair Professor, Dept of Mater.,Sci. and Eng., National Cheng Kung University, Tainan,Taiwan

Prof. Emeritus. Tokyo Institute of Technology, Japan

Abstract

Modern our society has been developed with various advanced nano-materials. Most of advanced materials, Metallurgical materials, Semiconductors, Ceramic materials and Plastics have been used in wide area of applications like structural, mechanical, chemical, electrical, electronic, optical, photonic, biological, medical, etc. Most of them except for bio-polymers & bio-minerals have never been produced via biological systems. Thus they have generally been fabricated artificially and/or industrially by so-called high-technology, where high temperature, high pressure, vacuum, molecule, atom, ion, plasma, etc.,in a particular chamber with limited volume have been used for their fabrications, then consumed huge amount of resources and energies thus exhausted huge amounts of wastes: materials, heats and entropy. To save this tragedy, we must consider “Cascade use of Heats”, and “Low energy Production of advanced nano-materials via water-based industries.” Bio-inspired processes, which mean that "Learn from Bio-systems then Exceed them" and/or exceed “Green Technology mostly based upon Bio-systems". They should also be necessary for SDGs (Sustainable Developing Goals.)

We have challenged to fabricate those advanced inorganic materials with desired shape/size/location,etc. directly in low energetic routes using aqueous solutions since 1989 when we found a method to fabricate BaTiO3 film on Ti substrate in a Ba(OH)2 solution by Hydrothermal Electrochemical[HEC] method at low temperatures of 60-200 C. We proposed in 1995 an innovative concept and technology, “Soft Processing” or “Soft, Solution Processing,” which aims low energetic (=environmentally friendly) fabrication of shaped, sized, located, and oriented inorganic materials in/from solutions1,2). It can be regarded as a green processing, or an eco-processing. When we have activated/stimulated interfacial reactions locally and/or moved the reaction point dynamically, we can get patterned ceramic films directly in solution without any firing, masking nor etching. Direct Patterning of CdS, PbS and CaWO4 on

papers by Ink-Jet Reaction method. Furthermore, we have succeeded to fabricate BaTiO3 patterns on Ti by a laser beam scanning3) and carbon patterns on Si by plasma using a needle electrode scanning directly in solutions4). Successes in TiO2 and CeO2 patterns by Ink-Jet Deposition, where nano-particles are nucleated and grown successively on the surface of substrate thus become dense even below 300 C will be presented. Nano-structured films will be also talked. .A recent novel subject, Soft Processing for various nano-carbons including Graphene, functionalized Graphene and Mxene will be introduced. Where we have succeeded to prepare functionalized Graphene Ink via successive processes under ambient temperature and pressure conditions.5-8) In addition we propose Heat cascades for Materials Fabrication to elliminate wastes (Heat and materials =Entropy).,9)

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The Role of Atmospheric Water Harvesting Systems in Green Roofs and Walls

Fotis Sotiropoulos

Department of Nuclear and Mechanical Engineering, Virginia Commonwealth University, Richmond, VA, USA

Abstract

Wind energy is rapidly becoming a disruptive renewable energy technology with the potential to dominate the world's electric energy production portfolio. Realizing this goal, however, necessitates broadening the focus of research from the individual turbine to integrated, interconnected multi-turbine wind farms. In this talk I will discuss recent advances in developing a high-fidelity, fluid-structure interaction computational fluid dynamics framework for carrying out large-eddy simulation of atmospheric turbulence past land-based and offshore wind-farms in arbitrarily complex terrains incorporating wind turbine blade aerolasticity and turbine controllers. I will present recent results that: 1) illustrate the ability of high-fidelity simulations to serve as a powerful tool of scientific discovery by augmenting knowledge derived from laboratory and field scale experiments to uncover novel complex flow physics; 2) demonstrate the predictive capability of high-fidelity simulations when applied to utility-scale wind farms; and 3) show that coupling ambient turbulent flow with advanced turbine control strategies can reduce blade bending loads pointing to the potential of control co-design as a powerful approach for reducing the levelized cost of energy of large wind farms. Finally, I will demonstrate the efficacy of developing highly efficient LES-data-trained reduced order models using machine learning and convolutional neural networks, which pave the way for a powerful computational framework for control co-design and optimization of large wind farms.

Keywords

Turbulence, Large eddy simulation, flow structure interaction, AI-augmented models

Biography

Fotis Sotiropoulos serves as the Provost and Senior Vice President for Academic Affairs and a professor of Nuclear and Mechanical Engineering at Virginia Commonwealth University. Prior to that he was:Dean of the College of Engineering and Applied Sciences and State University of New York (SUNY)Distinguished Professor at Stony Brook University (2015-2021); the James L. Record Professor of Civil Engineering and director of the St. Anthony

Falls Laboratory at the University of Minnesota, Twin Cities (2006-2015); and on the faculty of the School of Civil and Environmental Engineering at the Georgia Institute of Technology, with a joint appointment in the G. W. Woodruff School of Mechanical Engineering (1995-2005). His research focuses on simulation-based engineering science for tackling complex, societally relevant fluid mechanics problems in renewable energy, environmental, human health and biological applications. He has authored over 200 peer reviewed journal papersand book chapters, his Google Scholar H-index is 72, and his research results have been featured on the cover of several prestigious journals. He is the recipient of: the American Society of Mechanical Engineers (ASME)Fluids Engineering Award (2023); the American Geophysical Union (AGU) Borland Lecture Hydrology Days award (2019); the American Society of Civil Engineers (ASCE) Hunter Rouse Hydraulic Engineering Award (2017); and a CAREER award from the US National Science Foundation. He has been elected Fellow of the American Physical Society (APS) and the ASME and has twice won the APS Division of Fluid Dynamics Gallery of Fluid Motion (2009, 2011).

New Solutions for Storing and Using Surplus Electricity in Methanol

Edgar Harzfeld

Stralsund University of Applied Sciences, Faculty of Electrical Engineering and Computer Science, Stralsund, Germany

Abstract

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

Keywords

renewable energies; long-term storage; synthetic methanol; grid stabilization

Biography

Edgar Harzfeld, Professor at Stralsund University. Studies and research in Leipzig and Zurich. Since 1996 at the Faculty of Electrical Engineering and Computer Science of Stralsund University responsible for electrical power supply and renewable energy systems. Since 2004 - 2022 numerous research projects on the subject of electrical energy storage technologies.

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Climate Change Action Plans: Vision, Strategies, Procedures, and Outcomes

Yosef Jabareen

Department of Real Estate and Planning, University of Reading, Reading, UK

Abstract

Cities are facing mounting levels of risk and vulnerability, stemming from social polarization, poverty proliferation, violence, and, most recently, climate change. Climate change poses new risks and uncertainties, which often lie outside our range of experience and have the potential to affect the social, economic, and physical systems of any given city, impacting urban security and threatening the safety, the well-being, and the very existence of urban people. This paper rests on recognition of the fact that in recent years, a new type of city plan has emerged in response to the risks that climate change poses to contemporary cities. By means of these climate change-oriented plans, many cities, especially in developed countries, are now grappling with climate change through a multitude of practices aimed at mitigating greenhouse emissions and adapting to the anticipated, albeit uncertain impact of climate change. These recently devised plans are the product of tremendous efforts to counter climate change risk at the city level, and their major significance lies in the role they will play in shaping spatial, social, economic, and security-related aspects of cities in Europe and other parts of the world.

Despite their great importance, however, analysts have yet to assess the nature and impact of the plans at the national and local levels and their possible effect on the environment and on society. This paper aims to help fill this gap and examines the nature, vision, outcomes, practices, and impact of these crucial plans, as well as their contribution to the resilience of our cities and to global efforts toward reducing greenhouse gas emissions. The main objective of this study is to examine the recently issued inclusive, master, and strategic climate change-oriented plans for cities around the world, to assess their contribution to the efforts to cope with climate change risks, and to investigate their social policies and practices.

The study develops a framework to assess these plans and their concepts, strategies, visions, and outcomes. The study analyzed about 100 climate change-oriented plans around the world. It concludes that climate change and the many uncertainties it entails, challenge the concepts, procedures, and scope of conventional approaches to urban planning. Practically speaking, city planning serves as a synergetic vehicle, integrating social, mitigation, adaptation, economic, and spatial policies within each single plan. The power of plans is precisely this ability of incorporating the spatial and the social as well as other aspects in one frame. A Plan, then, is a frame that interprets social reality through ‘imagined’ representations of spatiality.

Keywords
Adaptation; Mitigation; Cities; Plans

Biography
Yosef Jabareen is a Professor at the Faculty of Architecture and Town Planning, Technion (Israel). This academic year (2022-2023), he is a visiting professor at the Department of Real Estate and Planning, University of Reading. Yosef graduated from Harvard University and previously was a lecturer and visiting scholar at MIT. He is a theorist in urban planning, where he focuses on city planning practices and their critical impact on sustainability, climate change, and social justice. Yosef is interested in the relations between the state and social, ethnic, and racial groups in planning and space production. He has published articles and books on the role of state planning in Israel and how it has been forging different spatial statuses among ethnic groups. In the climate change context, his recent book, The Risk City: Cities Countering Climate Change-Emerging Planning Theories and Practices around the World, contributes to understanding how cities worldwide cope with climate change-related risks and uncertainties and how they should be planning to become adaptive and more resilient.

Sustainable IoT in the Realms of Autonomous/Electric Vehicles

Xavier Fernando

Electrical, Computer and Biomedical Engineering Department, Toronto Metropolitan University, Toronto, Canada

Abstract

The Internet of Things (IoT) has been changing the way we live. It plays a key role in transforming society to create an interconnected globe. The world is increasingly populated with sensors and connected devices that automatically communicate, make decisions and perform complex tasks. Autonomous/electric vehicles good examples of complex IoT nodes that fuse information from a multitude of sensors plus 5G++ wireless networks and perform control operations in seconds. Especially electric vehicles are important in reducing the carbon footprint. Vehicular communications, Artificial Intelligence and Machine Learning algorithms play a vital role in realizing the benefits of autonomous/electric vehicles in saving energy.

There are a few issues in realizing a sustainable transportation sector. Mainly the 'range anxiety' faced by the commuters and the 'demand anxiety' faced by electricity providers. Systematic application of various IoT/AI based solutions and hybrid energy storage approaches will alleviate some of these issues. In this presentation, energy saving potential by autonomous/electric vehicle deployment and, a few approaches to overcome the hurdles will be highlighted.

Keywords

IoT, AI, ML, Electric Vehicles, Autonomous Vehicles

Biography

Xavier Fernando is a Professor at Ryerson University, Toronto, Canada. He has (co-)authored over 200 research articles, three books (one translated to Mandarin) and holds 3 patents. He is the Director of Ryerson Communications Lab that has received total research funding over $3.2 Million since 2008 from industry and government.

He is an Associate Editor for the IEEE IOT Journal. He was an IEEE Communications Society Distinguished Lecturer and delivered 70 invited talks all over the world. He has chaired the IEEE Toronto Section (2012-13) and IEEE Canada Central Area (2016-17) under IEEE Region-7. Currently he serves as the IEEE Canada Vitality Coordinator.

His work has won 30 awards and prizes so far including, number of IEEE awards, Professional

Engineers Ontario Award in 2016, IEEE Microwave Theory and Techniques Society Prize in 2010, Sarnoff Symposium Prize in 2009, Opto-Canada best poster prize in 2003 and CCECE best paper prize in 2001. Ryerson University nominated him for the Top 25 Canadian Immigrants award in 2012 in which was a finalist. He has been in the organizing/steering/technical program committees of numerous conferences and journals. He was a visiting scholar at the Institute of Advanced Telecommunications (IAT), UK in 2008 and MAPNET Fellow visiting Aston University, UK in 2014.

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Direct Model Predictive Control of Quasi-Z-Source Inverters

Ralph M. Kennel

Electrical Drive Systems and Power Electronics, Technical University, Arcisstr. 21, 80333 Muenchen, Germany

Abstract

In 2002, the topology of the Z-source inverter was proposed to overcome the limitations of traditional voltage source inverters such as the boosting mode and the problems of short circuit. The idea of this topology is based on an impedance network (Z network) which is used to replace the traditional DC link.

In operation an additional zero state appears following to the leg shoot-through of one phase, two phases or three phases, this case is not allowed in the control strategy of the traditional inverter. This alternative topology gives more flexibility and allows boosting the voltage across the DC- Link bus.

Most publications about impedance source inverters claim, that these are not superior to traditional voltage source inverters – especially their efficiency and dynamics are worse. We can show, however, that the reason for this lies in the control of the Z-source inverter. Traditional control (cascaded multi-channel PI control) is not really capable to control this system, because the number of control variables is very high, the cross couplings are more significant and the time constants are close to each other. Predictive control is a solution enabling the impedance source inverter to provide better performance for the power electronics.

These advantages might allow the proposed topology to be widely used in several industrial applications, especially in the distributed renewable energy power systems.

Keywords

Impedance Source Inverter; Predictive Control; Z Source Inverter

Biography

Ralph M. Kennel received his Dr.-Ing. (Ph.D.) degree from the University of Kaiserslautern in 1984. From 1983 to 1999 he worked for Robert BOSCH GmbH (Germany). From 1999 to 2008 he was Professor for Electrical Machines and Drives at Wuppertal University (Germany). Since 2008 until 2022 he has been Professor for Electrical Drive Systems and Power Electronics at Technische Universitaet Muenchen (Germany).

Dr. Kennel is a Senior Member of IEEE, a Fellow of IET (former IEE) and a Chartered Engineer in the UK. Within IEEE he is Treasurer of the Germany Section.
In 2018 Dr. Kennel received the Doctoral degree honoris causa from Universitatea Stefan cel Mare in Suceava (Romania).
Dr. Kennel has received in 2013 the Harry Owen Distinguished Service Award from IEEE-PELS, the EPE Association Distinguished Service Award in 2015 as well as the EPE Outstanding Achievement Award in 2019.
Dr. Kennel was appointed “Extraordinary Professor” by the University of Stellenbosch (South Africa) from 2016 to 2019 and as “Visiting Professor” at the Haixi Institute by the Chinese Academy of Sciences from 2016 to 2021. There he was appointed as "Jiaxi Lu Overseas Guest Professor" in 2017. In 2018 Dr. Kennel was appointed Guest Professor at Harbin Institute of Technology (HIT), Harbin, China. In 2019 Dr. Kennel was appointed „Honorary Chair Professor“ ("distinguished visiting professor") at Shandong University in Jinan, China
.

Research and Development for Renewable Energy Integration as Primary Power Generation Sources

Hideo Ishii

Advanced Collaborative Research Organization, Waseda University, 513 Wased at surumakicho, Shinjuku-ku, Tokyo 162-0041, Tokyo Japan

Abstract

In this presentation, I will introduce a Japanese national project related to technological development to spread renewable energy such as photovoltaic power generation and wind power generation, which is variable and interconnected via inverters, as the main power source in the power system. We describe the numerical simulation research conducted by our group in a project funded by NEDO (New Energy and Industrial Technology Development Organization) to monitor the state of inertia drop in electric power systems and its countermeasures, as well as a project to maintain an appropriate voltage in distribution systems. Regarding the inertia reduction of the power system, we created a model system that reflects the characteristics of the Japanese power system, and examined the effect of adding an inverter with a pseudo-inertia function to the renewable energy power supply. On the other hand, with regard to the voltage problem of the distribution system, a method of adjusting the power factor of the inverter for photovoltaic power generation was examined based on a model system simulating a typical distribution system in Japan. The installation of first-generation smart meters to all consumers will soon be completed across Japan, and the specifications for next-generation smart meters have already been decided, and not only electricity consumption but also voltage values on the meters will be measured. I also describe research on improving voltage control performance by utilizing voltage measurements of smart meters.

Keywords

Renewable energy generation, Power system inertia, Voltage problem, Smart meters

Biography

Hideo Ishii joined Tokyo Electric Power Company (TEPCO) in 1988. He was a visiting scientist in Massachusetts Institute of Technology from 1989 to 1991. He received Ph.D. from the University of Tokyo in 1996. From 2010, he has been engaged in some major smart grid related National projects in Japan as an organizer. He is now a Professor with Advanced Collaborative Research Organization for Smart Society (ACROSS) at Waseda University. His

current activity is in Electric Energy System, especially regarding Demand Response (DR) and integration of distributed energy resources (DER) including renewable energy. He has been leading DR standards in Japan. Since August 2020, he has been a Chair of IEC TC 8 SC 8C.

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Energy Elevation of the Population as a Way to Reduce External Energy Consumption

Doepp, Manfred MD

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Abstract

The energy consumption of mankind is too great. All experts agree on this. Among other things, this is due to ingrained behaviors that could be changed. For example, in the so-called 1st world, it is common practice to use air conditioning to raise room temperatures to 22 degrees centigrade in winter, whereas in summer temperatures are often lowered to 18 degrees centigrade. However, humans can live with temperatures between 20 and 30 degrees centigrade without any problems.

In cabs and public transport worldwide, it is common practice, especially in hot countries, to set the air-conditioning systems of motor vehicles to 18 degrees as well.

We see an important reason for this in the fact that the energy status of many people is not optimal. This concerns the biochemical energy of the ATP, the membrane potentials of the cells and mitochondria, as well as the psychic energy of the Chì/Prana/Od.

However, means exist to treat, alter and normalize these human energy phenomena. These include, above all, the adaptogens.Adaptogens or adaptogenic substances[1] are used in herbal medicine for the claimed stabilization of physiological processes and promotion of homeostasis.The concept of adaptogens was originally created in 1947 to describe a substance that may increase resistance to stress.

Adaptogens can increase stress resistance to the following factors:

- adverse environmental factors (external) such as cold, heat, noise, pollutants
- unfavorable psychological factors (internal) such as anxiety, depression, etc.[6][7]

-adverse or high physical stresses such as athletic competition and training[3].

Adaptogens also exert a positive effect on stress-induced diseases.[8] They can curb long-term damage from e.g. long-term stress and protect cellular structures.[3] Moreover, they can improve attention span[9] and mental performance, especially in the case of stress-related fatigue and exhaustion, as well as increase resilience.[5][6] Furthermore, they can improve physical recovery in athletes.[3]

These stress-shielding effects of adaptogens lie in maintaining the balance of various mechanisms associated with the hypothalamic-pituitary-adrenocortical axis. These include the regulation of key mediators of the stress response, including stress-activated c-Jun N-terminal kinases (JNK), chaperones, nitric oxide, and cortisol[5][10].

Examples of plants and mushrooms said to have such effects include Korean Ginseng, Siberian Ginseng, Morinda citrifolia,Noni, Shiitake, Reishi/Ling-zhi, Maitake, Almond mushroom, Schisandra, Rhodiola, Ashwaganda,Tulsi, Jiaogulan, Maca, Kalmegh, Astragalus mong., Cordyceps, and Cannabis/CBD.[39]

It is important to distinguish adaptogens from stimulants. Differentiation between adaptogens and stimulants:

The difference between adaptogens (such as Rhodiola rosea, Schisandra chinensis, Eleutherococcus senticosus, etc.) and stimulants (such as caffeine, nicotine, amphetamines, etc.) is that the latter can lead to tolerance after prolonged use and have a high potential for dependence. Depending on the substance, overdoses of stimulants can cause physical side effects such as high blood pressure, rapid heartbeat and sweating, as well as psychological side effects such as aggressiveness, overestimation of one's own capabilities and insomnia.

Adaptogens, on the other hand, do not cause sleep problems[9][6][20][36] or stimulant-like side effects, even with prolonged use, as they have only a stress-protective effect, i.e., they exclusively suppress the stress response[5][8][10][13]. Nevertheless, adaptogens exhibit a measurably powerful effect both with single doses and with prolonged use, as evidenced by increased mental and physical performance, especially in the face of fatigue and stress.[37][38]

I. Brekhman established three criteria that clearly distinguish adaptogens from stimulants (2):

An adaptogen is completely harmless to the body, even when taken long-term. It shows no adaptogenic effect in normal or minimally altered bodily functions; the adaptogenic effect only comes into play in the case of a corresponding challenge (e.g. stress situation).

An adaptogen non-specifically increases resistance to a wide range of physical, chemical and biological influences.An adaptogen achieves a normalizing effect on metabolism, regardless of the direction of preceding pathological changes.[13][16]

The use of adaptogens could be an important step with the goal of reducing the excessive use of air conditioning worldwide. Energy normalization - which means usually elevation - of people is a way to reduce external energy consumption.

Low Thermal Conductivity in Defect Pyrochlores

Sepideh Akhbarifar

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Abstract

Thermoelectric properties of a material are characterized by a figure of merit $ZT=S_2\sigma T/k$. S is the Seebeck coefficient, k thermal conductivity, σ electrical conductivity, and T temperature. $S^2\sigma$, the power factor, is the electricity generated and transported. Optimizing the variables in ZT by increasing the power factor and decreasing k leads to higher ZT value. i.e., better performance of a thermoelectric material. Therefore, research focuses on developing of respective materials. Low thermal conductivity is promoted by lattice defects and strong anharmonicity. Anharmonicity can be created through several strategies, e.g., introducing oxygen vacancies, lone pair electrons, resonant bonding, and rattling of atoms within the crystal lattice. Lattice defects increase phonon scattering which reduces thermal conductivity. Oxygen vacancies belong to the most effective lattice defects. Many materials with low thermal conductivity can contain two or more types of defects.

This investigation explores defect, i.e., oxygen deficient pyrochlores ($A_2B_2O_{7-x}$), here lead ruthenate $Pb_2Ru_2O_{6.5}$ and derivatives. The crystal structure contains oxygen vacancies and electron lone pairs in its A_2O' sublattice. The backbone lattice (B_2O_6) is free of defects. The effect of both types of defects on reducing the thermal conductivity will be investigated. Fractions of Ru^{4+} in $Pb_2Ru_2O_{6.5}$ were replaced by Pb2+ to study the effect of different concentrations of lone pair electrons on thermal conductivity. Secondly, fractions of Pb_{2+} were replaced by Y^{3+} to look at the effect of oxygen vacancies. All samples were prepared at high temperature at atmospheric pressure from cold-pressed pellets of mixtures of oxides. All derivatives maintained the cubic structure of $Pb_2Ru_2O_{6.5}$. All samples were single-phased. The composition was confirmed by XRF. The thermal conductivity was measured from room temperature to 300°C.

Keywords

Thermal conductivity, Thermoelectric, defect, pyrochlore

Biography

Sepideh Akhbarifar is a research scientist at the Vitreous State Laboratory/Physics Department of 'The Catholic University of America' in Washington, DC, and teaches as adjunct professor in the School of Engineering. She holds a Ph.D. in physic and two masters' in

chemical engineering and in nuclear environmental protection. Her research interests focus on environmental protection, including energy efficiency, reduction of CO_2 emissions, and clean air. Her research comprises currently thermoelectric ceramics, low CO_2-emitting cement (geopolymers) for construction and to fixate long-lived radionuclides, and cyclone de-dusters. Sepideh holds two patents and was honored as 'Young Women Inventor 2010' by the National Elites Foundation in Iran. She publishes widely and has contributed a chapter to a book on thermoelectricity. She presented her work worldwide at scientific conferences, many times as invited- and keynote speaker. Sepideh is actively engaged in several scientific societies and as a reviewer for several journals. At the MRS Fall meeting 2022 in Boston she was the lead organizer of Symposium EQ_{01} 'Thermoelectricity'.

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Can The Tree Save The Forest?

Orlando R. Baiocchi*, Tina Nailor* and CleonilsonProtasio de Souza****

*University of Washington Tacoma, 1900 Commerce Street, Tacoma, WA 98467, USA
**Universidade Federal da Paraiba, UFPB, Joao Pessoa, Paraiba, Brazil.

Abstract
Forest fires have been a major disaster in the history of humankind. The damage caused by those fires on the environment, on the economy, and the losses of life are devastating. Their forecast through the monitoring of the conditions that lead to their occurrence has been a constant challenge, emphasized by the vast and remote environments of forests. In this paper, we propose the use of a self-energized wireless sensor network that could replace or be combined with current processes of monitoring. This system uses harvested energy from the trees through the thermoelectric effect. The difference in temperature between the center of a tree and its external surface produces electricity at very low voltages. A sustainable electronic circuit makes it possible to raise these voltages to the threshold necessary to power the sensor network independently of chemical batteries, the most important aspect of this proposal. This makes the proposed system not only adaptable to the challenging remote locations by using 100% renewable energy but also expands the environmental and economic possibilities faced by monitoring systems today. Fundamental research, mathematical modeling, and experimental implementation necessary to advance this proposal have been done through an international cooperation involving the University of Washington Tacoma, the University of Paraiba, Brazil, and the University of the Azores, Portugal. Several publications and presentations at international conferences have shown the results obtained so far and have demonstrated the viability of this proposal.

Keywords
Energy, Harvesting, Forest, Fires

Biography
Orlando R Baiocchi is a Professor in Electrical Engineering and former Director of the Institute of Technology at the University of Washington Tacoma, USA. He has a Ph. D. in Electrical Engineering from the University College London, England. He has held a number of teaching, research, and administrative positions both in the United States and in Brazil. He has also led

many activities of international cooperation, more recently with universities in Brazil, Spain, and Portugal. His areas of expertise include Electromagnetics and Wave Propagation, Linear Systems, Technology and Society, Ethics, and Engineering Education. Current research also includes wireless network sensors for environmental monitoring, and energy harvesting. He has more than 100 publications in all these areas. He has been a reviewer for several institutions including the IEEE, the American Board of Engineering and Technology, the American Society for Engineering Education, and Momentum Press.

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An Advanced Software Tool for the Optimal Management of Photovoltaic Plants with Storage Systems and Programmable Loads

Gianfranco Rizzo[1,2], Maurizio Mirra[1], Francesco Tiano[1*], Matteo Marino[1,2]

[1)]University of Salerno, Italy; [2)] ePowerIng, spin-off of the University of Salerno, Italy

Abstract

The increasing diffusion of Photo Voltaic (PV) plants requires the recourse to smart managing techniques in order to maximize their benefits both in term of economic outcomes for the user and of environmental impact. In the paper, an advanced predictive model is presented, able to optimize the management of a PV plant including an energy storage system and programmable electric loads.

It includes state-of-art models of solar radiation considering the effects of cloudness, demand forecast based on regression models and non-linear constrained optimization algorithms. The model is also provided by a web interface, based on a server-client architecture. Some applicationsto an industrial plant and to energy communities are presented and the results discussed.

Keywords

Photovoltaic; Optimization; Forecast; Software

Biography

Gianfranco Rizzo. Born in Naples (1952). Degree cum laude in Mechanical Engineering at University of Naples (1975). Full Professor of Mechanical Engineering at University of Salerno. Work at FIAT (1978), Research National Council of Italy (1979-81), University of Naples (1982-1992), University of Salerno (1992-2022).

Chair of Mechanical and Management Engineering at University of Salerno (2011-2019). Chair of IFAC TC "Automotive Control" (2008-2011), Associate Editor of CEP, Board Member of International Journal of Energy Optimization and Engineering, International Journal of Powertrain, Detao Masters Academy; IAB Member of Combustion Engine Research Center, Chalmers University (2011-2012). Member of the Italian Committee at FIA (2015-2017).

Member of the Committee Regione Campania - Italian Space Agency (2016-2017). Member of the committee for PNR 2021-2027 on Sustainable Mobility (2019). Honorary Chair ECOSM18, China (2018).
CEO and Founder of eProInn and of ePowerIng, spin-off of the University of Salerno.
Awards: Best Paper Award at AVEC04, NL; DiVa Award; "Energy and Mobility 2010" H2Roma; "Io vivo sostenibile" 2011, Sarzana (Italy); "Il talentodelleidee" 2012; "Guangzhou Award for Urban Innovation" 2012. “Seal of Excellence” H2020; SMAU Award 2018.
Author of a patent "WO2011125084. KIT FOR TRANSFORMING A CONVENTIONAL MOTOR VEHICLE INTO A SOLAR HYBRID VEHICLE, AND RELEVANT MOTORVEHICLE OBTAINED BY THE KIT".
Research: About 200 papers on: Automotive Engines, Hybrid and Solar Vehicles, Thermal Power Plants, Renewable Energy Plants, CAES, Modeling and optimization of bio-economic systems.
h-index=17; Citations: 1.088 (Scopus, January 3rd, 2023).
Responsible of research projects with EU, industry and government.

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Production of Renewable Biodiesel from Thumba Oil Using Waste Marble Powder-Based Materials as Efficient Heterogenous Catalyst

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[2]Department of Chemical Engineering, The Maharaja Sayajirao University of Baroda-390001, India

Abstract
In this study, waste marble powder (WMP) is successfully utilized for the development of heterogeneous catalyst by calcination method and used in biodiesel synthesis by two-step transesterification process from thumba oil. This heterogeneous catalyst was characterized by Hammet indicators, Fourier transform infrared (FT-IR), and X-ray powder diffraction (XRD) techniques. The effect of the ball milling process on biodiesel yield was also studied. The maximum biodiesel yield reached about 92% under the optimal conditions. The optimum conditions for the highest yield were 4wt% catalyst loading, 65°C reaction temperature, 9:1 methanol/oil molar ratio, and 2 hours of reaction time. GC analysis was also done for biodiesel characterization. The catalyst activity was tested by reusability test and found small changes in biodiesel yield up to five runs. The solid heterogeneous catalyst from WMP exhibits excellent catalytic activity and stability towards the transesterification reaction, which proves that this harmful waste could be converted and used as a low-cost solid heterogeneous catalyst for biodiesel production from thumba oil.

Keywords
Biodiesel; Waste marble; Transesterification; Heterogeneous catalyst

Biography
Dr. Madhu Agarwal is Associate Professor in Department of Chemical Engineering, Malaviya National Institute of Technology (MNIT), Jaipur. She received her PhD in Chemical Engineering from MNIT, Jaipur. She is the author/co-author of over 100 scientific papers with more than 2000 citations including communications in national and international conferences. Her research interests are in the areas of biodiesel, modeling & simulation, water treatment, adsorption.

Dr. Jharna Gupta is Temporary Assistant Professor in Department of Chemical Engineering, The Maharaja Sayajirao University of Baroda. She received her PhD in Chemical Engineering from MNIT, Jaipur. She is the author/co-author of over 15 scientific paper with more than 200 citations including communications in national and international conferences. Her research interests are in the areas of biodiesel, synthesis of heterogeneous catalyst.

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Hybrid Technique for Enhanced Lipid Extraction from Microalgae Chlorella Species -a promising Renewable Biofuel Source

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Abstract

Third-generation biofuels produced from microalgal biomass hold great promise to become a reliable renewable fuel source in the future, replacing non-renewable fossil fuels. The benefit of microalgal sources for biofuel is its potential for mass production due to its high growth rate consuming less water. Ease of bio-oil extraction by cell disruption is important for the economics of biofuel processing as the bio-oil can be transformed into biofuels such as biodiesel, bioethanol, and biomethane. Ultrasound technology is one of the advanced methods used to extract bioactive compounds from various plant species by rupturing the microalgae cell wall; however, the energy requirements are high. This study presents a hybrid technique for the pretreatment of the microalgae species: chlorella biomass using a green approach that caused enhanced lipid extraction. The hybrid technique combines ultrasonication with a homogenization process using green solvents for oil extraction. Green solvents ethanol and ethyl acetate were studied for extraction of the lipids from the chlorella biomass. The biomass was emulsified in the homogenizer at high speeds and subjected to ultrasonication. Other green solvents used were aqueous deep eutectic solvents. Lipid extraction was studied using four different hybrid techniques by varying the solvents used for extraction and time for ultrasonication and homogenization in order to obtain the highest yield. This study developed a hybrid pretreatment technique that caused an increased lipid yield of 30% compared to the untreated biomass, which produced a yield of only 13%. GC MS analysis was carried out to identify the extracted components and SEM studies confirmed the cell wall breakage that released more lipids due to the hybrid processes.

Keywords

biofuel, chlorella, microalgae, lipid, extraction, hybrid technique

Biography

Dr Suja George is currently working as Professor in the Chemical Engineering Department at Malaviya National Institute of Technology, Jaipur, India. She has 26 years of teaching experience for B.Tech, M.Tech and PhD students in Chemical Engineering and has been actively involved in research for the past 20 years. Her current research interests include areas in Biofuels, Water & Wastewater Treatment, Defluoridation, Nanoparticle / Nano-adsorbent Synthesis, Microbial Fuel Cells and Process Modeling Simulation & Control. She has published more than 50 research articles in SCI journals and around 50 papers in National & International conferences. She has carried out projects related to Defluoridation of drinking water, Utilization of marble slurry powder for the production of hydroxyapatite for defluoridation of drinking water, Membrane Integrated Modified Nalgonda Defluoridation Technique for Drinking Water and Distillation Column Control using Artificial Neural networks.

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Experimental study on Hydrogen Production via Nabh4ethanolysis Using Bio-Waste-Derived Catalyst

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Abstract

The increasing level of greenhouse gases in the atmosphere due to harmful emissions from fossil fuels like coal and petroleum and their limited availability demands to look for alternative resources of energy that are clean and inexhaustible; one such energy resource is hydrogen energy, as it is clean and has high specific energy content.In this present study, household generated bio-waste is used to prepare asa metal-free catalyst to produce H2 via ethanolysis ofNaBH4.Initially, the bio-waste was treated with 1 M acetic acid and then burnt at 300˚C for 1 hour. The FESEM–EDS and FTIR were performed for the morphologies and chemical structures. The results show the successful activation of the bio-waste for its application as a catalyst for the ethanolysis of NaBH4. Subsequently, the reaction was carried out using different amounts of NaBH4 (0.15g, 0.2g, and 0.25g) and catalyst (0.1g, 0.15g, and 0.2g) at different temperatures (30˚C, 40˚C, and 50˚C) using 3 ml ethanol. Themaximum hydrogen production rate of 5676 ml min-1 g catalyst-1 wasobservedat 0.2g NaBH4, 0.1g catalyst, and 50˚C temperature by water displacement method.

Keywords

Ethanolysis, Bio-waste, Water displacement, Green gases, Catalyst

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Process Intensification of Biodiesel synthesis from Waste Cooking Oil Using Hydrodynamic Cavitation

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Abstract

This study reports the intensification of biodiesel synthesis from waste cooking oil using hydrodynamic cavitation (HC). Initially, the optimization of process reaction parameters such as oil to alcohol molar ratio (1:6.8) and catalyst concentration (NaOH; 1 wt. % of oil) was carried out by the statistical optimization technique of response surface methodology (RSM). A maximum 99% yield was obtained in 5 min of treatment time by using an orifice plate having 100 circular holes of 0.3 mm diameter each (throat perimeter/cross-sectional area (α): 13.33 mm-1) at the optimum operating inlet pressure of 7 bar. The study also indicated that the oil to alcohol molar ratio had the most significant effect on biodiesel yield rather than the individual effect of catalyst or the combined effect of molar ratio and catalyst. Afterward, biodiesel synthesis was carried out in the HC reactor to optimize cavitating devices (circular Venturi and three orifice plates). This study also presents the effect of geometrical parameters (flow area, throat perimeter, etc.) and geometrical configuration (Venturi and orifice plate) on biodiesel synthesis. LC-MS and FTIR analysis of the biodiesel product confirmed the formation of fatty acid methyl esters (FAME). The properties of the biodiesel obtained at optimized conditions using HC have been measured and compared with the standards. The energy efficiency evaluation of HC revealed that cavitating devices of higher α value significantly reduced the energy requirement for biodiesel synthesis compared to the other conventional approaches of cavitation and increased the overall reaction rate.

Keywords

hydrodynamic cavitation; biodiesel; waste cooking oil; venturi; orifice plate; energy efficiency

Biography

Dr. Virendra Kumar Saharan is currently working as an Assistant Professor in Chemical Engineering Department at MNIT Jaipur since July 01, 2013. His research interests include process intensification, wastewater treatment, advanced oxidation processes, hydrodynamic cavitation, sonochemistry, biofuels from waste biomass, and emulsification. Dr. Virendra Kumar

Saharan has developed and demonstrated energy-efficient processes using hydrodynamic and acoustic cavitation techniques for different applications such as wastewater and drinking water treatment, formulation of emulsion system for drug encapsulation, and valorization of waste cooking oil, and these have been published in high impact factor journals. He has authored 52 journal publications indexed in SCI journals, 07 book chapters so far. His Citations are 2500 with H Index 28 and i10 index of 39.

Metal-Insulator-Metal based Log Spiral Rectenna for Efficient IREnergy Harvesting

Hatem Rmili

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Abstract

This talk proposes, for the first time, a newly developed metal-insulator-insulator-metal (MIIM)-based log-spiral rectenna for energy harvesting applications. The designed resonant log-spiral antenna at 28.3 THz forwards the absorbed infrared (IR) electromagnetic (EM) radiations to the installed double insulator-based MIIM rectifying diode. The realized MIIM diode is formed by sandwiching the two insulators among the designed resonant antenna terminals (hot spot region). Antenna terminals are used as the electrodes of the rectifying diode. This novel approach ensures the maximum transfer of captured IR EM radiations by the antenna to the rectifying part with good impedance matching and thus increases the overall conversions efficiency. The study presents an in-depth analysis of the impact of the changing metal types (Au, Al, Ag, and Cu) and insulating materials (Al_2O_3, Cu_2O, Ta_2O_5, TiO_2, and ZnO with10 different formations) on the realized rectenna performance in terms of captured E-field enhancement, I/V, resistivity, and responsivity characteristics. It is found that the overall performance of the proposed double insulator-based rectenna system is better for the asymmetric configuration of Au- Al_2O_3- Cu_2O –Cu and it exhibits 100% enhanced non-linearity as compared to MIM-based configuration.

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Biography

Hatem Rmili received the B.S. degree in general physics from the Science Faculty of Monastir, Tunisia in 1995, and the DEA diploma from the Science Faculty of Tunis, Tunisia, in quantum mechanics, in 1999. He received the Ph.D. degree in physics (electronics) from both the University of Tunis, Tunisia, and the University of Bordeaux 1, France, in 2004.Actually, he is Full Professor with the Electrical and Computer Engineering Department, Faculty of Engineering, King Abdulaziz University, Jeddah, Saudi Arabia.

Professor Rmili's research interests concern applied electromagnetic applications involving antennas, metamaterials and métasurfaces. The main targeted applications are reconfigurable antennas for multi-standard wireless communications systems, security of chipless RFID systems with fractal tags, terahertz photoconductive antennas for infra-red energy harvesting, UWB nano rectennas for collection of solar energy, phase shifters for low-cost 5G communication systems, and microwave absorbing materials for stealth technologies.

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Production, Storage and Conversion of Hydrogen into Electricity: Technological Achievements and Remaining Challenges

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Abstract
Using renewable energies is mandatory to solve the question of global warming and recent acceleration of global CO_2 emissions. Nevertheless, renewable energy is inherently intermittent, costly, and location-dependent, and hydrogen may be used as a decarbonized carrier. Indeed, Hydrogen can be produced by water electrolysis when renewable electricity is available, stored, and converted later into electricity via fuel cells. Hydrogen can be used in various sectors of the economy, allowing the decarbonization of industrial sectors as production of steel, ammonia and fertilizers. It is then necessary to develop electrolysis industry with implantation of several high-power electrolysers farms, and develop heavy mobility with carbon-free hydrogen.
Development of the hydrogen sector has begun, and numerous applications exist today around the world. Nevertheless, some important challenges remain in the fields of production of hydrogen by electrolysis, its storage, and the conversion of hydrogen into electricity. They will be discussed in the presentation.

Keywords
Hydrogen; Fuel cells; Electrolysers

Biography
Annie LE GAL LA SALLE is a researcher at Institut des Matériaux de Nantes (IMN) Jean Rouxel in France. She chairs the Fuel-cell sub-group of the Electrochemical Storage and Conversion of Energy team of IMN, is a member of the executive board of FRH2 French Research network (FR2044) devoted to Hydrogen, and manages the relations between IMN and the West Atlantic Marine Energy Community. She coordinates several collaborative programs devoted to solid oxide cells, with a special interest in enlarging operating conditions of these devices (as fueling cells with gaseous mixtures issued from wastes and polluted air,

or electrolyzing seawater). She also provides several courses in engineering schools and at university.

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Optimization of Thermal Energy Storage by Thermocline Technology

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Abstract

It has received an increasing attention because integrated TES systems can largely enhancing the reliability and the dispatchability. Low-cost single storage tank based on the thermocline technology becomes an alternative to commonly-used two-tank system. However, the improper inlet/outlet manifolds may cause the strong mixing of hot and cold fluids and disturb the temperature stratification, resulting in reduced thermal performances of the storage tank.

An original CFD-based optimization algorithm is developed to determine the optimal flow distribution and restricted thermocline propagation manner using a SMT tank at high temperature as an example. A practical method for homogenizing residence times of the thermal front in order to flatten the thermocline zone is proposed, based on the insertion of a geometrically optimized perforated

The feasibility of optimization algorithm is then validated experimentally by testing of a lab-scale cylinder SMT storage tank at low temperature, by measuring the local temperature evolutions of the fluid during both the charging and discharging operations. Results show that optimized Ring-opening plate distributors can significantlyimprove the energy and exergy efficiencies under large range of operating conditions.

After that, the mechanism of dynamic mixing and the jet entrainment phenomenon are particularly addressed by measuring the flow profiles inside a rectangular SMT tank using Particle Image Velocimetry (PIV) method. The local competing relation between the convection and diffusion heat transfer mechanisms on the degradation of temperature stratification is particularly explored.

Sustainable and Efficient Mobility Services

Marilisa Botte

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Abstract

Climate change and global warming are key issues to be addressed for the survival of our planet. Obviously, an integrated approach is required to successfully face them, within which the adoption of smart and sustainable forms of transport has crucial importance. In order to reduce transport externalities (such as noise and air pollution, congestion and so on), new mobility paradigms have been developed which involve electric means, micro mobility, MaaS ecosystems, V2X communications and shared services.

For instance, the new paradigm of MaaS (Mobility as a Service) needs to be developed as public transport oriented in urban and metropolitan areas, with sustainable options acting as feeding solutions (such as shared scooter services; micromobility modes, etc.); on the other hand, it has to be able to provide tailored services in inner areas with low demand. Similarly, V2X communication and autonomous vehicles could seem to be devoid of drawbacks but, actually, it will be as if each one of us had a personal chauffeur with a strong increase in the number of trips; this could lead to safety and congestion issues. Therefore, figuring out the advantages and disadvantages of each one of the above- mentioned options results to be crucial for the effectiveness of planning decisions of our governments.

Keywords

Sustainable mobility; MaaS services; Micromobility

Biography

Marilisa Botte holds an MSc degree in hydraulics and transportation systems engineering (2014) and a PhD in civil system engineering (2018), both from Federico II University of Naples, Italy. Currently, she is Assistant Professor at Federico II University of Naples, Italy. She has authored more than 50 papers in peer-reviewed journals and conference proceedings. Her research interests include sustainable mobility, MaaS systems, transportation and urban planning, rail system analysis and management, energy-saving strategies.

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Does Shale Gas Exploitation Contribute to Regional Sustainable Development? Evidence from Chongqing, China

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Abstract
Shale gas is a growing contributor to natural gas production in China, and is seen as a key component of the country's energy transition. As a major shale gas producing region, Chongqing has large shale gas production, and high expectations for its future development. However, it is unclear how regional sustainability will be affected by this shale gas boom. To help answer this question, this paper establishes a sustainability evaluation framework covering three economic-social-environmental dimensions and 18 specific indicators; obtains a composite sustainability index of districts and counties in the Chongqing region based on the entropy weight method (EWM); and then empirically analyzes the impact of shale gas development in Fuling and neighboring districts by using the synthetic control method (SCM). Our results show that shale gas development has an accelerating effect on the growth of local sustainability levels, but that such positive benefits are relatively limited in both time and space. In terms of time, since the initiation of shale gas development in 2012, the accelerating effect largely disappeared by 2018 (with the greatest effect being in 2015), and that the effect typically lasts approximately 3-6 years. Spatially, shale gas development may only have an impact on the level of sustainable development locally, with no significant spillover effects to the nearby districts without shale gas development. These findings have implications for the future development of shale gas in both China and elsewhere.

Keywords
shale gas; regional sustainable development; synthetic control method (SCM)

Biography
Dr Yongmei Bentley is Principal Lecturer in logistics, and portfolio leader of postgraduate partnership programmes of the University of Bedfordshire, UK. Yongmei has extensive experience in programme management, teaching, research projects, and other academic

and professional activities. Yongmei's teaching and course management have covered both undergraduate and postgraduate levels in business and management subjects, but specifically in logistics, supply chain management, operations and project management. Her research Interests include: carbon challenges, sustainable logistics and supply chain management, supply chain collaboration for sustainability, food entrepreneurship, green operations management for SMEs, renewable energy and the impact of oil price on global logistics management. She has published many journal papers related to her teaching and research areas.

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Design of Energy Storage Systems for Net-Zero

Tony Roulstone

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Abstract
The reducing cost of solar and wind energy together with the commitments to net-zero emissions will mean that UK energy systems for 2050 and similarly those in many other countries will be dominated by variable renewable supplies. Electricity systems are expected to be very reliable but renewable energy is inherently intermittent. One solution this problem is energy storage. The scale and the periodic nature of the energy storage problem are explored. There are different needs for storing energy for: days, weeks and years. Therefore different storage technologies may be required for these different periods. An UK energy system with three types of storage is modelled. Also, we examine how best to schedule these store in light of the economics of renewable energy and some potential storage technologies.
The scale of energy storage needs for the UK is large - more than a thousand times that of current storage systems and storage would have a significant effect on the energy costs of a 2050 energy system based largely on solar and wind.
The approach and methods used could be used for any country that is planning an energy system with a majority of variable renewables and a net-zero carbon target.

Keywords
Net-zero; energy storage; renewable system modelling

Biography
Tony Roulstone established and teaches on the Nuclear Energy Masters programme in the Department of Engineering at the University of Cambridge. His research interests are the economics and safety of nuclear power with a focus on Small Modular Reactors. He is leading several SMR research projects in the UK. Also, he is involved with projects on the industrialisation and the economics of fusion.

He was a visiting Professor of Nuclear Engineering at City University in Hong Kong 2012-2018. He writes for the technical press on nuclear economics and policy matters and he is leading a group on energy storage needs for the Royal Society Working Group on Energy Storage.

He received his degree from the University of Cambridge and has spent much of his career in the nuclear and aerospace industries, starting with UKAEA working on fast reactor systems and including 20 years at Rolls-Royce where he became Managing Director of the Nuclear Group in 1992. He has held several corporate Rolls-Royce plc roles in both aero-space engineering and strategic transformation.

He provides consultancy widely in the engineering, technology and services sectors and has completed several policy studies for Government on SMRs, and for politicians on business enterprise and on large-scale procurement.

He is a Fellow of the Institution of Mechanical Engineers, an Associate Member of the Nuclear Institute. He is an independent adviser on SMR design.

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Next Generation of Thin Film Photovoltaic's Based on Van Der Waals Compounds with Low Dimensionality

Edgardo Saucedo

Photovoltaic Group, Electronic Engineering Department, EEBE/ETSEIB, Polytechnic University of Catalonia (UPC), Barcelona, Spain

Abstract

This presentation will review the latest progresses achieved on emerging thin film photovoltaic technologies, mainly those related to inorganic materials with low dimensionality. Recently, anisotropic materials related to the quasi-one-dimensional (Q1-D) Sb2(S,Se)3 system have attracted a lot of interest from the thin film photovoltaic community, thanks to their unique combination of electric and optic properties, that can be tuned by controlling the orientation of the material. Playing with this concept, efficiencies above 10% have been demonstrated recently, with the key advantage that the absorber can be synthesized at temperatures below 400 ºC. The presentation will start with an update of the most relevant inorganic materials with low dimensionality developed until now, including the state-of-the-art of their efficiencies and their main characteristics, with special emphasis in the latest developments achieved for Q1-D $Sb_2(S,Se)_3$. Then, the future strategies to boost the efficiency above 15% will be presented, including doping and alloying strategies, as well as the synthesis of these compounds under exotic conditions. Finally, the incoming materials inspired by Sb2(S,Se)3 system, including cationic and anionic substitution will be discussed, with special emphasis on their anisotropic properties for photovoltaic applications.

Keywords

Thin film photovoltaic; Low dimensional semiconductors; Q1-D Sb2(S,Se)3; Chalco-halie compounds

Biography

Prof. Edgardo Saucedo received his PhD in Materials Physic at the Universidad Autónoma de Madrid, Spain in 2007. In 2007, he joined IRDEP (Paris, France), working in the development and optoelectronic characterization of CIGS low cost based solar cells. In 2009, he joined the spin-off NEXCIS, to further pursue their training in thin film photovoltaics, with special emphasis in technology transfer. From 2010 until 2020 he was the Deputy Head of the Solar Energy Materials and Systems Laboratory at the Catalonia Institute for Energy Research (IREC),

Barcelona, Spain. Currently he is Full Professor of the Electronic Engineering Department at the Polytechnic University of Catalonia, Barcelona, Spain, leading the Thin Film Photovoltaic Group.

He has been granted in the past with a Juan de la Cierva and with a Ramon y Cajal fellowships. He holds five patents and has authored or co-authored about 247 papers in recognized international journals, and he has more than 350 contributions to the most important Congresses in Physics, Chemistry and Materials, and more than 50 Invited Talks around the world. He has been involved in more than 35 European, Industrial and Spanish Projects, has been the coordinator of 4 FP7 and H2020 projects including KESTCELLS, STARCELL, INFINITE-CELL and CUSTOM –ART, and 4 national projects. He has supervised twelve PhD Thesis and is currently supervising five more. He has an h factor of 42 (Scopus) and over 6500 citations, and has been recently awarded with the ASEVA Toyota Award in 2020 and ICREA Academia Award in 2021.

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Use of Renewable and Sustainable Energy in Schools From Tropical Countries : Future for a Better Apprenticeship

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[2]Secretary of Science, Technology and Higher, Professional and Technological Education - Avenida Conselheiro Furtado, 2520, Belém - Pará - Brazil

Abstract

Over the years, the need for knowledge about climate issues continues to be extremely important for people's lives and survival. When it comes to the evolution in society's lifestyle, as the urbanization process intensifies, and there are changes in the natural landscapes, as well as deforestation, and other issues such as the waterproofing of urban surfaces through intensive paving and construction of buildings makes climate a variable vulnerable to change. And so, it may cause an increase in anthropogenic heat released into the atmosphere. In addition, a typical problem that accelerates with the growth of cities is the difficulty of obtaining pleasant thermal sensations, influencing the population to resort to artificial forms of heating or cooling, generating an increase in the demand for electricity. Thus, the objective of this work was to monitor and analyse the environmental conditions of the metropolitan region of Santarém, focusing on the school environment of "Colégio São Raimundo", to disseminate knowledge to students and the community about the conditions of human thermal comfort in the school environment through of knowledge about relative humidity and temperature measurements as part of the school's environmental monitoring. The period analyzed was from October 2019 to February 2020 of hourly data from 8:00 am to 6:00 pm on temperature and relative humidity of the air collected from a digital thermo hygrometer from the Instrutemp brand (ITHT2250) in order to calculate the thermal comfort index of Temperature and Humidity (UTI). It was found that the air temperature ranged from 24º to 32 ºC, October and December stood out for reaching high air temperatures around 32.8°C with temperature peaks at 1 pm. Regarding the relative humidity of the air, there was a decrease in this percentage throughout the day in all the months in which the measurements were taken. However, air humidity did not present dangerous indexes to the health and well-being of students and other visitors, and the thermal comfort index of the place of study varied on average between 74 and 86 during the measurement times in the different months, verifying There is a moderate condition of stress on thermal comfort in normal situations, which indicates the need for the government to invest in public policies to

improve school thermal comfort aimed at better learning and teaching conditions, for example, renewable energy sources use to use in splits air conditioning.

Keywords
Biometeorology; Thermal Comfort; Comfort Indices

Biography
Gabriel Costa is a meteorologist (UFPA), with PhD in Sciences (applied ecology, USP) currently effetive professor at Universidade Federal do oeste do Pará (Ufopa, Pará State- Brazil). Is research group leader IBAMA (Interaction Biosphere-Atmosphere and Micrometeorology on Amazonia). Have interest in biosphere-atmosphere interactions, with special emphasis on the energy fluxes, Greenhouse gases emissions, renewable and sustainable energy, biogeochemistry cycles over tropical ecosystems. This includes the interaction between climate and health correlations, by air pollution.

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Performance Analysis of the Glass-Glass Double-skin Façade System: Design Criteria and Examples

Silvia Brunoro

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Abstract
The aim of the paper is to provide an advance of knowledge in the field of the dynamic high-efficient double glazed envelope - called double skin glass-glass facade - born about twenty years ago in northern Europe, that can improve the overall energy balance of the building by reducing thermal losses, gaining solar energy and provide passive cooling. Reconnecting to the trend of international studies on the theme, the study proposes a substantial advance in knowledge regarding the evolution of the glass-glass double-skin facade system, the definition and classification of the general operating aspects, the use of high performance materials and devices, the compliance in relation to the main building types (residential, tertiary, school buildings) and the specific criticalities of the temperate-Mediterranean climate and the design criteria.

Keywords
Envelope; double layer glass façade; energy efficiency

Biography
Silvia Brunoro is Associated Professor of Technology of Architecture at the Department of Architecture of the University of Ferrara. Main field of research are sustainable refurbishment, energy efficiency and innovation of technologies and materials. She is author of several publication concerning energy efficiency and she has been involved in numerous national and European researches.

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Discovery of New Strain, Biosynthesis, Purification and Structure Property Relationships of Cyanobacterial Phycobilins with Special Emphasis in Oscillatoria sp. BTA 170

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Abstract

In the present investigation, the C-PC, A-PC, and PE content of Oscillatoria sp. (BTA-170) were determined to be 287.03 mg/L, 254.23 mg/L, and 82.34 mg/L. The purity index of C-PC, A-PC, and PE were determined to be 0.98−1.23, 0.78−0.0.96, and 0.85−0.99, respectively. The deactivation rate constant (kd) for C-PC, A-PC, and PE at various temperatures was evaluated and the effect of sugar on the deactivation rate constant (kd) was estimated. Results showed that, the kd value for PBPs was found to be low in the temperature range of 45°C to 55°C, but as the temperature goes up, the kd value increased. The kd value of C-PC was found to be 0.331 at 85°C, with glucose lowering the value to 0.129 at the same temperature. Fructose, galactose, and lactose can all lower the Kd value for C-PC to 0.142, 0.136, and 0.159 at 85°C, respectively. PBPs were tested for their ability to scavenge DPPH radicals at concentrations of 2, 4, 6, 8, and 10 mg/ml at 45, 55, 65, 75, and 85 degrees Celsius. In fresh conditions, the PBPs inhibited DPPH radicals by 65.82 percent, but this changed dramatically following heat treatment, and the change in inhibition percentage was studied by changing the sugar molecules. There were no significant changes in inhibition percentage at temperatures below 55°C, but it declined dramatically as the temperature was increased. At 85°C, the inhibition percentages changed from 65.82 percent to 16.45 percent, and glucose could raise the inhibition to 46.07 percent with a sample concentration of 10 mg/ml at 85°C. Similarly, with 10 mg/ml of PBPs, fructose, galactose, and lactose increase by 45.94%, 19.2%, and 45.96% at 85°C, respectively. PBPs had an IC50 of 9.52 mg/ml, which was enhanced to 30.45 mg/ml by thermal treatment at 85°C. Sugar was found to be beneficial in lowering the IC50 at all temperatures. The glucose, fructose, and lactose were productive to increase the value from 30.45mg/ml to 17.33ml/ml, 18.30ml/ml, and 17.68mg/ml respectively at 85°C. The presence of free radicals accelerates the ageing process and causes tissue damage in the body, which can lead to the development of a variety of diseases. The present findings indicate that PBPs from Oscillatoria sp. could be useful food additives for scavenging free radicals.

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Application of Multiple Electrostatic Separationsand Vacuum Pyrolysis for Rare-Earth Elements Recovery from Printed Circuit Boards

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Abstract

The aim of this study was toinvestigate the distribution of metal elements (MEs), bromine (Br), elements contained in refractory oxides (EROs), and rare-earth elements (REEs) in different fractions of mechanically treated and magnetically separated (multi-stage electrostatic separation (ESS)) waste electronic material. Additionally, low-temperature vacuum pyrolysis (T = 550 °C, p = 10 mbar) was applied to the nonconductive fraction of the separated electronic material. X-ray fluorescence analysis was used for the determination of EROs, Br, and MEs in waste electronic material (raw material, fraction after electrostatic separation, and metallic-nonmetallic fraction of pyrolysis), while inductively coupled plasma mass spectrometry was used for REEs quantification. In the first step, the electronic material was separated into three fractions by using ESS: conductive (C1), nonconductive (NC1), and mixed (M1). MEs (Cu, Sn, and Pb) and REEs were predominantly distributed in the M1 fraction of ESS, while the NC1 fraction was enriched with Br. Further (subsequent) ESS of M1 fraction revealed the dominance of MEs over Br, EROs, and REEs in the conductive fraction (C2), while Br, EROs, and REEs showed dominance in the nonconductive fraction (NC2) of separated waste electronic material. The pyrolysis applied on the NC2fraction revealed that the solid residue phase and oils were the main products accounting for 54.4% wt. and 35.4%. wt., respectively. Based on the obtained results, pyrolysis of separated waste electronic material (NC2 fraction) brought to significant enrichment of pyrolysis products with MEs, EROs, and REEs.
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Corrosion and Corrosion Fatigue of High Alloyed Steels in Geothermal Energy Production

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Abstract

In the geothermal environment corrosion fatigue may severely lower the lifetime expectancy of high alloyed steels. Therefore, the corrosion fatigue (CF) of duplex stainless steel X2CrNiMoN22-5-3 was investigated in the Northern German Basin electrolyte at 369 K using a specifically designed corrosion chamber. Although the failure mechanism is independent of surface roughness (low scatter ranges technical surface: TN=1:1.35, polished surface: TN=1.1.95), the life expectancy in purely alternating axial cyclic load to failure was clearly related to surface finish and applied stress amplitude. Specimen with technical surfaces tested at high stress amplitudes (>275 MPa) lasted longer (cycles to failure: P50% at Sa 300 MPa=5x105) than specimen with polished surfaces (cycles to failure: P50% at Sa 300 MPa=1.5x105). When applying a protective potential a significant increase of CF life range from 4.7 x 105 (free corrosion potential) to 107 cycles (potential range from USHE = –450 to –900 mV) was observed. CF damage was clearly related to lateral grain attack within corrosion pit cavities located perpendicular to the load applied. Additionally, multiple fatigue cracks and preferable deterioration of austenitic phase and intact ferritic phase. A delta-like micro crack structure and a curved path characterizes crack termination with little to no base metal deterioration. Crack initiation may be due to early pit formation resulting in depassivation but also due to local depassivation then resulting in pit formation – both initiation mechanisms lead to crack propagation and early failure. At low stress pitting is the initiating crack growth process whereas at high stress amplitudes the formation of micro cracks is reason for crack propagation and failure..

Keywords

corrosion, corrosion fatigue, geothermal energy production, high alloyed steel

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Is Determining Mean Radiant Temperature via Angle Factors Correct? A Case study: University Office Building

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[3]Energy Systems Engineering Department, Atılım University, 06830, Ankara, Turkey

Abstract
Thermal comfort is conventionally based on four environmental (air temperature, air velocity, relative humidity, and mean radiant temperature) and two personal (basic clothing insulation and metabolic rate) parameters. The air temperature, air velocity, and relative humidity can be obtained easily with simple sensors, and personal parameters can be determined by tables in international standards; however, obtaining the mean radiant temperature is more costly and time-consuming. Measurement and calculation methods and some assumptions are used to obtain the mean radiant temperature. A calculation method based on angle factors is usually utilized to determine the mean radiant temperature. Even though the total of calculated angle factors should be 1 theoretically, the total may found differ from 1. This study questions the accuracy of obtaining the mean radiant temperature via angle factors whose total is smaller than 1 and investigates the accuracy if the total of the calculated angle factors is normalized to 1. The mean radiant temperature values from the globe thermometer measurement method were taken as a reference method. A total of 417 mean radiant temperature data from measurement and calculation methods were collected in a university office building, which has a warm Mediterranean climate (Csb) according to Köppen Geiger Climate Classification, in the summer season. The results indicated that a significant error (MAPE=1.99%) occurred in the mean radiant temperature values which were obtained via calculated angle factors and the measurement method. When the total of the angle factors is normalized to 1, the error was decreased to MAPE of 1.51% for the case building.

Keywords
Thermal Comfort, Mean Radiant Temperature, Angle Factors

Biography

Mehmet Furkan ÖZBEY is a Research Assistant at Atılım University, Turkey. He is interested in thermal comfort in an indoor environment and the impacts of human behaviour on the energy efficiency in buildings.

Dr. Cihan TURHAN is an Associate Professor at Atılım University, Turkey. His main research areas are indoor and outdoor thermal comfort, psychological parameters of the thermal sensation, and their results in the energy efficiency of the buildings.

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Synergistic Gasification of Biomass in the Presence of Methane and CO_2

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Abstract

Transition from fossil fuels to renewable technologies is extremely challenging as renewable energy sources like solar, wind, and biomass are highly unreliable, subject to variation in geography and local climatic conditions. Transition from fossil hydrogen to renewable hydrogen is bridged by the unique 'natural gas – biomass co-processing. At WVU, hydrogen rich syngas production through renewable hardwood biomass gasification was obtained through synergistic natural gas – biomass co-processing. About 5% methane co-processed with biomass at 850oC on Fe-Mo/CNF catalyst produces H_2:CO ratio of 6 with a very low CO_2 concentration of < 5% in the syngas. About 60 to 80% hydrogen was obtained in the product gas on the Fe-Mo/CNF, Ni-Mo/CNF, and Mo-Pd/CNF catalysts. Synergistic methane activated biomass gasification could be a promising technology for hydrogen rich syngas production as it requires very low concentrations of methane which could be obtained from flare gas. Flare gas is natural gas flared during commissioning of new wells or maintenance of existing wells in shale gas field. On-site utilization of flare gas with biomass could greatly curb CO_2 emission while producing hydrogen rich syngas. CO_2 utilization in the methane activated biomass gasification was studied by adding 1% CO_2 to the gas feed. CO_2 and CH_4 activation at high temperature was performed on Fe, Ni, and Pd active sites while Mo active sites are responsible for deoxygenation of oxygen rich biomass. In-situ conversion of raw biomass co-processed with 5% methane produces H2-rich syngas on the carbon nanofiber supported catalyst. CNF support is also obtained from the biomass feedstock by impregnation with metals and pyrolysis at 700°C. This process is 95% renewable with net reduction in CO_2 emissions by recycling of CO_2. Detailed mechanistic investigation through molecular simulations helped ascertain the unique reaction pathway occurring on dual active sites on a transition metal doped β-Mo_2C-CNF catalyst. Application of renewable technologies is on the rise especially in power generation but is still far from being a mainstream source of hydrogen and power.

Keywords

Biomass; hydrogen; carbon dioxide; biomass gasification

Biography

Dr. Jianli Hu is a Chair Professor and the Director of Shale Gas Center at West Virginia University. He leads an interdisciplinary team carrying out cutting edge research in natural gas conversion and renewable energy utilization. His research interests span across the fields of reaction engineering, surface chemistry, plasma and microwave-enhanced catalytic reactions. Before joining WVU, Dr. Hu led innovation efforts at Koch Industries, Pacific Northwest National Laboratory and BP Oil. He has been granted 40 U.S. patents and published over 100 peer-reviewed journal articles and 200 conference papers.

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In-situ Modification of Anodic Titanium Oxide and Its Application in Energy Field

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Abstract

Anodic titanium oxide (ATO) in the form of titania nanotubes or nanopores is produced during electrochemical anodization (EA) of titanium. Anodization is a relatively inexpensive, simple, and quick method to produce nanostructured oxide on a surface of valve metals and their alloys. Moreover, the anodizing conditions (like temperature, electrolyte type, pH, applied voltage and treatment time) applied during process, influence the morphological features (i.e., geometry and arrangement of nanopores or nanostructures) and thus properties of the resulting nanostructured oxide.

ATO is widely applied towards photocatalysis, solar cells, purification, and biomedical implants. A lot of significant research has been focused towards optimizing anodization process to fabricate controlled, stable, and reproducible nanostructures of ATO. Among these, the use of organic-based electrolyte, like ethylene glycol (with NH4F and water), to anodize Ti has been widely applied and researched. Interestingly, this is possible to modify ATO morphology, composition and properties by changing composition of electrolyte.

In this study, the details of electrolyte composition in Ti anodization to fabricate controlled nanostructures with incorporation of selected elements will be given. The bandgap of resulted anodic oxide will be presented.

Keywords

Titanium Anodization; Anodic Titanium Oxide; In-situ Incorporation; Bandgap

Biography

Dr. Marta Michalska-Domanska is Senior Assistant Professor at Institute of Optoelectronics, Military University of Technology, Warsaw, Poland. She graduated in Physical Chemistry at University of Warsaw, completed her PhD at Military University of Technology (MUT, Poland). She took part in COST project (Action MP 1302) in intership in University of Tybingen, Germany. She done her postdoc in corrosion science (AlMagic grant) at TU Delft, Netherlands. In 2021 Dr. take part in postdoctoral fellowship at Universidad Complutense Madrid, Spain.

She is an expert in the electrochemical synthesis of nanomaterials, especially in anodization of aluminium and titanium as well as influence of the materials state on its properties. She works in materials science field and focus especially on synthesis and characterization of nanomaterials for photovoltaics, biomedical and spectroscopic application.

She received two awards for her PhD thesis: MUT Rector's Award for distinguished PhD thesis and The Polish Prime Minister Award for the best PhD thesis from all the defended thesis in Poland last 2015. In 2016 she received Scholarship for Young, Outstanding Researchers from the Polish Ministry of Science and Higher Education for the entire academic work. She was Principal Investigator in 6 big projects. She is also Evaluator in Maria Skłodowska-Curie Action projects, funded by EU and in national funding Institutions.

She was Invited or KeyNote Speaker at 14 International Scientific Conferences. She is reviewer for many high impacted journals, such as Electrochimica Acta, Langmuir, Corrosion Science etc. Dr Michalska-Domanska is Co-Editor of 5 books, co-author of 48 scientific publications, 13 chapters and her H-index is 17 (according to Scopus).

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Assessment on Energy Efficiency and CO2 Emission Inhibition Effect of Renewable Hydrogen Supply Chain

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Abstract

The power produced from renewable energy sources should ideally converted into H2 for the purpose of long-term storage and long-distance transportation. In this study, it was assessed 3 GW class of wind turbine were installed in Yokkaichi city, and that the electricity generated, estimated based on meteorological data, was converted into H_2 by electrolysis of water and transported to consumers in Yokkaichi city, Nagoya city or Kyoto city after (1) compression, (2) liquefaction, (3) conversion into compressed methane or liquefied methane, (4) conversion into organic hydride, and (5) conversion into ammonia. These procedures for conversion and transportation were assessed from the viewpoint of energy efficiency, CO_2 emission inhibition and resilience evaluation. In addition, the assist effect of a cold heat generated from phase change of LNG on liquefaction of H_2 was also evaluated from the viewpoint of energy efficiency. As a result, the energy consumption and CO_2 emission during the transportation in the case of liquefied methane are smaller compared to the other cases. The annual available power energy which is supplied for two-person household satisfied the energy demand of 36.7 households. When H_2 is used for mobility as a fuel after transportation, the CO_2 emission inhibition effect is the largest compared to a gasoline vehicle. The energy loss ratio is the smallest in the case of liquefaction of H2 utilizing the cold heat generated from phase change of LNG. The energy assist ratio of the cold heat provided by LNG to the total energy needed for liquefaction process of H_2 is 64.3 %.

Keywords

Renewable Energy; Smart Energy Network; Cold Heat Generated from Phase Change of LNG; CO_2 Emission Inhibition Effect

Biography

Akira Nishimura received the B.S. Eng., the M.S. Eng. And De. Eng. degrees in Chemical Engineering from Nagoya University, Japan in 1995, 1997 and 2000, respectively. He worked at Center for Integrated Research in Science and Engineering, Nagoya University as research associate from 2000 to 2002. He moved to Mie University in 2002 and an assistant professor and promoted to associate professor from 2014. His current researches are smart city and smart network utilizing renewable energy such as photovoltaic and wind power acctively, H_2 production from biogas dry reforming in membrane reactor, clarification on heat and mass transfer characteristics of PEFC and CO_2 reduction by photocatalyst using solar light. He has published 91 papers in reviewed journals.

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Recovery of Waste Energy to Produce Useful Utilities from Hot and Cold Systems

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Abstract

A brief overview is first presented on waste energy recovery. Two thermal energy recovery plants are then presented – one hot and the other cold. Specifically tailored for tropical countries, the 2 thermal plants can contribute to greater energy and cost savings, and are also more space-efficient. Additionally, they can significantly reduce energy consumption and trim the amount of carbon dioxide emitted to the environment by 2 to 4 per cent for countries at business-as-usual levels while meeting varying needs of electricity, potable water, cooling and heating. The first plant comprises a thermally-integrated smart plant that uses natural gas as the main energy source to power micro turbines to produce electricity. Waste heat from the exhaust gas generated is efficiently recovered and channelled back to drive heat-driven chillers to produce chilled water, which is required to cool and dry air for air-conditioning. The plant is also able to recycle waste water of any kind to produce portable water. Hot water or steam can also be produced by tapping into the waste heat generated from the plant. In the second plant, cold energy is harvested during LNG to CNG conversion and utilized to deliver useful utilities, namely, chilled water, electricity, cooled dry air and potable drinking water. Experiments conducted have highlighted that up to 80% of the cold energy can be harvested which would otherwise be released to the environment. The innovative aspect of the two presented thermal plants entails the cascading hierarchy of waste energy, both hot and cold, and optimal recovery process to produce invaluable utilities in the smartest manner. These plants are designed and engineered to fulfil the demand of energy conservation and emission reduction during normal operation, as well as during peak-load demands in order to strengthen the energy-water-environmental nexus.

Keywords

Thermal Energy; Heat Recovery; Cold and Hot Energy; Energy Efficiency

Biography

Dr Chua Kian Jon is currently an Associate Professor with the Department of Mechanical Engineering, National University of Singapore. He has been conducting research on renewable energy systems and heat recovery systems since 1997. He has conducted both modelling and experimental works for specific thermal energy systems. He is highly skilled in designing; fabricating; commissioning and testing many sustainable energy systems to provide for heating, cooling and humidity control for both small and large scale applications. He has been elected to several fellowships including Fellow of Royal Society, Fellow of Energy Institute and Fellow of IMechE. He has more than 200 international peer-reviewed journal publications, 6 book chapters and two recent monographs on advances in air conditioning (https://www.springer.com/gp/book/9789811584763 and https://www.springer.com/gp/book/9783030808426). He was highlighted among the top 1% of scientists in the world by the Universal Scientific Education and Research Network and top 0.5% in the Stanford list of energy researchers. His works has garnered more than 12,800 over citations with a current h-index of 60. Further, he owns more than 10 patents related to several innovative cooling and dehumidification systems. On a regular basis, he has been invited to deliver many plenary and keynote talks on his research findings. He is the Principal Investigator of several multi-million competitive research grants. Additionally, he has been awarded multiple local, regional, and international awards for his breakthrough research endeavours.

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Spray Flash Processes: Breakthrough Technologies for Renewable and Sustainable Energy Materials

Denis Spitzer*, Jakob Hübner, Anna Ott, Marc Comet, Guillaume Thomas, Pierre-Henry Esposito, Guillaume Galland, Guillaume Direur

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Abstract

Whether for energetic materials, for fuel cells, for batteries, for photocatalysis, or for new medicaments, new formulation and synthesis technologies that imply vacuum spray are currently revolutionizing many key domains such as health, security and energy transition. These new technologies are essential to produce breakthrough nanometric and submicron-sized materials of sufficient quality and quantity. After presenting the need of different materials, the presentation will focus on the description of two formulation and synthesis processes conceived and studied at the NS3E laboratory: the so-called Spray Flash Evaporation (SFE) process for formulation and the Spray Flash Synthesis (SFS) process for synthesis. The presentation will in particular insist on the versatility of pure and composite materials accessible with SFE and SFS, but also on the wide scope of applicative domains covered. After describing the two processes, we will present different materials previously designed and produced by both processes. These materials include organics such as energetic materials and more efficient active pharmaceutical ingredients, with high bioavailability, but also different inorganic materials for fuel cells, photovoltaic, and superconductor applications. Due to the breakthrough character of both processes, we will also describe the cutting-edge metrologies, used to investigate them on a fundamental aspect. These metrologies are used in real-time (ex. Phase Doppler Particle Analysis) during the functioning of the processes or in an off-line manner (ex. AFM-Tip Enhanced Raman Spectroscopy) to characterize the obtained products. Different examples of real-time solvent droplet sizes and velocities analyses to understand the spray processes will be showed. In the case of the off-line material analysis, examples of structural material characterization on nanoscale level will be highlighted.

Keywords

Spray Flash Evaporation; Spray Flash Synthesis; AFM; TERS

Biography

Dr. Habil. Denis SPITZER received his PHD in physical chemistry in 1993 at the University Louis Pasteur of Strasbourg. He is the founding and current Director of the NS3E Research Laboratory UMR 3208 ISL/CNRS/UNISTRA. He conducts research in continuous formulation and synthesis processes of organic, inorganic and organic/inorganic nano- and submicron sized materials such as pharmaceutics and materials for the energy transition. He is the inventor of the SFE and SFF processes. He is the author of more than 160 publications. He received in 2013 the award of strategic thinking given by the French Homeland Minister, in 2015, the « Grand Prix Lazare Carnot » award of the French Academy of Science, and more recently, in 2022, the CNRS Innovation Medal for his work on conceiving and investigating the SFE and SFS processes.

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Affordable and Clean Energy and Their Innovation in Relation to Sustainability

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Abstract

The paper focuses on the assessment of the relationship between innovation, affordable and clean energy and sustainable development. The work focuses on the analysis of innovative performance, affordable and clean energy and sustainability in countries in individual member states of the European Union according to the SDG index. The most important areas of affordable and clean energy affecting innovation as a tool for sustainability in this area are analysed and identified in more detail. We focus on the specific goal “Affordable and clean energy” and its characteristics: population with access to electricity, population with access to clean fuels and technology for cooking, CO2 emissions from fuel combustion per total electricity output and share of renewable energy in total primary energy supply. The contribution was created as part of the Grants No. 1/0475/22 "Environmental Consumer and Environmental Citizen", 1/0495/22, “Sustainability of Value Supply Chains and its Impact on the Competitiveness of Companies in the Forest and Forest-Based Sectors" and 1/0494/22 “Comparative Advantages of the Wood Based Sector under the Growing Influence of the Green Economy Principles” for Scientific Grant Agency of the Ministry of Education Science Research and Sport of the Slovak Republic and the Slovak Academy of Sciences.

Keywords

affordable and clean energy, SDG index, sustainability, population

Biography

Erika Loučanová works at the Department of Marketing, Trade and World Forestry, Technical University in Zvolen. She gives lectures in the area of Innovation Management, Project management and innovation management, Innovation Analysis and Strategy, Methods and Technique creativity and Law. PhD degree in Industrial Economics: Economics of Trade and Industry dedicated to “Innovative model of increasing the competitiveness of small and medium-sized enterprises of the woodworking industry”. Assoc. Prof. degree in Economics and Management dedicated to: "Innovations in the Concept of Sustainable Development"

Her research includes broader issues of forest-based and wood sector, especially innovation management (innovation management, innovations, ecological innovations, innovation analyses, innovation strategies, interaction between subjects creating trust in personal connections to innovation networks and clusters operating on social capital and principles of sustainable development), as well as innovation-related social and environmental issues. She also implemented several scientific projects via national grant projects.

Digital Twin-Based Battery Management System

Jun Xu

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Abstract
Battery management system is indispensable to ensure the safety of batteries. More and more researches have been studied on this topic to obtain accurate modelling, state estimation, etc. Besides, digital twin technology has been widely utilized for the management of shop floor. This speech will demonstrate digital twin-based battery management system design, including digital twin-based battery modelling and digital twin-based battery state estimation.

Keywords
Green Roofs; Green walls; Atmospheric water harvesting; Sustainability

Biography
Jun Xu is currently an Associate Professor and Doctoral Supervisor with the School of Mechanical Engineering, Xi'an Jiaotong University. He serves as IEEE Senior Member, IEEE Power Electronics Society Technical Committee on Electrical Transportation Systems,the Division Chairman of Shaanxi Power Supply Society, Chairman of Youth Working Committee of SAE-Shaanxi.Dr. Xu's research interests include design, modeling, and control of battery systems, electric vehicles, renewable energy systems, and robots.

Dr. Xu has published more than 80 peer-reviewed papers, including 3 ESI highly cited paper. He owns more than 20 granted invention patents, one of them had been industrially transformed. He has delivered several keynote/invited speeches in academicconferences.Dr. Xu serves as conference Chair, organizing committee Co-Chair, and conference committee for several academic conferences.

Dr. Xu has been the Principal Investigator for over 30 research grants, including National Key Research and Development Plan Project topic, Ministry of Industry and Finance ProjectSub-topic, National Natural Science Foundation of China, Shaanxi Province Key Research and Development Plan Project.

Dr. Xu is the recipient of the China Industry-University-ResearchCooperation Innovation Award, the second Prize of China Invention and Entrepreneurship Achievement Award, the First Prize of the Shaanxi Province University Science and Technology Award, the Second Prize of the Shaanxi Province Teaching Achievement Award, and the Special Award of University Teaching Achievement Award.

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Using Renewable Energy when Available

Hermann Kaindl

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Research Institute for Cryptoeconomics, Vienna University of Economics and Business, Vienna, Austria
Institute of Computer Technology, TU Wien, Vienna, Austria

Abstract

The availability of renewable energy is highly volatile. Storage options and market management will play a major role in the best possible use of renewable energy. Storage capacity is, however, a scarce resource.

Hence, we pursue another approach instead and in addition to storing renewable energy, we strive for using it when available. This is the central strategy behind two nationally funded research projects, which are jointly run by universities and industry partners, where this speaker serves as the consortium leader in both projects:

1. eAlloc – Dynamically Optimizing the Allocation of e-cars to Charging Sites *
2. EnergyDec – Decision-making und Optimization for Distributed Energy Management **

e-mobility is one of the most important ap¬proaches to avoid CO_2 emissions in the transport sector. A major issue with e-mobility are cur¬rently the range of e-cars and potentially very long charging times during longer trips. Improving the user experience with e-charging during such trips is important, since it will improve the acceptance of e-cars. However, e-mobility will not help reducing CO_2 emissions unless it uses primarily renewable energy. Efficient charging of e-cars on motorways is important for ensuring e-mobility, where both the user experience of drivers and matching demand with availability of renewable energy matter. Hence, we opt in eAlloc for dynamic optimization of the allocation of e-cars to charging sites, balancing the interests of e-car drivers, charging stations and electricity networks simultaneously, with special emphasis on utilizing renewable energy for reducing CO_2 emissions.

Energy management systems of buildings currently focus primarily on optimizing individual buildings in separation. It is, therefore, a matter of optimizing the consumption at a location

according to its technical possibilities and its level of self-generation of renewable energy. The EnergyDec project aims to develop a new approach for distributed decision-making that can include combined top-down and bottom-up decisions as well as those between peers at the same level. This approach will be integrated in different ways with local optimization for individual buildings for cross-location decision making for many diverse buildings innovatively. Local optimizations can be included for distributed decision-making, but the targets for optimizing selected buildings can also be changed through cross-location decisions to achieve, e.g., peak shaving and, in particular, the use of renewable energy.

The approaches to using renewable energy when available that we are developing in these two projects, based on industrial research, will help improve matching the demand for energy with the availability of renewable energy and, hence, reduce the need for storing energy.

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** This project is partially co-funded by the KLIEN in the “Energieforschung (e!MISSION)” funding program, 7th call, and managed by the FFG under project no. 888428.

Keywords

e-mobility; dynamic optimization; energy management of buildings; distributed decision-making

Biography

Hermann Kaindl joined the Institute of Computer Technology in early 2003 as a full professor, where he served in this position until September 2022, for several years as the department head and the head of the organizational unit entitled “Software-intensive Systems”. He served for several years as a member of the Senate at TU Wien, and from October 2019 until September 2022 as a Vice Chairman. After his retirement as a state official, Hermann Kaindl is still working on several (funded) research projects as an employee of University for Continuing Education Krems, Vienna University of Economics and Business, and TU Wien.

Prior to moving to academia, he was a senior consultant with the division of program and systems engineering at Siemens AG Austria. There he has gained more than 24 years of industrial experience in requirements and software engineering, human-computer interaction and artificial intelligence. He is a Senior Member of the IEEE and a Distinguished Scientist member of the ACM.

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Facilitating Ecosystem Restoration by Onshore Wind Energy Projects is the Way to Go: A Win-Win for The Renewable Energy Sector, Climate, Biodiversity and Societal Benefits

Kris Decleer

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Abstract

The only climate model showing a breakthrough roadmap to stay below the 1.5 degrees Celsius temperature rise by 2050 is the 'One Earth Climate Model' (https://www.oneearth.org/below-1-5-c-a-breakthrough-roadmap-to-solve-the-climate-crisis/). Besides the rapid reduction in fossil fuel emissions, the challenge is to halt all carbon emissions from ecosystem degradation simultaneously and massively invest in large-scale ecosystem restoration. The model projects that land sinks such as forests, wetlands and grasslands must enable 110 GtCO2 natural C removal by 2045 and 440 GtCO2 by 2100. Ecosystem restoration will also contribute to climate adaptation and generates multiple societal benefits of large public interest, such as recreation.

In Flanders (Belgium), the nature and wind energy sectors are looking for a better collaboration to pursue a win-win in combatting the climate and biodiversity crisis. This implies:

- mutual recognition there is a huge need for both additional nature and land for wind turbines;
- early and intensive dialogues for local wind energy projects;
- thorough ecological impact studies, considering the often extensive local knowledge of nature NGO's;
- alignment of the wind energy project with specific nature goals;
- investment of a part of the economic profits of wind energy in effective ecosystem restoration by the nature sector, rather than in spending huge compensations for renting land of private land owners;
- where possible, nature agencies and NGO's can share land for the erection of wind turbines;
- increase public support by allowing citizen participation in economic profits.

In the presentation, some early experiences from Flanders will be shared.

Biography

Kris Decleer is a landscape ecologist with extensive experience in ecosystem restoration.

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Sea Energy Converters: An Overview of Environmental Impacts, Economic Aspects, and Trends in Research and Installations

Marcello Ruberti

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Abstract
The sea is a huge and inexhaustible reservoir of energy, with an estimated potential of at least 10 TW of electricity. Although, to date in the world, it remains almost entirely untapped. Since the ultimate source of the sea's energy is the sun, it qualifies as a renewable source, has no operational or fuel costs, and is relatively non-polluting if compared to conventional sources of energy. Unfortunately, technologies to capture energy from the oceans on a large scale are still in the early stages of their development and have very high capital expenditures (CAPEX). In principle, and considering the number of patents, at least five types of ocean energy can be converted: sea currents, waves, tides, salt content, and thalasso-thermal energy. The main objective of this presentation is to analyse the present situation and future potentials through a survey of world trends in research and installations.

Keywords
hydropower; environment; patents; costs

Biography
Degree in Economics, PhD in "Commodity Sciences" (thesis on the electrification process in Italy). Interreg scholarship for research activities on "Energy Saving in the Industrial Sector", with a final report published. Scientific responsible of several Ministerial research projects. Research activity and internship at the Department of Mechanical and Aeronautical Engineering of the University of Patras (Greece). Research and internship activities at the Mechanical Engineering Department of the University of Salento (Italy). Research activity by collaboration agreement with the Department of Biological and Environmental Sciences and Technologies of the University of Salento. Official expert Commodity Sciences since 2002. Currently, Aggregate Professor in Commodity Sciences at the University of Salento. The research carried out mainly focused on energy issues, alternative sources of energy, impact

on the environment of production cycles, waste management and recovery of agricultural and industrial by-products, and quality systems and assurance. Author of about 120 publications, including papers and monographs.

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Technical Issues to Boost the Exploitation of Photovoltaic Energy

Monica Borunda

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Abstract

Nowadays, photovoltaic (PV) power deployment must be stimulated due to the imminent climate emergency and the future need of alternative energy sources to satisfy the growing energy demand. PV power generation depends on many technical issues to accomplish optimal exploitation of the solar energy resource. Among them, there are two main technical issues to consider, the solar resource and the PV panel conditions of operation.

The detailed knowledge of the solar resource at the site of interest plays a crucial role to estimate the PV power to be generated. Before the installation of PV technology, solar resource evaluation and forecasting at different time horizons are mandatory tasks to obtain the best benefit.

Likewise, PV panel conditions of operation under true local weather conditions must be carefully analysed to achieve optimal operation despite losses, which may not be considered in a rough analysis.

To shed light on these main technical issues, statistics and machine learning can be used as shown in this presentation.

Keywords

Solar energy; Photovoltaic energy; Forecasting; Photovoltaic power generation

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Decentral Hydrogen

Paul Grunow

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Abstract

Decentral hydrogen is introduced as fast transition path to short and long-term power storage. It circumvents slow infrastructure installments and enables on-site storage and heat coupling in addition to direct use of local electric power. The power-to-gas approach is extended to small combined heat and power devices in buildings that alternately operate fuel cells and electrolysis. While their heat is used to replace existing fossil heaters on-site, the power is either fed into the grid or consumed via heat-coupled electrolysis to balance the grid power at the nearest grid node.

In detail, the power demand of Germany is simulated as a snapshot for 2030 with 100% Renewable sourcing. The standard load profile is supplemented with additional loads from 100% electric heat pumps, 100% electric cars and a fully electrified industry. The renewable power is then scaled up to match this demand with historic hourly yield data from 2018/2019. An optimal mix of photovoltaics, wind, biomass and hydropower is calculated in respect to estimated costs in 2030. In most master plans, hydrogen is understood to be a substitute for fossil fuels. This talk focuses on hydrogen as a storage technology in an all-electric system. The target is to model the most cost-effective end-to-end use of local renewable energies, including excess hydrogen for the industry. The on-site heat coupling is the principal argument for decentralization here.

Essentially, it flattens the future peak from exclusive usage of electric heat pumps during cold periods. Batteries are tried out as supplementary components for short-term storage, due to their higher round trip efficiencies. Switching the gas net to hydrogen is considered as an alternative to overcome the slow infrastructure expansions. Further decentral measures are examined in respect to system costs.

Keywords

Decentral Hydrogen, Prosumers, Renewable energy systems

Biography

Paul Grunow has completed his Ph.D at the age of 30 years at Technical University Berlin and Helmholtz-Zentrum Berlin (former Hahn-Meitner-Institut in Berlin-Wannsee) and postdoctoral studies at COPPE/UFRJ in Rio de Janeiro, Brazil. He is the general manager of Trinity Solarbeteiligungen GmbH, an investment company in renewable energies. Before, he co-founded three companies in the area of photovoltaics based in Berlin, i.e. Solon SE, Q-Cells SE, PI Photovoltaik-Institut Berlin GmbH. He has published more than 50 papers in reputed journals.

Software-Defined Power Electronics for Grid-Interactive Electric Vehicles

Preindl Matthias

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Abstract

Transportation electrification is a key technology to addressing climate change. Electrified drivetrains use high-voltage batteries (or fuel cells) as energy source and require a number of power converters including a motor inverter, a battery charger, and a DC/DC converter to supply the auxiliary 12V battery. This talk focuses on a novel family of software-defined power converter concept based on Lego-like power electronic modules called autoconverter modules (ACM). The ACM abstract key power electronic complexity, including the switching, electromagnetic compatibility (EMC), and component protection, and leverage variable-frequency critical soft-switching (VF-CSS) to achieve a high efficiency and power density. ACM can be aggregated by software to form power converters for motor drives or battery chargers and are reconfigurable. This concept is leveraged to integrate the motor drive and a bidirectional battery charger that exceeds the 2025 DOE power density and cost targets. Drivetrains with readily available bidirectional EV charging can enable a wider adoption of vehicle to grid services. These grid interactive EV simplify the wider adoption of EV and facilitate the grid's transition toward renewable energy by providing battery storage.

Biography

Matthias Preindl received the B.Sc. degree in electrical engineering (summa cum laude) from the University of Padua, Italy, the M.Sc. degree in electrical engineering and information technology from ETH Zurich, Switzerland, and the Ph.D. degree in energy engineering from the University of Padua, in 2008, 2010, and 2014, respectively. He is currently Associate Professor of Power Electronic Systems in the Department of Electrical Engineering at Columbia University, USA. Prior to joining Columbia University in 2016, he was an R&D Engineer of Power Electronics and Drives at Leitwind AG, Italy (2010-2012), a Post Doctoral Research Associate with the McMaster Institute for Automotive Research and Technology, McMaster University, Hamilton, ON, Canada (2014-2015), and a Sessional Professor in the Department of Electrical and Computer Engineering, McMaster University (2015).

He serves as Area Editor of IEEE Transactions on Vehicular Technology, Associate EiC of Springer Nature/China SAE Journal of Automotive Innovation, and as the general chair of the 2022 IEEE/AIAA ITEC+EATS. Dr. Preindl is a Senior Member of IEEE and a Fellow of IET. He received the Fast Company's World Changing Ideas Awards honorable mention (co-recipient, USA, 2022), Horiba Awards Honorable Mention (Japan, 2019), the Futura Foundation Award (Italy, 2017), the NSF CAREER Award (USA, 2017), as well as best paper and presentation recognitions including the 2019 IEEE Transactions on Industrial Electronics best paper award. His research interests include the design and control of motor drives, power electronics, and batteries for transportation electrification and renewable energy.

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Consistent Planning with Changing Sustainability Targets

Robert Bordley

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Abstract

Sustainability goals have repeatedly shifted. For example, carbon dioxide targets have shifted from 550 ppm to 450 ppm. More aggressive goals reduce the potential damage from excessive levels. But they reduce the time available for maturation of untested but higher potential technologies. This reflects genuine uncertainty about the impacts of different levels of pollution as well as different prioritizations of different kinds of environmental damage. As a result of this volatility, plans with fixed targets must constantly be updated or discarded. This can lead to inefficient use of scarce scientific, engineering and political resources.

This same issue of volatility arises in product design where product requirements, especially software requirements, often change. This paper develops a new planning method which explicitly recognizes the possibility of targets changing. The objective function is consistent with standard principles of rationality (while recognizing Nobel-prizing winning findings on bounded rationality.) The objective function can be easily adjusted based on new information. As volatility increases and targets become unknown, the objective function reduces to standard economic utility models. As the uncertainty about a potential emissions metric increases, the objective function focuses resources on other more well understood metrics.

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Use of RPAS (Drones) For Masonry Arch Bridges Inspection: Quality and Sustainable Work with Preventive Guarantee

Rubén Rodríguez Elizalde

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Abstract

Using of remotely piloted aircraft system (RPAS), better known as drones, has spread with multiple and very diverse applications on last years. It includes civil engineering structures inspections. Starting from several real structural inspections of masonry arch bridges, this conference was born. The inspections were conducted by the author experimentally, in order to demonstrate that the aircraft can serve as a quality tool to make this work that is being carried out by qualified personnel and expensive auxiliary means currently. At the end, the author tries to demonstrate that we can obtain identical or even better quality results, reducing the health and safety risks for the workers who do that work, with time and costs significant savings.

Keywords

Drones, Heritage Buildings, Bridge Inspection, Structure.

Biography

Rubén Rodríguez Elizalde is Geologist and Civil Engineer, PhD in Architecture and Heritage and Senior Occupational Health and Safety Degree. On professional level, he is specialized in pathology and structural rehabilitation. In addition, he has carried out preventive management tasks, fundamentally in construction, metal and entertainment sectors for the last fifteen years: he has worked as execution director, health and safety coordinator on project phase and health and safety coordinator on execution phase. In this sense, he has been health and safety coordinator of great renown works in Spain. Currently, he is a professor at various university centers, such as European University of Madrid. In addition, he is Member of the National Association of the Technical Inspection of Structures in Spain, member of the Geology Applied to Engineering Spanish Association and member of the International Association for Engineering Geology

and the Environment. In addition, he is Technical Director at EIP, company specializing in structural rehabilitation and prevention management in the construction sector. As a final anecdote, it should be noted that Rubén is a Remote Piloted Aircraft (RAP) Pilot and a Pilot Instructor and Examiner. That is why he can talk us about both aspects fusion: he can talk about the application and use of drones for monitoring construction structures.

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Stereolithographic Additive Manufacturing of Functional Components for Sustainable Developments

Soshu Kirihara

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Abstract

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

Biography

Soshu Kirihara is a doctor of engineering and a professor of Joining and Welding Research Institute (JWRI), Osaka University, Japan. In his main investigation “Materials Tectonics as Sustainable Geoengineering” for environmental modifications and resource circulations, multi-dimensional structures were successfully fabricated to modulate energy and materials flows effectively. Ceramic and metal components were fabricated directly by smart additive

manufacturing, design and evaluation (Smart MADE) using high power ultraviolet laser lithography. Original stereolithography systems were developed, and new start-up company "SK-Fine" was established through academic-industrial collaboration.

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Obstacles to the adoption of energy-saving measures in the building sector: a survey in Brazil

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Abstract

Energy is one of the most critical factors for the growth of the world economy, thus its demand has increased over the years. Such growth brings, among several concerns, environmental impacts, mainly the increase of greenhouse gas emissions. For decades, the industrial sector was responsible for the greatest part of the energy demand, but as time went by the consumption shifted toward the building sector. In Brazil, the building sector is responsible for 51% of the electricity consumed, and about 10% of the total greenhouse gas emissions. These numbers continue to grow, despite significant efforts made by the government to reduce energy consumption. A way to reach this goal, without affecting the occupants' welfare, is the adoption of energy-saving technologies. There are several of these technologies available, bringing lots of benefits. However, there are obstacles that hinder their adoption. Thus, before overcoming such obstacles, it is necessary to know them. Therefore, this article aims to identify the obstacles that hinder the adoption of energy-saving technologies, by means of a systematic literature review. Subsequently, this paper also verifies whether such obstacles make sense in the Brazilian context. So, in order to accomplish this goal, a literature review of more than 450 articles was gathered from the SCOPUS database, and 27 obstacles were found to the adoption of energy-efficient technologies, which were classified into 6 groups, named as Financial/Economic; Market; Technological; Professional/Technical; Governmental/Political/Regulatory; and Cultural/Social/Behavioral. Furthermore, a survey among one thousand Brazilian professionals was carried out. The results are analyzed by two multivariate techniques, cluster and factor analysis, validating these obstacles as well as the proposed taxonomy for Brazil. The results also show that the two most important categories of obstacles are Governmental/Political/Regulatory, and Financial/Economic, showing that Brazilian society has high expectations that the government will be more active in this matter. Furthermore, the survey respondents gave insights into important points concerning technology, education, etc.

that should be verified in a timely manner. These findings can assist government agencies, researchers, and experts to develop guidelines and strategies to overcome such obstacles.

Keywords
Energy Efficiency; Energy-Saving Technologies; Barriers; Building Sector; Brazil

Biography
Talita Mariane Cristino is a Mechanical Engineering doctoral student in Management and Optimization at the State University of São Paulo "Júlio de Mesquita Filho" (UNESP), under the guidance of Professors Dr. Otavio Jose de Oliveira and Dr. Antonio Faria Neto. The research carried out by Talita Mariane Cristino has received financial support from the Sao Paulo State Research Support Foundation, process nº 2021/01423-9. The student has research experience in the Energy Management System area, mainly in the building sector, applying multivariate statistical methods for data analysis, and has published scientific articles in international high-impact factor journals. Professor Dr. Otavio Jose de Oliveira is a full Professor and Head of the Production Department of FEG/UNESP. He works mainly with Integrated Management Systems, Lean Six Sigma, and Sustainability.. Professor Dr. Antonio Faria Neto is a researcher in Energy Efficiency at FEG/UNESP. He is curretly dedicated to research in Multivariate Statistics applied to Engineering and Energy Management Systems.

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Ship Alternative Energy, Problems and Prospects for its Implementation

Valentyn Nastasenko

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Kherson State Marine Academy (Ukraine)

Abstract

The modern transport fleet consumes about 6% of the total oil-based fuel. The share of greenhouse gases obtained during its combustion is ≈ 3% of the total amount of their emissions. Given that to reduce the threat of the greenhouse effect, it is required to reduce CO2Currently, among the developments of alternative ship power systems, the most attention is paid to sailing systems, since only 120-130 years ago masted sailboats formed the basis of the transport fleet. But the commissioning of the Suez Canal, in which the movement of sailing ships was excluded by the lack of sufficient wind power, led to their displacement by ships with a mechanical drive. However, since the 60s of the twentieth century, when there was a threat of a shortage of oil reserves, sailing systems began to pay attention again. At the same time, the initial task was fuel economy, and only in recent decades has it been considered in conjunction with the task of decarbonization.

The second important direction in the development of ship alternative energy is solar energy, since much attention has been paid to it on land in recent years.

Therefore, the main goal of this work is to evaluate the real possibilities of using alternative energy systems in the transport fleet.emissions by 7.4% annually, the decarbonization of the energy systems of the transport fleet allows us to solve the problem of reducing harmful emissions by 40%. Therefore, shipbuilding companies could not remain aloof from solving this problem, and at the present stage of development of the transport fleet, much attention has been paid to alternative energy systems.

Work results. Analysis of the proposed ship sailing systems showed that the main problems of their application are:

1. The need for a large sail area for the development of power equal to the power of modern marine engines. Since this complicates sail control, their real power does not exceed 10 – 12 MW, which limits the carrying capacity of ships to 20 – 25 thousand tons (more cost-effective is the carrying capacity of 60 – 100 thousand tons).
2. Decrease in the speed of cargo delivery, since modern ships carry it out at a speed of 10–20

m/s, and such an average annual speed of steady winds is achieved only in the “roaring” 40th latitudes and the “furious” 50th latitudes. In the tropics and subtropics, the average annual wind speed does not exceed 5 m / s, so the sails there are useless cargo, which reduces the volume of cargo transportation and the profitability of the vessel.

There are even more problems with ship solar power, because with its average daily power of 0.05 kW per 1 m^2 of solar panels, the maximum power within the actual areas of ships does not exceed 1 MW, with a required minimum power of 10 – 12 MW.

At the present stage, hydrogen energy is the most promising, but its application requires solving the technical and economic problems of hydrogen production, its storage and use in ship propulsion systems.

Conclusions: The use of sailing systems in reality is limited to cruise ships, pleasure yachts and a transport fleet with a carrying capacity of 20-25 thousand tons only on fixed routes. The use of solar energy is limited to auxiliary ship systems. Therefore, the only real alternative ship energy is hydrogen, the development of which should be given more attention.

Biography

Nastasenko Valentyn. Dr. of Technical Sciences, Professor of Transport Technologies Department, Kherson State Maritime Academy (Ukraine).

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Modification of Aqueous Zinc-Ion Batteries

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Abstract

Aqueous rechargeable batteries have the advantages of low cost, safety, and environmental protection, and are a promising energy storage system. Compared with other energy storage systems, aqueous Zn-based batteries have attracted extensive attention in academia. Because zinc has the advantages of high specific energy, abundant raw materials, and low cost, and among the negative electrode materials of aqueous rechargeable batteries, zinc also has the advantage of low redox potential.

In order to increase the energy density of aqueous Zn-based batteries, researchers have done a lot of work in improving the reversible capacity of positive and negative electrodes. However, it is equally important to increase the operating voltage of the battery.Herein, inspired by our previously reported high-voltage supercapacitor with alkaline–acidic electrolyte, the feasibility of using hybrid alkaline-mild solution electrolyte to improve the operation voltage and widen the electrochemical window of the zinc-manganese battery is explored1. By using the alkaline (1 M NaOH and 0.01 M $Zn(AC)^2$)-mild (2 M $ZnSO_4$ + 0.1 M $MnSO_4$) hybrid electrolyte with Na+-form Nafion membrane in between, Zn metal and MnO2 as negative and positive electrodes, the aqueous Zn//MnO2 battery with hybrid electrolyte (ZMBH) can be operated in the voltage range of 1.4 to 2.2 V, with the average discharge voltage of 1.7 V. It delivers a high discharge capacity of 282.2 mAh g-1 at the current density of 200 mA g-1, corresponding to a high energy density of 487 Wh kg^{-1}, based on the mass of positive electrode material.

Due to serious corrosion of Zn anode and dendrite growth, further application of ZIBs is hindered. An ionic-electronic hybrid coating modified zinc anode (Alg-Zn+AB@Zn) containing zinc alginate (Alg-Zn) and acidified conductive carbon black (AB) was further designed2. Among them, zinc alginate formed by the interaction between sodium alginate and Zn^{2+} in the electrolyte acts as an ionic conductor. Zn^{2+} is restricted by the carboxylate group in zinc alginate during the transport process, so a "channel" is formed on the zinc surface to guide the migration of zinc ions, thereby regulating the flux of zinc ions. At the same time, AB acts as an electronic conductor with high electrical conductivity and specific surface area, which can reduce the nucleation potential and local current density and provide nucleation sites. Affected by these synergies, the assembled symmetric cell can stably maintain extremely low polarization (47 mV) for 500 hours. In addition, Alg-Zn+AB@Zn/AC full cell exhibits excellent cycle stability. The capacity retention of nearly 100% can be achieved over 10,000 cycles at 10 A g^{-1}, and 16000 cycles at 20 A g^{-1}.

Keywords
Zn ion battery; Energy density; Anode

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Biography
Weijia Fan received her B.S. degree in 2022 from the School of Energy Science and Engineering, Nanjing Tech University, China. Currently, she is a PhD student in the group of Prof. Yuping Wu at School of Energy and Environment, Southeast University. Her research focuses on the exploration of aqueous batteries.

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Design and Regulation of Lithium Metal Anode Interface Based on Composite Artificial Coating

Xiaosong Xiong, Yuping Wu*

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Abstract

The ever-growing global demand for green energy and energy structure adjustment are promoting the upgrades of advanced energy storage system. As a result, the exploration for high performance electrode materials is greatly stimulated when the state-of-the-art lithium ion battery is reaching its theoretical energy density due to the specific capacity limitation of intercalation active electrode materials. Characterized by the ultrahigh theoretical specific capacity (3860 mAh g−1) and the lowest electrochemical potential (-3.04 V vs. standard hydrogen electrode, S.H.E.), lithium metal has become the most promising anode material to support the development of advanced energy storage system.

As is well known, the reactive lithium metal will react with electrolyte solvents and lithium salts spontaneously to form an inert solid electrolyte interface (SEI) on the anode interface, which could protect the reactive lithium from further side reactions. However, the structure and composition of the native SEI are both inhomogeneous to deteriorate the nonuniform Li+ ions flux and ramify Li deposition. Moreover, its inherent fragile feature is hard to sustain the huge stress change during the lithium deposition/stripping process. Consequently, the growth of lithium dendrites and the formation of “dead lithium” on anode will be aggravated by the local concentrated electric field and Li+ ions flux, resulting in the rapid failure of lithium metal anodes and imposing safety issues.

The stability of the electrode/electrolyte interface is the key factor to inhibit the growth of dendrites and alleviate the loss of active lithium, thus ensuring the practical application of lithium metal anode for the future application. Herein, from the perspective of lithium metal anode interface, artificial modified layers were constructed on anode to regulate the electrode interface and realize the stable cycling performance of lithium metal anode under low N/P capacity ratio. Firstly, flexible polymethyl methacrylate (PMMA)/polyvinylidene difluoride (PVDF) composite modified layer with fiber structure was prepared to alleviate the volumetric change of anode and regulate the lithium ions flux. Next, enhanced Li transfer kinetics and regulated the Li ions flux on anode were realized by lithiophilic AlN/Poly(vinylidene fluoride-co-hexafluoropropylene) (PVDF-HFP) composite modified layer. Then, a design of “inverse concentration gradient” was raised and realized by Li4Ti5O12 composite modified layer. As a

result, concentration polarization at the electrode interface was greatly alleviated and the cycling performance of lithium metal anode was improved especially at high current density. Finally, a lithiophilic and conformal polyaniline electrode interface modified layer has been prepared by in situ electropolymerization method toward dendrite-free and long lifespan lithium metal anode, The lithiophilic PANI layer could greatly boost the Li plating/stripping kinetics and improve the initial lithium nucleation/plating process substantially, enabling uniform lithium plating/stripping behavior without dendritic lithium

Keywords
Lithium metal anode; electrode interface; modification layer; ions transfer

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Biography
Xiaosong Xiong is currently pursuing his Ph.D. under the supervision of Prof. Yuping Wu at Southeast University. His current research interests focus on lithium metal anode interface modification, solid state electrolyte application and understanding of degradation mechanisms of solid batteries.

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Micro-scale Compressed Air Energy Storage Systems

Yasser Mahmoudi

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Abstract

To achieve the highly ambitious net-zero target by 2050, the decarbonisation of UK power sector requires significant actions at regional and local levels. The UK's energy system is transforming rapidly to a more decentralised mode with solar and wind being deployed in district buildings, and local communities. The intermittent nature of these renewable sources, however, presents a great challenge to power network stability. Energy Storage is a key solution to this challenge through the provision of flexibility to store excess electricity for times when it is in demand. The majority of recent installations deploys fast response electricity storage systems (e.g., batteries) with short-duration storage and short-discharge duration of 1-4 hours. However, technologies such as compressed air energy storage with long-duration electricity storage (days-weeks) and medium-duration discharge (over 4 hours) are required to ensure power supply security in all weather conditions. This talk covers the fundamentals of compressed air energy storage (CAES) with the particular focus on novel technologies developed in our group based on near-isothermal CAES systems. Results from CFD, Experiment, Thermodynamic, economic and environmental impact analyses will be presented.

Keywords

compressed-air energy storage; isothermal compressor/expander; phase change material; microgrid power network

Biography

Dr. Yasser Mahmoudi Larimi is an Associate Professor (Senior Lecturer) in Low Carbon Energy Systems with the Department of Mechanical, Aerospace, and Civil Engineering at The University of Manchester. Prior to this, he was an Assistant Professor (Lecturer) at Queen's University Belfast. He completed a 3-year postdoctoral appointment at the University of Cambridge working on combustion noise analysis in Rolls-Royce gas turbines. He has an international profile in clean and sustainable energy development through studying fundamentals and designs of low-carbon thermal and power systems, aiming to achieve net-zero emission by 2050. As principal investigator, he has attracted >£2million grants from research councils and industries for his research compressed air energy storage and solar photovoltaic-thermal

systems as well as transport in porous media. He has given over 20 invited talks in conferences, universities and industrial events. Dr Larimi chairs the UK 'Turbulent Heat Transfer' Special Interest Group within the UK Fluids Network. Dr Larimi is a Fellow of Higher Education Academy, and is an Associate Editor of Frontiers in Thermal Engineering- Advancements of Cooling and Heating, and Special Topics & Reviews in Porous Media: An International Journal. He is an invited author of a book on Convective Heat Transfer in Porous Media, and the author on over 100 peer-reviewed journal and conference publications.

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An Analysis Framework for Environment Impact of Lithium New Energy Industry in China

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Abstract
Under the context of global carbon neutrality, the lithium new energy industry will play a vital role in promoting the development of new energy vehicles and new energy systems. But many people remain concerned about the impact of the lithium new energy industry on the environment. This paper presents an analysis framework from the perspective of life-cycle thinking for exploring the environmental impact of the entire industry chain of the lithium new energy industry. As a typical technological path of lithium resource development, the lithium new energy industry based on lithium-mica deployment is took as a case to demonstrate the application of the framework and related methods proposed to assess the environmental impact. The results indicate that the lithium new energy industry will lead to significant negative environmental impact including water consumption, water pollution, radioactive gas, and hazardous waste. Some measures and suggestion in terms of technique, regulation and policy from the perspective of life-cycle thinking are provides to address these issues. The proposed framework can effectively help China identify appropriate solutions and measures, which is helpful to promote the sustainable development of the lithium new energy industry aiming at attaining the goal of global carbon neutrality.

Keywords
Carbon neutrality; Lithium new energy; Analysis framework; Environment impact; Industry chain; Life-cycle thinking

Biography
Dr. Jiehui Yuan is now an associate professor of School of Economics and Management, Yichun University, Jiangxi, China. He is the supervisor of Institute of Energy & Resource, Environment and Carbon Neutrality, Yichun University and the supervisor of Professor Workstation of New Energy and Carbon Neutrality, Yichun University. He is a committee member of Energy System Engineering Committee of China Energy Research Society and is a member of a council of

Clean Energy Vehicle and Vessel Branch of China Transport Association. He received his PhD from China University of Petroleum- Beijing in 2015 and conducted postdoctoral research at Tsinghua University Beijing from 2015 to 2017. His research interests include energy system analysis, technical and economic evaluation of energy, life cycle analysis, energy policy, etc. Over these years he has published more than ten high-quality peer-reviewed papers including Applied Energy, Energy, Energy Policy and Sustainability. He has also been authors or co-authors of 4 books.

Nonporous Separators as a Good Solution to Self-Combustion of Electric Vehicles

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Abstract

Electric vehicles (EVs) are well acknowledged as a valid way to reduce use of oil and protect the environment. In the case of battery-type EVs, its safety has always been a challenging concern since it is based on lithium ion batteries using combustible organic electrolytes. Through our study, we invented a nonporous separator, which can also be gelled by the organic electrolytes. Its use for lithium ion batteries can not only greatly enhance the safety of EVs but also hinder the self-combustion of EVs. This will markedly promote the deployment process of EVs.

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Biography

Dr. Yuping Wu is a full professor of Southeast University, and Fellow of RSC. He got Ph. D. degree from Institute of Chemistry, CAS in 1997, and then worked at Tsinghua University, Waseda University, and Chemnitz University of Technology (AvH Fellowship), separately. In 2003 he became a full professor of Fudan University. His research is focused on energy storage systems and their key materials. He published over 410 papers with H-index over 96 (WoS) and 9 books. His researches led to some edge-cutting technologies such as pore-free separators for lithium batteries, and aqueous rechargeable lithium batteries. He achieved quite some awards including one of the Most Influential Minds over the World in 2015 from the Most Cited Researchers by Thomson Reuters.

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Sustainable Development in Remote Rural Communities: Needs and Challenges

Zeel Maheshwari

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Abstract

Sustainable development in remote rural communities is a crucial challenge for ensuring the well-being and prosperity of residents in these areas. Remote rural communities often face significant barriers to economic growth and development, such as limited access to resources, infrastructure, and markets. This can lead to poverty, social exclusion, and environmental degradation. However, sustainable development in remote rural communities can be achieved by focusing on the unique needs and challenges faced by these communities. This may involve investing in renewable energy and sustainable agriculture, promoting conservation of natural resources and biodiversity, and improving access to education and healthcare. It requires a holistic approach that takes into account the unique needs and challenges of these communities, as well as a commitment to collaboration and the responsible use of resources.

Harnessing locally available renewable energy resources as an environmentally friendly option is gaining momentum. Smart Integrated Renewable Energy Systems (SIRES) offer a resilient and economic path to "energize" the area and reach this goal. It is a viable and effective strategy to provide basic needs such as biogas for cooking, water for domestic and irrigation purposes and electrical energy for lighting, communication, cold storage, educational and small- scale industrial purposes, by smartly matching them to available resources. In SIRES, each system component is optimally sized to minimize cost and maximize the reliability using techniques such as genetic algorithm. Smart sensors will be strategically placed at locations where amount of resources have to be monitored. Sensors will also be located where the status of system components should be monitored. Intelligent controllers will be used to turn on/off renewable technologies. Data obtained from the sensors can be transmitted through a basic telemetry/cellular network for use in further research and improvement.

The foremost step is to determine energy requirements, analyse resources availability and optimal size system components based on the objectives defined by the customers. SIRES can be tailored to suit the socioeconomic setting of the locale. Innovative financing ideas need to be developed for the users to pay for the benefits in monetary or in other forms. Involving local communities in decision-making processes is also critical to the success of SIRES.

This can help ensure that development projects are aligned with local priorities and that the benefits of these projects are shared equitably. System components can be standardized as much as possible for mass production, replicability and lower cost. The ultimate action is to set up proof-of-concept SIRES experiments to serve as centers for research, development and training, preferably in academic settings.

SIRES promotes socio economic development and improve the living environment by fulfilling the fundamental energy requirements with the help of low cost renewable technologies and intelligent energy management systems. It will promote sustainable socio economic development and improve the living environment by fulfilling the fundamental energy requirements with the help of low cost renewable technologies and intelligent energy management systems.

Keywords
Integrated Renewable; Sustainable Development; Rural communities; Energization

Biography
Zeel Maheshwari received her Masters and PhD degree in Electrical and Computer Engineering at Oklahoma State University (OSU) in December 2013 and December 2017 respectively. She is currently working as an Assistant Professor at Northern Kentucky University (NKU), USA. She received Dorothy Westerman Hermann Endowed Professorship in Science at NKU and is first from her department to receive it. She is the secretary of the IEEE Renewable Technology Subcommittee since January 2021. She has more than 15 technical papers published in the field of sustainable development in rural communities. Her areas of interest are Smart Grids, Integration of Renewable Energy Systems, Microgrids, Neural Networks, Deep learning and Fuzzy Logic.

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Hydrogen and Natural Gas Pipeline Systems (H-NGPS) Resilience Evaluation and Research

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Abstract

With the increasing of the hydrogen usage, the transportation of hydrogen has been the hot point of the renewable energy. The most common way of the hydrogen transportation at present and in the future is the pipelines which mostly change by natural gas pipelines. Because of the importance of natural gas and its key roles, the natural gas pipeline system is still the core of the whole energy system of system. Both for hydrogen and natural gas, the security of pipeline system is necessary and important for the operators and researchers.

For H-NGPS, in the long term, the trend will has three stages, including single natural gas transportation, hydrogen-natural gas mixing transportation and single hydrogen transportation. The security of Hydrogen and Natural Gas Pipeline Systems(H-NGPS) should consider both pipe safety, supply safety, market safety and structure safety. With the development of integrity and reliability on oil and gas pipeline systems, resilience research of H-NGPS has been focused more, which is still in budding stage. It is important to build a methodology framework of the H-NGPS resilience evaluation, according to the practical characteristics of H-NGPS. Based on the disturbances of H-NGPS, which are deterministic and probabilistic, an integrated framework is proposed for evaluating the supply resilience of H-NGPS, a novel concept proposed from this research.

The framework of supply resilience proposes three dimensions of the resilience evaluation, which are global dimension, temporal dimension and threshold dimension. Supply resilience is considered with deterministic and probabilistic disturbances of H-NGPS. It is difficult to analyse the supply resilience based on hydraulic calculation, so the evaluation is based on complex networks theory (CNT). Based on the relationship between the degrees of nodes and connections between edges, the hydrogen and natural gas flow are seen as flows in CNT, integrated with operation and structural parameters to calculate the amounts and routes of gas

supply, before/after disturbance, to provide information for the pre-disturbance performance and topological structure, including choices of spare gas sources and gas routes. The focus is changed from whole system to the affected area, based on complex networks theory and graph theory. For the supply resilience under probabilistic disturbance, Markov Chain Monte Carlo (MCMC) simulation is applied to determine the status of the network pipes. The model is verified by two practical numerical examples, from Europe and China, showing the process of analysis in detail.

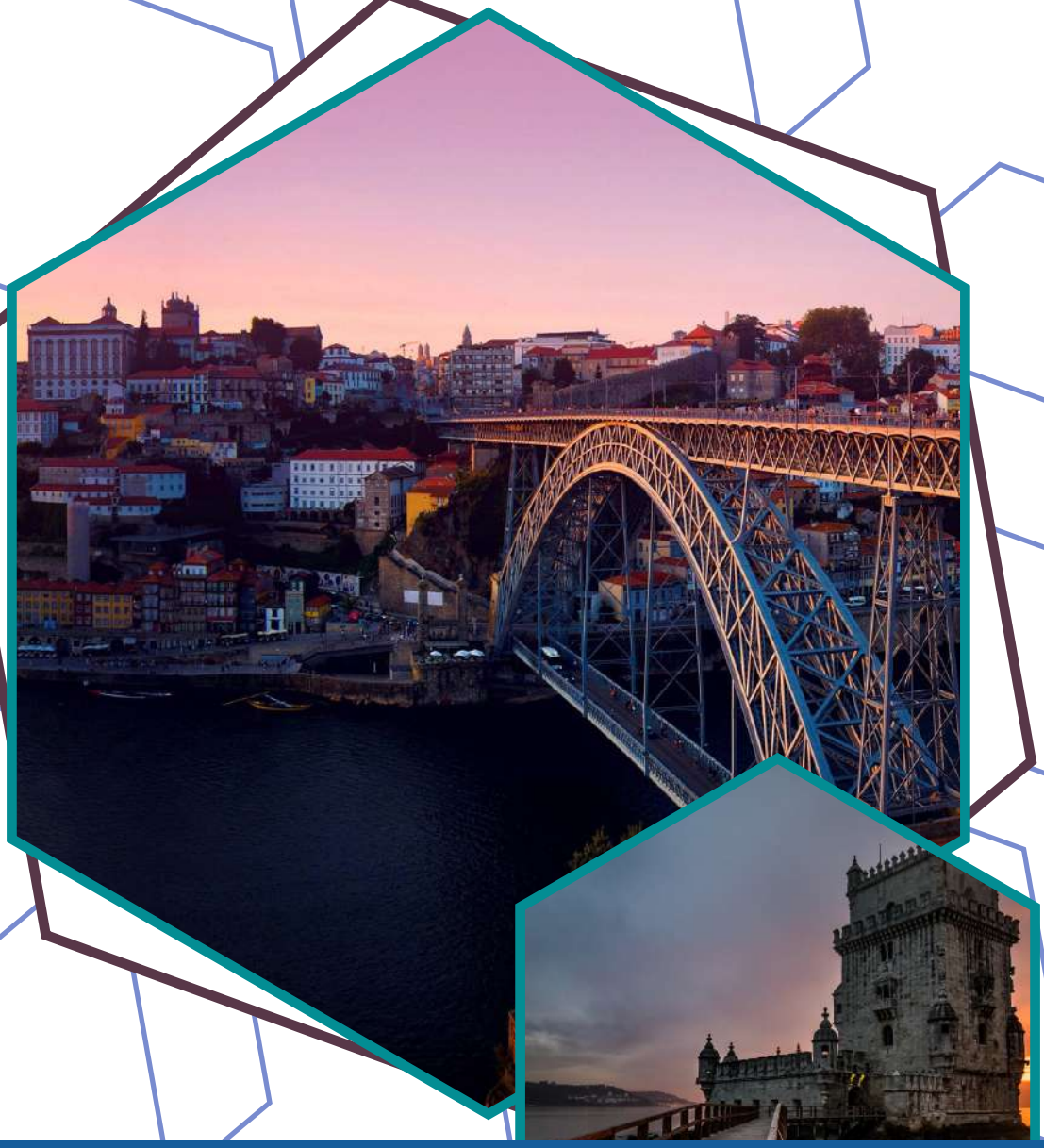
The results can contribute to the guidance of H-NGPS topological designing and the building of prewarning scheme, including spare gas sources and gas routes optimization, and the strategy of pipeline maintenance, also can help the rapid analysis of disturbance consequences and the enhancement of evaluating accuracy in H-NGPS resilience, especially for the whole systems topological modification and dealing with the fluctuation of different gas types to be transported.

Keywords

Hydrogen; Natural gas; Pipeline system; Resilience

Biography

Zhaoming Yang focuses on the research of Oil & Gas transportation and storage for 7 years, especially on the areas of system resilience, multiphase flow and separation technology. He received bachelor and master degrees in China University of Petroleum (East China), and does Ph.D. research in City University of Hong Kong and China University of Petroleum (Beijing). Now he is in Aalborg University, Risk, Resilience, Safety, and Sustainability of Systems Research Group. He has published papers in Journal of Cleaner Production, Energy, Journal of Natural Gas Science and Engineering, Petroleum Science, Reliability Engineering System Safety, International Journal of Oil Gas and Coal Technology et al, and also has applied more than 10 patents in key areas of Oil & Gas industry. He is the session chair of CUE2022-Applied Energy Symposium: LOW CARBON CITIES & URBAN ENERGY SYSTEMS.



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