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Abstract Book

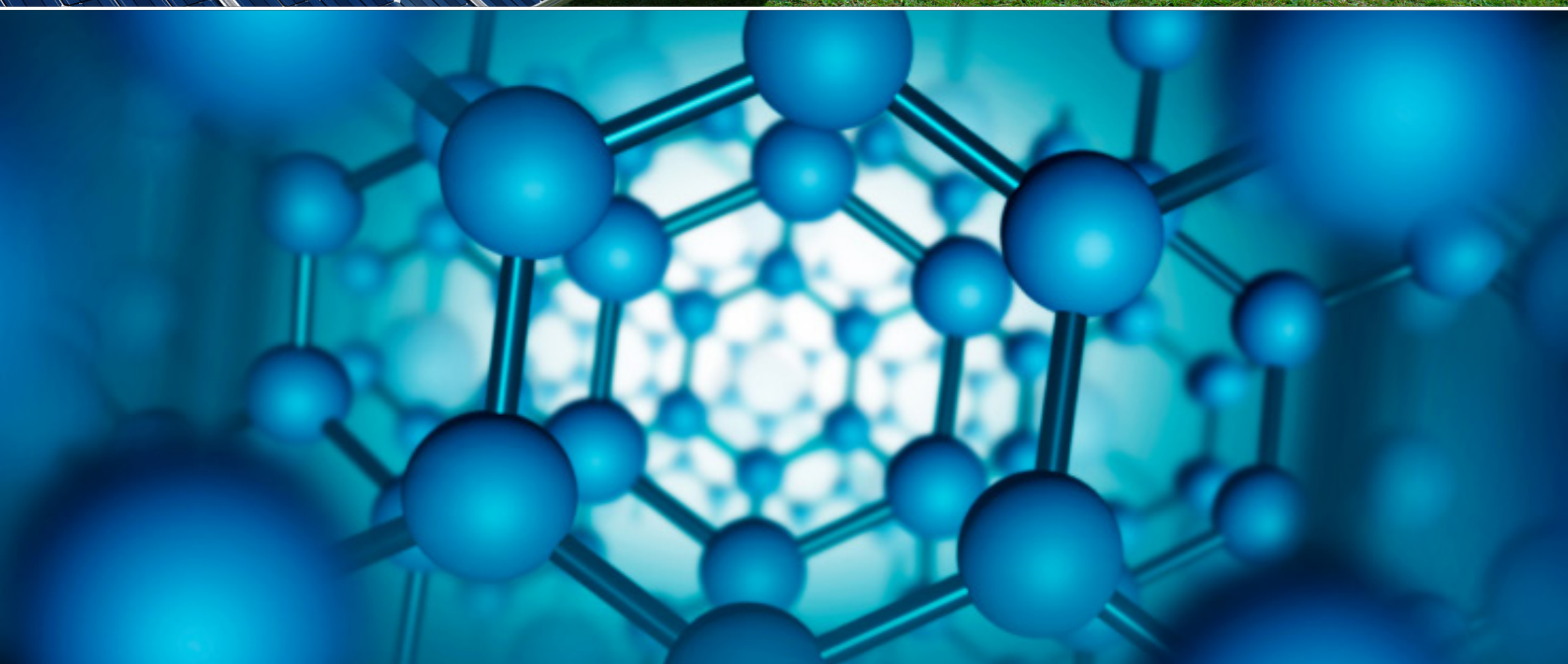
ISPEE2023 & ISMSN2023

International Summit on
Power and Energy Engineering

November 23-24, 2023 | Lisbon, Portugal

International Summit on
Materials Science and Nanoscience

November 23-24, 2023 | Lisbon, Portugal



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 Summit on Materials Science and Nanoscience and International Summit on Power and Energy Engineering will be held in Lisbon, Portugal during November 23-24, 2023.

ISMSN2023 & ISPEE2023 shares an insight into the recent research and cutting edge technologies, which gains immense interest with the colossal and exuberant presence of young and brilliant researchers, business, delegates and talented student communities.

ISMSN2023 & ISPEE2023 goal is to bring together, a multi-disciplinary group of scientists and engineers from all over the world to present and exchange break-through ideas relating to the Materials Science and Nanoscience & Power and Energy Engineering. It promotes top level research and to globalize the quality research in general, thus makes discussions, presentations more internationally competitive and focusing attention on the recent outstanding achievements in the field of Materials Science and Nanoscience & Power and Energy Engineering.

We’re looking forward to an excellent meeting with scientists from different countries around the world and sharing new and exciting results in Materials Science and Nanoscience & Power and Energy Engineering.

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The Use of Cellulose Nanocrystals as Scaffolds for Nanodevices, Supramolecular Chemistry Using Nature's Most Abundant Template

Dimitris S. Argyropoulos
Departments of Chemistry & Forest Biomaterials, North Carolina State University, Raleigh, NC, USA

Abstract

Over a number of years work in our laboratory has been exploring the use of cellulose nanocrystals (CNC) as scaffolds for the creation of novel nanomaterials with unique and stimuli responsive characteristics. The forces responsible for the spatial organization within cellulose, coupled with traditional chemistry are aimed at creating structures via molecular self assembly; These concepts have been the inspiration for our supramolecular research.

In this lecture we will report on our systematic efforts aimed at functionalizing CNCs by using both grafting from and grafting onto approaches. The selective creation and activation of a nano-pattern on CNC will be described and the chemical methods used to create the foundation for novel CNC based materials (including self-assembled Cellulose NanoPlatelet Gels), photo reversible light induced and novel antimicrobial assemblies will be described.

Biography:

Professor of Chemistry at North Carolina State University. He has also served as a Finland Distinguished Professor of Chemistry with the department of Chemstry of the University of Helsinki, Finland and Distinguished visiting Professor with the centre for Advanced Materials and the Department of Chemistry King Abdulaziz University, Jedah, Saudi Arabia.

Professor Argyropoulos's reserach team is internationally recognized for his leading contributions to Green Chemistry using cellulose and lignin wood-based polymers. His work focuses at promoting our understanding of the structure and reactivity of such polymers and the development of novel NMR and material science techniques for the structural elucidation and upgrading of these biopolymers. The efforts of his research group have been disseminated in excess of 200 scientific papers, numerous scientific conferences invited presentations and patents. Professor Argyropoulos is a fellow of the Royal Society of Chemistry, International Academy of Wood science and the Chemical Institute of Canada.

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Resurgence of Hemp and Current Status of Exploring this Plant in Agriculture (Including Remediation of Polluted Lands), Industry, Medicine, Cosmetics, and in other Areas

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2) Institute of Natural Fibres and Medicinal Plants - National Research Institute (IWNiRZ-PIB), Wojska Polskiego 71 B, 60-630 Poznań, Poland
3) Institute of Human Genetics PolishAcademy of Sciences, Strzeszyńska 32 str., 60-479 Poznań, Poland

Abstract

The main goals of hemp breeding are: a significant increase in biomass production, fibre content, and fibre quality (fineness) as well as an increase in the amount of nuts (seeds). Industrial hemp – Cannabis sativa L. - containing less than 0.3% of Δ9-tetrahydrocannabinol (Δ9-THC) and marijuana hemp, both species are known to the world for more that 7000-8000 years. Industrial hempyield of dry mass is 10 -15 Mg (tons) from 1 ha of cultivated area. In one vegetation period 1 ha of hemp absorbs about 11 Mg (tons) of CO2 from the atmosphere, and also this plant is capable to absorb about 160g Cu, 70g Pb, up to 7g Cd from 1 ha of soil, which makes this plant useful for the remediation of soils contaminated by the industry.China in the last 5 years has become a cannabis super power, farmers and government of China made a revolution in the area of agriculture and industrial use of hemp. Hemp panicles, which constitute about 30% of whole plants are the source of many cannabinoids and terpenoids, as well as other high added value agro-chemicals. Cannabis nuts are used for the production of valuable food oils, cake and fodder for birds, fish and other animals. The main active compounds extracted from Cannabis sativa are cannabinoids whose psychological functions range from locomotors activity to memory, pain perception, and to other activities. The important role of these phyto-chemicals has been perceived in the world and many research centres.

More than 104 diverse groups of compounds like CBG, CBC, CBD, Δ9-THC, Δ8-THC, CBL, CBE, CBN, CBND, CBDT, and a group of terpene compounds have been recognized in Cannabis Sativa L., for a total of about 550 compounds. In the past two years, the US

Food and Drug Administration released Epidiolex, a strawberry-flavored syrup containing cannabidiol, an active analgesic and cardiac agent, as the main CBD ingredient (a product of GW Pharmaceuticals), for the US and European markets.
United Nations commission which proved the positive role of marijuana for medical use; on December 2020 UN reclassified officially cannabis as a less danger drug. From panicles are obtained cannabinoids and essential oils (for cosmetics, food products, aromatherapy, and plant protection). Summing up, the developments in cannabis and marijuana hemp contribute to growing area of cultivation, modern processing and application of hemp. The hemp fibre used for textiles include more friendly apparels, high performance military uniforms (with special functions), and ecological nonwoven used in many areas: from agriculture, environmental protection, defense. Fibre is used also in composites and packaging, while cellulose for pulp and paper production. Advances are noticed in processing technology in producing not only 100% pure hemp fabrics, but their blends with cotton, viscose and even silk, and also with man-made fibres. Shives are used e.g. for production of various bio-composites including healthy building materials, glued with lime and Portland cement. Works are also carried out on super-capacitors where hemp wastes are processed into carbon-nano materials for high power supercapacitors.

Keywords:
hemp; cultivation; processing; application

Biography:

Prof. Dr. R. Kozłowski graduated from A. Mickiewicz University, Poznan, Poland (chemical faculty, applied chemistry). Professor of Chemical Technology. Director for scientific research of the governmental Institute of Natural Fibres, Poznań, Poland (1976 – 1987, and 2016 – 2017), Director General ofthis Institute (1987 – 2008).From 2009 – 2016 professor consultant at the Institute of Natural Fibres and Medicinal Plants, Poznań. From 2009 –2015 scientific advisor at the Institute for Engineering of Polymer Materials and Dyes in Toruń. From 2004 constantly: editor –in- chief Journal of Natural Fibers (Haworth Press 2004 – 2008, Taylor&Francis 2008 –until now). Professor Honoris Causa of Pontifical Catholic University Ibarra, Ecuador. The Textile Institute (UK) honorary member of Council from 1988. From 1989 constantly: Coordinator of FAO ESCORENA European Cooperative Research Network on Flax and other Bast Plants. From 2008 coordinator of the ESCORENA Focal Point (European System of Cooperative Research Networks in Agriculture) under auspices of FAO. In period 2009 –

2013 Director of BASTEURES project, AurelVlaicuUniversity of Arad, Romania. Author of chapters in more than 30 books edited by: Woodhead Publishing Ltd., Elsevier, Nova Science Publishing, Taylor & Francis and others. Editor of the Handbook of Natural Fibres, 2 volumes (2012), Woodhead Publishing, UK. Co-editor of the 2 nd edition of the Handbook of Natural Fibres, 2020. Examiner and evaluator of several PhD and professor thesis – abroad and in Poland. Promotor of PhD thesis. Author of 30 patents, 26 implemented technologies. Co-author of more than 300 papers. Expert in natural fibrous materials, mainly flax and hemp, especially in cannabinoids and terpenoids from flowering panicles of hemp, methods of their obtaining and modification, polymers and composites - their technical application and modification, flame retardancy of natural and man-made fibres and derived products. Member of American Chemical Society (ACS), ICOMOS (International Council of Monuments and Sites), Paris, and many other professional scientific and innovative institutions in Poland and abroad.

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Recent Progress in Intumescent Coating More Effective for Fire Protection of Forest Wood and Composite Materials

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2. Journal of Natural Fibers (Editor-in-chief), Former Director of the Institute of Natural Fibres, Poznań, Poland

Abstract
Intumescent coatings covering textiles, wood, composites and forest (creating the barriers the spread of fire). They cut oxygen supply and cut heat penetration from flammable surfaces e.g. textiles, nonwoven, wood and other. They are also effective and not expensive on the base of textiles and nonwoven, flexible and rigid barriers which protect flammable materials. There are mainly two types of barriers: modified resins, carbonizing agents, foam forming agents, dehydrating agents and according to area of application - different modifiers, including nano-modifiers and flexible and rigid. Another types of intumescent materials were developed on the base of alkali silicates (not emitting toxic gases), lithium, sodium and potassium, which also can be used as a coat on textiles, nonwoven, wood, composites and even metals (9). They start swelling over 1000C, or in contact with flame due to endothermic process and is associated with an emission of water vapor. The solid foam is rigid and consists of hydrated silica and some products of decomposed mineral endothermic fillers (3). The fire proofing efficiency of protected surface is determined by: heat release rate, the effectiveness of combustion heat, the mass loss rate and specific swelling ability of this coating. After some modifications of this type of barrier coating was also developed another type as sealant for fire barrier doors and for protective coat of chassis and rubber tires of military vehicles, resistant to napalm conditions (1), (2). They can be formulated as rigid and flexible fire barriers. A new effective intumescent coating – EXPANDER FR, transparent system based on modified nano-scale silica.

There is strong correlation between char yield and fire resistancy because char is formed and are emitted non-combustible gases and water vapor. The presence of formed char inhibits spread of the flame, acting as a thermal barrier around the unburned material. This resulted in perfect insulation of covered flammable materials (flexible textile barriers, wood, composites). In case of catastrophic fires of forest bush, fields, wastes and garbage dumps happen around the word. Special intumescent coating spread on surface 5-10 m while formulate the barriers stopping the penetration fires spread.
In case of polymers and polymer composites the temperature of burning surface of polymer

is close to the temperature at which extensive thermal degradation occur (300 – 600oC). The bottom layer of char, near the protected surface, has similar temperature below 300oC whereas the upper surface is exposed to almost 1500OC (4),(5),(6).
Fire protecting coatings with intumescent properties were used for about 50-60 years (7)(8). Currently, we investigate the new type of expanding product on the base of fibrous textile and special nano-fillers with high effect of endothermic effect. (9) (10).with minimum toxic gases emition.

Keywords:
Intumescent coatings, flexible and rigid barriers.

References:
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(2) R. Kozlowski, D. Wesołek, M. Władyka-Przybylak. European Patent application No 05776862.4. An intumescent fire retardant and the method of its manufacture.

Biography:

Kajetan Pyrzyński was born in 1946 in Sarbia. From an early age he was interested in history and literature, as well as science. Therefore, in October 1967, he began studying at the Poznań University of Technology, Faculty of Machines and Vehicles. After graduating, he worked as a researcher for 3 years. In 1984, he founded a company that is still run today under the name Delta, which in 1987 obtained the status of an Innovation and Implementation Company granted by the Minister of Economy. The company deals with the production of chemical preparations of various degrees of technological advancement. Since 2009, Honorary Consul of the Republic of Peru, member of the prestigious association Cofradia Internacional de Investigadores, member of the World Esperanto Association, member of the Society for the Preservation of Monuments. He visited about 70 countries on several continents. Among the numerous interests of Kajetan Pyrzyński, the need for writing occupies a special place. So far, several books and several volumes of poems have been published. Particularly noteworthy are Constitution in Verse (2014), Honestocracy, Honest Democracy (2019), Happy People (2020), Creation of the World (2022) and others. Author of numerous scientific publications, scientific communications and patents, especially in the field of research on fire retardants. Organizer of international scientific conferences aimed at bringing the world of science and industry closer together entitled "Melpin Conference On Technology Transfer For The Development Of New Products In Chemical Smes".

Multi Process Hybrid3D-Printing Approach

Christian Schmid[a*]
aFH Kufstein Tirol Bildungs GmbH, University of Applied Sciences, Tirol Austria

Abstract
Hybrid processes are combining different manufacturing technologies to improve eco-nomical and functional aspects. Digitalization enables users to integrate different single systems into one multi process unit. This approach, together with the application of additive manufacturing technologies facilitates companies to realize customized products economically. To improve production flexibility, workstations with different integrated processes like subtractive, additive as well as handling and mounting operations offer the option to manufacture with a minimum of jigs and tools and a maximum of flexibility. In the presentation 2 different approaches will be discussed, basing on two different additive processes:
1. Wire and Arc Manufacturing (WAAM) is an additive manufacturing process located in the group of DED Directed Energy Deposition 3D-Printing.
2. Binder jetting (BJT) an additive manufacturing process joining a powder with adhe-sives.
Both processes are combined with additional robots and working heads to turn out dif-ferent production steps in one setup. The approaches will be presented and discussed regarding economical, technological and sustainability aspects.

Keywords:
Hybrid manufacturing; Wire and Arc Additive Manufacturing; Binder Jetting; Hybrid 3D Printing

Biography:
Born on 20.06.1965 in Hanover, he completed his studies in mechanical engineering at the University of Hanover with a focus on "Research and Development". During his doctorate, he worked as a research assistant at the Laser Zentrum Hannover e.V., where he and his research group received the Science Award 2000 "Laser Technology" of the Friedrich-Alexander-University Erlangen for the development of novel laser handheld devices for material processing. He wrote his doctorate on the same topic. In 2000, together with two partners and Volkswagen AG, he founded a company for the development of hand-held laser devices for body welding. From 2006 to 2011 he took over the research management in the Department of Blasting Technology at the Institute of Welding Technology of the TU Clausthal and helped to build up the Clausthal Center for Materials Technology CZM. To this day, he is a lecturer in Clausthal

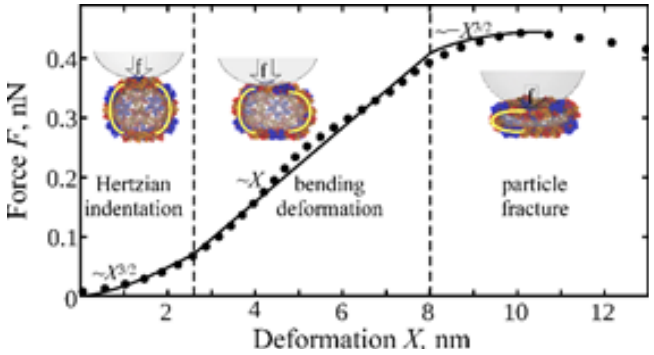
for "Laser Material Processing" with examination authorization. In addition to his work at the TU Clausthal, he founded SET Ltd. in 2007 as a development and service company for mobile laser applications and additive manufacturing in the aerospace industry for Airbus and Boeing with locations in Birmingham, Hanover and Santa Ana (USA). He developed and patented a standard laser process for the production of large-format layup tools for Airbus, Boeing and Spacex. After the successful sale in 2017, he became Chief Technology Officer and Head of Development for an international group of companies based in Zurich. The development focus there was on metal and plastic large-scale 3D-printers for aerospace applications. In 2018, he successfully introduced a quality management system in accordance with the aviation standard. In 2019, he again founded a company as a development and consulting company for additive manufacturing and product development. He also supports several start-ups in the field of additive manufacturing. Over the years, he has applied for more than 30 patents, utility models and trademarks. Since 2020, he has been a professor at the FH-Kufstein Tirol, responsible for the topics in the field of product development. There he teaches in Bachelor's and Master's degree programs topics from product development and additive manufacturing such as "Digital Product Development" with contents of "Mixed, Augmented and Virtual Reality", “Innovation Management” as well as Product and Concept Development, "Advanced Prototyping", Rapid Product Development", "Rapid Prototyping Technologies" and other subjects. He also supervises Bachelor's and Master's thesis from the above-mentioned areas. His research work is mainly based on the topic of "Digital Product Development" with "Additive Manufacturing" to improve sustainable manufacturing technology and organization. The targeted combination of traditional and additive manufacturing as well as the sensible use of digital technologies to reduce energy, material and time expenditure and the smart implementation to an adapted extent are essential objectives. Research projects such as the development of a fully digital process for the production of individual ski liners, quality improvement of additive manufacturing processes with recycled 3D printing filaments or the development of hybrid 3D structures follow this approach. Schmid has published over 50 national and international articles. Current publications deal with the following topics: 3D printing of hybrid structures, ski boot 4.0 app and 3D printing processes, guidelines for process-oriented design for wire and arc additive manufacturing.

Dynamic Force Spectroscopy in Silico: Exploring Strength, Deformability, Toughness and Mechanical Fatigue of Biological Nanoparticles

Valeri Barsegov
University of Massachusetts, Lowell, MA 01854, USA

Abstract

Mechanical testing experiments in silico provide high-resolution view of dynamic processes in biological nanomaterials to enable researchers to explore their mechanical and material properties. First, the computational aspects of the biomaterials structure modelling and high-performance computing will be described. Second, Fluctuating Nonlinear Spring model for describing mechanical deformation of biological nanoparticles will be presented. This model is applied to the protein nanoshells of bacteriophage P22, Human Adenovirus and Herpes Simplex viruses. These nanoshells are soft (~1-10-GPa elastic modulus) with low ~50-480-kPa toughness – a regime of material behavior that is not well understood, and with their strength increasing while their toughness decreasing with particle size. The nanoshells of bacteriophage P22, Human Adenovirus and Herpes Simplex virus are weakly ductile with deformations <10-20% of their size. Larger nanoparticles are more resilient and more plastic compared to smaller particles. Third, a computational approach to "fatigue testing in silico" will be described. This approach is applied to encapsulinnanocompartment, CowpeaChloroticMottle Virus (CCMV) nanoshell, and microtubule (MT) filament to describe their damage-dependent biomechanics (strength, deformability, stiffness), thermodynamics (released and dissipated energies, enthalpy, entropy) and material properties (toughness). Thick CCMV and MT nanoparticles experience material fatigue due to slow recovery and damage accumulation, while thin encapsulinnanoshell shows little fatigue due to rapid remodeling and limited damage. The results challenge the existing paradigm: damage in biological nanoparticles is partially reversible; fatigue crack may not grow with each loading cycle and may heal; nanoparticles adapt to deformation amplitude and frequency to minimize the energy dissipated; and using crack size to quantitate damage is problematic as several cracks might form simultaneously. Dynamic evolution of strength, deformability, and stiffness, can be predicted by analyzing the damage. Fatigue testing in silico can be used to explore damage-induced changes in the material properties of other biological nanoparticles.



Biography:

Valeri Barsegov obtained his PhD degree from the University of Texas at Austin, USA, in 2001. He is Chemistry Professor at the University of Massachusetts, USA. He has ~100 publications (cited ~1800 times), and his H-index is 25. His research has contributed to the emergence of new fields of research: (i) biomechanics of hemostasis/thrombosis [Acta Biomaterialia,136, 327 (2021); Acta Biomaterialia, 131, 355 (2021); Proc. Natl. Acad. Sci 115, 8575 (2018); Structure 26, 857 (2018); J Am Chem Soc 139, 16168 (2017); J Am Chem Soc 134, 20396 (2012)]; (ii) physical virology [Acta Biomaterialia, 122, 263-277 (2021); Biomacromol 17, 2522 (2016); PLoS Comp Biol 12, e1004729 (2016) J Am Chem Soc 136, 17036 (2014); Biophys J 105, 1893 (2013)]; and (iii) high-performance computing [Proteins 78, 2984 (2010); J Phys Chem B 115, 5278 (2011); JComp Chem 37, 1537 (2016)]; and (iv) computational cell biology [PLoS Comp Biol 18, e1010165 (2022)].

Two Measurement Methods of Electron Inelastic Mean Free Path in Carbon and Polycarbonate

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1. Nuclear Engineering Department, Ben Gurion University of the Negev, Israel
2. Nuclear Research Center (NRCN), P.O. Box 9001, Beer-Sheva, Israel
3. Additive Manufacturing Center, Rotem, Ind, Israel

Abstract

The electron Inelastic Mean Free Path (IMFP) is widely utilized in surface analysis techniques like X-ray Photoelectron Spectroscopy (XPS) and Auger Electron Spectroscopy (AES). It is employed alongside experimental data to determine the average depth of the solid surface under analysis using a specific method. Additionally, the IMFP is used to correct for relative sensitivity factors in quantitative surface analysis methods that rely on electron emission or ejection, requiring knowledge of low energy electron transport parameters. Moreover, the IMFP is applicable to calculating single electron transport in solids.

This study explores two experimental methods for evaluating the IMFP of low Z materials in the energy range of 5 to 15 keV. The Wide Energy Spectrum (WES) method was conducted at the Spanish CRG BM25 beamline (SpLine) in the ESRF Synchrotron. The experimental results, which extracted IMFP values for Carbon and Polycarbonate at 5-15 keV electron energy, validated the effectiveness of this method. The Total Current Measurement (TCM) method was carried out using the Quanta 200 SEM. The experimental results for Polycarbonate submicronic layers at 2-15 keV electron energy were compared to the Polycarbonate data obtained from the WES experiments.

Through the comparison, a correlation was established between the attenuation ratio of inelastic electrons in the TCM experiments and the average energy loss values in the WES experiments. This correlation was utilized to extract IMFP values for Polycarbonate at electron initial energies of 5.94 keV, 7.94 keV, and 9.95 keV, based on the WES experiments. A correlation curve for IMFP as a function of initial energy was derived from these results.

The IMFP values and the derived correlation curve were compared to the WES IMFP values and exhibited close agreement, confirming the relationship between the two methods. The

approximated correlation curve was also compared to the IMFP values derived from the correlation and demonstrated remarkable similarity, validating the use of this approximation. Furthermore, the derived correlation curve was compared to the NIST IMFP curves and showed good agreement.

Overall, the study successfully investigated and compared the IMFP values obtained through the WES and TCM methods, establishing their correlation and demonstrating the accuracy of the derived approximation. The results were also validated by comparison with existing IMFP curves from NIST, highlighting the reliability and applicability of the derived correlation curve.

Keywords:
Inelastic; Scattering; Spin-coating; Synchrotron.

Biography:

Prof. Itzhak Orion is a senior researcher at the Ben-Gurion University of the Negev, department of Nuclear Engineering. Prof. Orion's work involves collaboration with most of the medical radiation therapy institutes in Israel. His research activities concentrate on radiation physics, simulations, and methods development.

He received his B.Sc. (1990) in physics from the Hebrew University in Jerusalem, and M.Sc. (1993) in nuclear physics from Ben-Gurion University of the Negev. He received his Ph.D. in nuclear engineering at the Soreq Nuclear Center, Israel, in the field of calculations and simulations of radiation release after nuclear reactor accidents.

Prof. Itzhak Orion is an expert in mathematical simulations methods for radiation theory, and for applications in the field of medical physics, and in radiation safety. He collaborates with the Monte Carlo calculations team at the high energy laboratory at KEK, Japan.

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Development of Giant Permittivity Dielectrics Based on Strontium Titanate

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[1]*CICECO – Aveiro Institute of Materials, Department of Materials and Ceramic Engineering, University of Aveiro, 3810-193, Aveiro, Portugal*
[2]*TEMA – Centre for Mechanical Technology and Automation, Department of Mechanical Engineering, University of Aveiro, 3810-193, Aveiro, Portugal*

Abstract
Development of giant-permittivity and high-tunability dielectric materials has attracted great interest because of growing demand for smaller and faster energy-storage and electronic devices [1-4]. Materials such as CaCu3Ti4O12, displaying the giant dielectric permittivity due to extrinsic Maxwell-Wagner interfacial polarization effect, have previously been reported. Ferroelectric materials possessing intrinsic ionic polarization due to a phase transition to the polar state have also been indicated to possess high dielectric permittivity. Here, a class of the giant-permittivity materials based on SrTiO3 ceramics doped with about 1% of trivalent ions like yttrium, dysprosium and gadolinium as well as their processing concept, which yields the dielectric permittivity up to ~209 000 at 10 kHz, is reported [1,5-7]. The giant permittivity is explained by a coupling of the polar cluster relaxation mode with the donor substitution induced electrons at low temperatures and by the Maxwell-Wagner relaxation around room temperature. Besides the fundamental understanding, this discovery opens a new development window for high-frequency and low-temperature electronic and energy-storage applications.

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Keywords:
Electroceramics; Donor doping; Sintering atmosphere; Polar clusters.

Biography:

Dr. Oleksandr Tkach is an Assistant Researcher of the University of Aveiro and CICECO – Aveiro Institute of Materials, a premier Materials Science institution in Portugal. He graduated in Microelectronics and Semiconductor Devices by the National Technical University of Ukraine "Kyiv Polytechnic Institute". Dr. Tkach got Ph.D. in Materials Science and Engineering from the University of Aveiro that was followed by postdoctoral studies at University of Porto, Portugal, and University of Mainz, Germany.

He has published over 100 articles in reputed journals as well as 8 book chapters, and edited a book, serving also as an editorial board member of several journals. Present research interests of Dr. Tkach include the development of giant permittivity dielectric oxides for energy storage; thermoelectric and piezoelecric oxide materials and composites for energy harvesting technologies; nanostructured magneto electrics for sensor and electronic applications; and alternative energy efficient concepts for electrically assisted ceramic sintering.

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The Role of Organic Quinuclidine Cation in Switchable Dielectric Properties of an Organic-Inorganic Hybrids Compounds

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[2] *Institute of Low Temperature and Structure Research, Polish Academy of Sciences, Okólna 2, 50-422 Wrocław, Poland*

Abstract

Materials exhibiting switchable properties with multiple alternative states can be successfully used as switches of electrical signal, in optoelectronic devices, sensors, actuators, capacitors or nonvolatile memories. In the last few years they received particular attention due to both the strictly fundamental features of hybrid materials as well as promising basic elements in electrical and electronic industries. This presentation is based on the main pillars: controlled synthesis and characterization of hybrid organic-inorganic dielectrics including the phase transition investigation of obtained quinuclidine (Q) based HOICs. The synthesis and structure of a series of Q-based organic–inorganic hybrids containing chloride and bromide metals are presented. The dynamic disorder observed in the structure of QMeX (Me = Mn, Cd, Cu, Co, Pb, X=Cl, Br) is discussed based on the comprehensive study e.g. variable temperature single crystal X-ray diffraction, IR, Raman, and dielectric spectroscopy. An important problem raised is the impact of an organic cations on controlling switchable properties of dielectric constant (High and Low dielectric state). The effect of Q cations on structural phase transformations and the temperature-dependent dielectric response will be discussed. It has been shown that the dielectric constants can be switched/tuned between two stable states (ON/OFF) in the vicinity of the PT temperature. Such behavior discloses their potential applications as a switchable dielectric material. The intermolecular interactions and dynamics of the systems around PTs will be disused based on the vibrational spectroscopy measurements. The reorientation of Q cations is the major force driving PT in most of synthesized crystals and their role on the switchable and structural properties will be discussed.

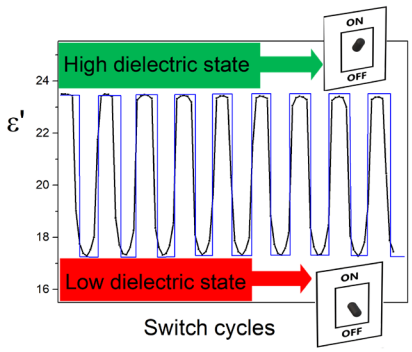

Fig.1. □'- switching of the of QMnCl recorded after at least 9

dielectric switching, HIOPs, phase transition, quinuclidine

Biography:

I became involved in research activity from 2004 year when I started my work at the Laboratory of Dielectric Materials at Wrocław University of Science and Technology. Since the beginning of my career as a researcher, I have been focused on the manufacturing and properties of ferroics materials and multifunctionalporous glasses-based nanocomposites. Currently I am a head of Advanced Dielectric Materials Group at the Wrocław University of Science and Technology. Research topics conducted in my group are related to the design and synthesis of organic-inorganic hybrids, including perovskite-type compounds with designed physicochemical characteristic, including thermal, electrical, nonlinearand sensing properties.

Applications of Quality by Design Approach in Nanotechnology

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Abstract
Nanotechnology became a widespread technology in recent years in several medical and pharmaceutical applications. The major goals in designing nanoparticles as a delivery system include enhancing bioavailability by enhancing solubility and dissolution rate, targeting the drug to specific organs and controlling drug release rate. Quality by design (QbD) encourages the pharmaceutical industry to use risk management and science-based manufacturing principles to gain process and product understanding and thus assures quality of the product. The lecture will discuss the application of QbD approach in the pharmaceutical nanotechnology.Response surface methodology using computer based factorial design to study the effect of critical factors on various quality attributes of APG nanoparticles will be discussed. Based on the optimization procedures, risk assessment and using prior knowledge and experience will be focused to define the criticality of factors based on their impact by Ishikawa fishbone diagram and preliminary hazard analysis (PHA) tool.

Biography:
Dr. Mohamed Abbas Ibrahim is a professor of Pharmaceutics, Al Azhar University, Assiut, Egypt.Currently, he is a professor inKayyali Chair for Pharmaceutical Industries, Department of Pharmaceutics, King Saud University, Saudi Arabia. He earned a Ph.D. in Pharmaceutical Technology from the University of Regensburg, Germany, in collaboration with Al-Azhar University, Cairo, Egypt. His research interests include biomaterials as drug delivery systems, pelletization, nanotechnology and tablet technologyand polymeric drug delivery systems. He supervised more than 10 master and Ph.D. students in Egypt and Saudi Arabia. Dr. He published more than 100 research and review articles, in addition to book chapters in these areas.

Development of Environmentally Friendly Near Infrared Colloidal Quantum Dots for Photodetection

Jianying Ouyang,* , Neil Graddage, Jianping Lu, Barbara Martin, Ye Tao, Jianfu Ding, Patrick Malenfant

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Abstract

Low-cost photodetectors with sensitivity in the second near-infrared window (NIR-II, 1000–1700 nm) are highly demanded. Recently, we made the first demonstration of an Ag2Se colloidal quantum dots (QDs) photodiode with sensitivity up to 1200 nm. By employing secondary phosphine to elevate the precursor reactivity, the Ag2Se QDs with a distinct excitonic absorption peak was achieved. These nanocrystals were deposited from solution into a mesoporous TiO2 scaffold to increase the light absorption and charge separation and reduce the exciton diffusion length. By incorporating a suitable hole-transporting layer between the active layer and Ag anode, the resulting devices showed a responsivity of 4.17 mA/W at 1200 nm.1 Also, Ag2Te QDs are excellent for advancing the detection wavelength. Their synthesis with desired particle sizes, narrow size distribution and high photoluminescence quantum yield (PL QY) is challenging. We systematically investigate critical parameters affecting the synthesis in an organic phase. It shows that high Ag/Te feed ratio leads to smaller size and higher PL QY; under 4:1 Ag/Te feed molar ratio, addition of secondary phosphine leads to narrower size distribution and excellent colloidal stability; under 6:1 Ag/Te feed molar ratio, excess 1-dodecanethiol as a strong ligand slows the nucleation and results in fewer nuclei, leading to a broad size distribution and poor optical properties; additional n-trioctyl phosphine as a weak ligand provides better colloidal stability; and another weak ligand n-tributylphosphine improves Ag2Te QD colloidal stability, focuses size distribution, and enhances PL QY. After optimization relatively large Ag2Te QDs with distinct excitonic absorption peaks (~1050 – 1450 nm) and PL emission peak 1.3 – 1.7 μm (QY up to 6.2%) were obtained. NIR-II photodetection has been demonstrated with a responsivity of ~1.5 mA/W at 1400 nm.2 More recently, we have been developing Sn-based chalcogenide QDs. These results demonstrate

Reference:
[1] Graddage N, Ouyang J, Lu J, Chu TY, Zhang Y, Li Z, Wu X, Malenfant PRL, Tao Y. Near-Infrared-II Photodetectors Based on Silver Selenide Quantum Dots on Mesoporous TiO2 Scaffolds. ACS Applied Nano Materials 2020, 3: 12209–12217.
[2] Ouyang J, Graddage N, Lu J, Zhong Y, Chu TY, Zhang Y, Wu X, Kodra O, Li Z, Tao Y, Ding J. Ag2Te Colloidal Quantum Dots for Near-Infrared-II Photodetectors. ACS Applied Nano Materials 2021, 4: 13587–13601.

Keywords:
Environmentally Friendly; Near Infrared; Quantum Dots; Photodetection.

Biography:

Dr. Jianying Ouyang is a senior research officer at National Research Council Canada (NRC). Dr. Ouyang received PhD in Polymer Chemistry from National University of Singapore in 2003. In 2005, Dr. Ouyang joined NRC as a visiting fellow and conducted research in synthesis and characterization of colloidal quantum dots (QDs). In 2008, Dr. Ouyang was hired by NRC as a research officer, and continued QDs research for applications including bio-imaging, photovoltaics, and near infrared photodetection. In recent years, Dr. Ouyang also dedicated in purification and enrichment of semiconducting single-walled carbon nanotubes (SWCNTs) used in printable electronics including thin film transistors (TFT), gas sensing, and near infrared photodetectors. Dr. Ouyang has published a number of papers in peer-reviewed scientific journals, such as ACS Nano, Angewandte Chemie, Small, Chemistry of Materials, and ACS Applied Materials & Interfaces, etc.

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Advancing Microplastic Research with Environmentally Relevant Particles

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Abstract
Plastic pollution is globally recognized as an environmental challenge affecting ecosystems and human health. The majority of plastic waste flows from land to oceans, significantly impacting marine life and organisms. More recently, there has been growing concern about small fragments at the micro and nanoscale, which originate from the breakdown of larger plastic litter. This concern has driven research efforts to understand the sources, distribution, fate, and impact of these particles [1]. However, their small size poses challenges, including the lack of adequate methods for qualitative and quantitative studies [2]. Within this context, there is a pressing need to create high-quality reference or test materials for laboratory studies, protocol optimization, and database construction. These materials should mimic real particles as closely as possible. This contribution presents a study of micro and nanoplastics through the preparation of more realistic test materials referred to here as "true-to-life" materials. In the case of microscale fragments, "true-to-life" microplastics were generated by mechanically fragmenting commonly used plastic items. These materials were then characterized to reveal specific features of the resulting test materials. These findings indicate that the shape, morphology, and physicochemical characteristics of the fragmented debris vary depending on the type of plastic. This can serve as an indicator for future research into shape analysis of microplastics exposed to the environment and for the development and validation of standardized test procedures to evaluate the biological impacts of plastic particles and chemicals leached from weathered plastic in model organisms. Regarding nanoscale fragments, "true-to-life" nanoplastics separated from larger microscale pieces were used to investigate the nanoscale behavior of interactions with biological systems. Specifically, the formation of a protein corona from human plasma was examined, revealing that "true-to-life" nanoplastics exhibited a different protein corona composition compared to synthetic polystyrene nanobeads [3]. These findings underscore the importance of integrating field and laboratory data under more environmentally relevant conditions. They suggest that "true-to-life" nanoplastics are a more authentic material for studying environmental nanoplastics, opening up the possibility of uncovering new and unexpected results in biological interactions.

Keywords:

microplastics; nanoplastics; test materials.

Biography:

Stefania Federici received her PhD in Technologies and Energetic Systems for Mechanical Industry (University of Brescia) in 2012 and her M.Sc. degree (cum laude) in Physics from Università Cattolica del Sacro Cuore in 2008. She is currently Senior Research Fellow at the Department of Mechanical and Industrial Engineering at the University of Brescia. Her research activity is focused on the realization of more realistic test materials for micro and nanoplastics environmental pollution. She is also interested in the study of the interaction between nanoplastics and biological systems. She is responsible for the "Chem-Bio-Nano Interfaces" division at the Chemistry for Technologies Laboratory at the University of Brescia. She is Action Chair of the COST Action "Plastics monitoRIng detectiOn RemedIaTion recovery – PRIORITY", which connects about 450 researchers from 48 countries working on micro and nanoplastics issues. She participates in several national and international projects dealing with micro and nanoplastics.

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Low Density Recycled AA2070 Al-Cu-Li Alloy Processed by Powder Metallurgy Technology

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Abstract
This research focused on analyzing the impact of iron in high-performance aluminum alloys, specifically the Al-Li-Cu alloy AA2070, with the aim of assessing its feasibility in secondary aluminum alloy production. This approach aims to reduce costs and broaden the applications of these alloys. Secondary aluminum powder was used as the base material, adjusted to match the alloy's stoichiometry, and was compared to the same alloy obtained from primary sources.

The powders were compacted at 700 MPa using a uniaxial press and subsequently sintered at three different temperatures (525°C, 550°C, and 575°C) under a nitrogen protective atmosphere in a Carbolite S302RR tube furnace. Physical and mechanical properties of the samples were evaluated through Archimedes' methods, Vickers hardness tests, and scanning electron microscopy (SEM) for microstructural analysis.

The results indicated that primary alloys achieved higher relative density compared to secondary alloys, except at 575°C, where the secondary alloy surpassed the primary. This can be attributed to the presence of iron in the secondary alloys hindering the densification of secondary aluminum and suppressing the formation of the liquid phase, which explains the results at 575°C in primary alloys.
SEM images revealed proper compaction and sintering processes in both alloys, with residual microporosity decreasing as the sintering temperature increased. Both alloys exhibited an FCC_A2 matrix phase and a circular phase associated with AlxCuy, but secondary alloys contained iron-based intermetallics. The accumulation of copper at the grain boundaries due

to the presence of iron corroborates the findings in hardness results and suggests an impact on mechanical properties.
Hardness values of secondary alloys were consistently higher at all temperatures, with the difference increasing with sintering temperature. This is attributed to the formation of an iron-based secondary phase, Al13Fe4, confirmed by ThermoCalc simulations and EDS analysis, which increases the stiffness of aluminum alloys and suppresses grain growth by limiting the diffusion of copper-based phases in that region.

In summary, the production of AA2070 aluminum alloys from secondary aluminum using the powder metallurgy method yields pieces of similar quality to those from primary sources. The density of secondary samples is affected by the presence of iron, allowing for higher sintering temperatures due to the "pinning" effect at grain boundaries, enhancing their mechanical properties. However, iron-related secondary phases result in coarser secondary phases at grain boundaries, increasing hardness but reducing ductility, suggesting that secondary alloys may require post-treatment to match primary alloy properties.

Keywords:
Secondary Aluminum Alloy; Powder Metallurgy; AA2070; Mechanical Properties.

Solder Casting Of Electrical Powerlines

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Abstract

Additive manufactured electronics (AME) and Hybrid Additive Manufacturing (HAM) are becoming more and more popular, especially with new founded facilities, industrial solutions and co-operations around the world. Technologies for AME at HAM focusing on different conductive materials and processes. Most used methods are powder-based laser melting systems and conductive filaments for Fused Deposition Modelling (FDM). Nevertheless, both approaches are cost intensive, in addition, the FDM approach exhibits weaknesses in terms of electrical conductivity and current capability. As shown in prior publications, these limitations could be overcome by an additive manufacturing approach which is implementing standard solder material into additively manufactured structures by casting the solder direct into additive manufactured polymer structures. To develop this technology, further experiments have been taken to improve the accuracy and the possibility to connect smaller parts. Furthermore, the stability of the casting process was optimized which lead to smaller electrical structures. The thermoplastic polymer shows a good acceptance to the process and the outcoming powerlines meets the requirements to produce prototypes with integrated powerlines in a one-step-process.

Keywords:
Additive Manufactured Electronics. Hybrid Additive Manufacturing, Solder Casting

Biography:

Michael Petke (1982) has a technical education in electronics, industrial engineering and more than 20 years of experience in developing, teaching and purchasing of electronic components. The scientific orientation began with the start of his work at the FH Kufstein in 2019. Since then, the focus of research activities is in the field of teaching methods, electronics and additive manufacturing. Together with the research team at the University of Applied Sciences in Kufstein Tirol, he is developing the process of solder casting as a new approach to Hybrid Additive Manufacturing.

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Operando X-Ray Scattering During Polymer Processing

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Abstract

It is now some 42 years since the first experiments were performed at the first second generation synchrotron light source, the Synchrotron Radiation Source (SRS) at Daresbury in England. This pioneering source was built around a lattice of bending magnets which were the principle source of radiation. In the intervening years many new synchrotron light sources have been design and constructed. There are now about 70 facilities world-wide. These more recent synchrotrons have been designed to allow insertion devices such as undulators to be inserted straight sections of the synchrotron ring. An undulator contains a periodic array of magnets and the characteristics of these arrays largely determine the energy of the radiation produced. The undulator is a harmonic device and the radiation produced is very intense and is highly collimated in the plane of the orbit of the electrons. Much of the work included here was performed at the ALBA synchrotron light source in Barcelona, Spain. This is a third generation 3.0GeV machine in which six of the ten operational beamlines have an insertion device as the source of radiation. Undulator sources at a third-generation synchrotron light source are a billion times brighter than a conventional laboratory based X-Ray.

Researchers working on the SRS Daresbury were quick to identify the advantages of combining small-angle X-Ray scattering (SAXS) and wide-angle X-Ray scattering (WAXS) in to a single experiment. Other developments quickly followed, SAXS/WAXS experiments were combined with a differential scanning calorimeter stage, so as to obtain structural information as well as the phase transition. Rarely were the intensity scales of the SAXS and WAXS measurements placed on to an absolute or comparable scale and in some cases this resulted in the misinterpretation of the data by the researchers involved. Other combined techniques followed, SAXS/WAXS were combined with tensile measurements, humidity, magnetic

fields, raman scattering, and flow fields. Some processing type experiments were undertaken, reaction injection moulding was one of some note in which researchers showed great ingenuity in combining the different techniques.

The late Professor H.G.Zachmann in Hamburg at the HAYSLAB initiated a series of pioneering experiments exploiting a dedicated polymer science beamline most notably on fibre spinning. This led others to explore performing industry relevant polymer processing on the same beamline and at other synchrotron facilities. In this presentation we will review work such operando measurements performed by the authors of this presentation and other published work. We critical review the benefit of operando measurements and introduce our most recent work on industrially relevant injection moulding 3D printing. We identify the positive features of this type of measurements and the limitations. We look forward to developments which may come forward in the next few years.

Keywords:
Polymer Processing; X-Ray Scattering; Injection Moulding; 3D Printing; Operando measurements;

Biography:

Geoffrey Mitchell is Professor and Coordinator Researcher at the Centre for Rapid and Sustainable Product Development at the Polytechnic of Leiria in Portugal. He is Adjunct Professor at the Sri Jayachamarajendra College of Engineering, in Mysore India, Visiting Medical Physicist, Oxford University Hospitals Trust, Oxford UK and Emeritus Professor at the University of Reading in the UK. His eclectic research work bridges material science, physics, biology, chemistry, computer simulation and technology and he is passionate about the opportunities which arise from additive manufacturing. He has pioneered the development of in-situ time-resolving neutron and x-ray scattering procedures to evaluate the structural and morphological transformations involved during manufacturing including Reaction Injection Moulding and Injection Moulding of semi-crystalline thermoplastic polymers and biopolymers. He has applied this approach to 3D printing to develop the concept of morphology mapping. He is a strong advocate for Climate Change and the challenges of sustainability. He has edited a number of books, the most recent “Controlling the Morphology of Polymers” and “Electrospinning – Principles, Practise and Possibilities” with a second edition to be published in 2024. He currently was writing a book in partnership with Professor Mahadevappa Kariduraganavar at Karnatak University in Dharwad India on “Design, Processing and Degradation of Plastics”.

Supramolecular Semiconductor Materials for Organic Electronics

Aurica Farcas,
"Petru Poni" Institute of Macromolecular Chemistry-700487 Iasi, Romania

Abstract

The interest in the area of semiconducting polymers (SMPs) for organic electronics has intensified during the past few decades as a consequence of their numerous advantages over conventional inorganic materials [1]. Being in direct competition with inorganic materials, there are still many points for improving SMPs`s charge carrier mobility that is the main difference between them [2]. Although tremendous effort has been devoted to tune SMPs's charge-transport properties through molecular design undesirable long wavelength emission bands considerably affects electronic and transport properties of SMPs. Over the past decades, the field of polymer science has witnessed remarkable innovations and progress, alongside major advances in the complementary field of supramolecular science, which offer great opportunity for new concepts, new materials with unique properties and novel practical applications. In particular, so-called supramolecular SMPs have been recognized as promising materials, which attracted much attention due to their molecular structures and reduced aggregation tendency as a result of a single polymer chain encapsulation [3]. The design and synthesis of such supramolecular SMPs, through the use of mechanically interlocked molecules of polypseudorotaxanes (PPs) or polyrotaxane (PRs) types open the gates to unprecedented opportunities in many fields of science. Previously studies, demonstrated that these supramolecular SMPs provided evidence for a low aggregation and enhanced environmental stability both in solutions or solid state [3,4].

Based on our experience concerning the synthesis of such PPs and PRs architectures [5-8], we are aiming to present here new and original supramolecular SMPs based on poly(3,4-ethylenedioxythiophene) (PEDOT) and poly[2,7′-(9,9-dioctylfluorene-alt-2′,7-fluorene)] (PF) encapsulated into 2,3,6-tri-O-methyl cyclodextrins (TMe-CDs) and cucurbit[7]uril (CB7) host molecules. The novelty of our presentation occur through: i) novel approaches for the synthesis of such supramolecular compounds; ii) the presence of TMe-CDs and CB7 on PEDOT and PF backbones was reflected in improvement of the solubility in either polar or non-polar organic solvents as well a good solubility in water, which allowed the processing of these supramolecular systems by spin coating even in water; iii) meanwhile, the photophysical

and transport properties of these encapsulated materials will be compared with those of the pristine PEDOT and PF compounds. To conclude, the aim of this presentation is to provide an overview on approaches that have been employed to synthesize two types of SMPs and to show that the encapsulation could effectively improve PEDOT and PF's optical properties, solubility, and morphological characteristics, which are advantageous for their optoelectronic applications.

Keywords:
PEDOT; polyfluorenes; polyrotaxanes; electrical conductivity.

Biography:

Aurica Farcas has a background in organic chemistry and leads a research group focused on the development of supramolecularorganic semiconductors useful as optoelectronic materials. She received a doctorate degree in Polymer Chemistry from Petru Poni Institute of Macromolecular Chemistry (ICMPP) Iasi-Romania in 1998. Afterwards she was a post-doctoral fellow in the group of Professor Silvia Janietz at Fraunhofer Institute for Angewandte Polymerforschung, Golm-Germanyin semiconducting organic materials (2001). Then, she continued her training with Professor Harry W. Gibson at Virginia Polytechnic Institute& State University Blacksburg–USA, and Professor Helmut Ritterat Heinrich Heine University Düsseldorf-Germany, where the work was focused on the synthesis of supramolecular conjugated materials. Since 2006, she has been invited professor/collaborator at the University d'Evry(France), Jacobs University (Germany) and CYCergy Paris Université (France). Her interests also include solution-based synthesis of supramolecular conjugated polymers and their interactions with biological entities, activities that are instrumental for future applications in the field of nanobiotechnology. She is senior-author of more than 70 research articles published in ISI-indexed journals, and is also author of two books on conjugated polyrotaxanes, and six book chapters. She has been the recipient of 40 national and international research grants, and has submitted 21 patent applications, out of which three are employed in industry.

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Receiver/Reactor Engineering and Multi-Spectral Bands Radiative Power Delivery Technology for Solar Energy Efficient Utilization

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School of Energy Science and Engineering, Harbin Institute of Technology, 92 West Dazhi Street, Harbin, 150001, China

Abstract
The combination of solar-driven thermal chemical energy storage technology and CO2 capture/enrichment technology can overcome the intermittent, low-density, and non-uniform nature of solar energy utilization, providing a viable technological route to green and sustainable carbon-based energy production with net zero/negative carbon emissions. However, the performances of radiative heat and mass transfer along with the catalysis system are the key issues affecting the feasibility, stability, and high-efficiency solar energy utilization through solar thermal-chemical energy conversion and storage mechanism. An appropriate design of a receiver/reactor model and adequate consideration of the coupled thermal-optical transport properties in solar thermal chemical energy conversion and storage process could provide a theoretical basis for optimal radiation modulation and the application of advanced photothermal catalysis concepts. In this study, receiver/reactor engineering and the coupling mechanism of the multispectral directional radiative transfer and power delivery technology were investigated for solar energy efficient utilization through a thermochemical energy conversion mechanistic pathway. A multispectral radiative transfer model is constructed considering the xenon lamp as well as the high-temperature walls and medium in the reactor as short- and long-wave radiation sources, respectively. The radiative transfer properties of porous media as participating media have been analyzed by their peculiarity of spatial configuration. Using numerical and experimental methods, the issues affecting solar multi-spectral bands radiative power delivery and conversion have been highlighted. The results indicate the potential strategies and improvement for the optimization toward efficient utilization of solar energy. This work provided an in-depth understanding of solar receiver/reactor engineering and the coupled thermal-optical field properties in solar radiative power delivery and conversion processes.

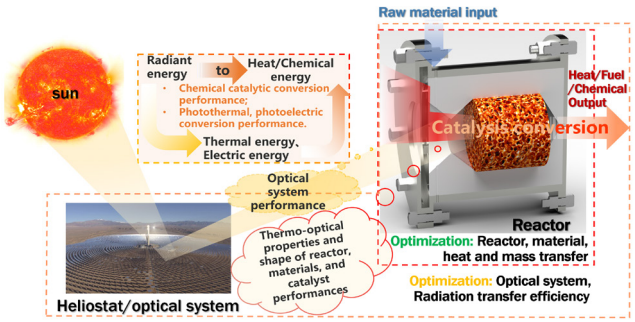

Fig. Solar energy conversion mechanism providing theoretical guidance for system optimization.

Keywords:
Solar energy utilization; Receiver/reactor; Photo-active porous absorber; Thermal-optical properties.

Acknowledgments:
This work was supported by the National Natural Science Foundation of China (52227813), and funding for research projects of the Chinese Society for Degree and Graduate Education (No. 2020MSA352).

Biography:

Dr. Guene Lougou Bachirou is an Associate Professor in the School of Energy Science and Engineering at the Harbin Institute of Technology (HIT), Harbin, China. He received a B.S. degree in ES Science Physics and Chemistry in 2010 and an M.S. degree in Renewable Energy and Energy Systems in 2012 from the University of Abomey-Calavi, Benin, and a Ph.D. degree in Power Engineering and Engineering Thermophysics in 2018 from the Harbin Institute of Technology. He joined the School of Energy Science and Engineering at Harbin Institute of Technology in 2019, as an Assistant Professor (2019-2021). Currently, he is an Associate Professor and Deputy Director of the Overseas Expert/Exchange Office at the Harbin Institute of Technology. His current research interests are in the areas of solar thermochemical cycles and energy storage technologies. He is serving on the editorial boards of the Journals of Energies and Rare Metals. He is a Member of the International Solar Energy Society (ISES) anda Member of the Royal Society of Chemistry (RSC). His contributions to research and education have been recognized with several honors and awards including the Award for the Chinese Government Scholarship for Outstanding International Students (2017), Outstanding graduate students (2019), Science and technology award “Excellent Doctoral Dissertation Award” (2020), the 2020 National Science and Technology Award “Foreign Youth Talents Program”, the 2021 National Science and Technology Award “Foreign Young Scholars Research Fund”, and the Best Paper Award”Journal of Energy Chemistry” (2022).

Contactless Magnetic Sensing in Condition Monitoring and Anomaly Detection for Smart Grid: New Possibilities and Alternatives

Philip Pong
Department of Electrical and Computer Engineering-New Jersey Institute of Technology, USA

Abstract

Our physical and cyber environments are becoming increasingly intertwined with smarter sensing, communication, and data analytics. Our daily livings are indeed surrounded by a wide variety of sensors, IoT connectivity, and edge computing devices, constituting smart grid, smart city, smart transportation, and so on. The availability of sensing devices with measurement, communication, and processing capabilities is providing fine-grained data. Together with multimodal sensory data collection and sensor fusion can result in actionable insights and decisions. This synergy can lead to improved ways and quality of life in what we call smart living.

Magnetism is one of the six energy forms of measurands in sensing. Magnetic sensing plays a critical role in smart living due to various sources of magnetic fields such as magnetic fields from current-carrying wires and permanent magnets which are geometrically determined by Biot-Savart Law and Ampere's Law respectively. These magnetic fields can range from DC to AC, from low frequency to high frequency. Modern civilization heavily relies on electricity which are generated, transmitted, and utilized through various kinds of transmission medium and electrical machines that are composed of current-carrying conductors, electromagnets, and permanent magnets. As such, magnetic field sensing is an important source of data and thus information for condition monitoring of power generation, transmission, and distribution.

In this talk, we will discuss the various opportunities and alternatives magnetic field sensing can offer in condition monitoring and anomaly detection in smart grid and smart city. Since it is contactless sensing, its installation is easy and it can be easily retrofitted to the existing plant and equipment. This will minimize cost, avoid wear and tear, and meet stringent reliability requirement. Contactless magnetic sensing can complement the traditional contact measurement techniques and help to overcome the major obstacle towards pervasive sensing due to its scalability.

Biography:

Philip W. T. Pong received a B.Eng. from the University of Hong Kong (HKU) in 2002 with 1st class honours. Then he obtained a PhD in engineering at the University of Cambridge in 2005. He was a postdoctoral researcher at the Magnetic Materials Group at the National Institute of Standards and Technology (NIST) for three years. Currently he is an Associate Professor in the Department of Electrical and Computer Engineering at New Jersey Institute of Technology (NJIT).His research interest focuses on the fault detection, predictive maintenance, and anomaly

detection of power grid. He is the Founding Director of the Green Technology Research and Training Laboratory, leading the research and education activities of offshore wind energy at NJIT. Philip Pong is a Fellow of the Institution of Engineering and Technology (FIET), a Fellow of the Institute of Physics (FInstP), a Fellow of the Energy Institute (FEI), a Fellow of the Institute of Materials, Minerals and Mining (FIMMM), a Fellow of the Hong Kong Institution of Engineers (FHKIE), a Fellow of the NANOSMAT Society (FNS), a chartered physicist (CPhys), a chartered engineer (CEng), a chartered energy engineer, a registered professional engineer (R.P.E. in Electrical, Electronics, Energy), and a Senior Member of IEEE (SMIEEE). He serves on the editorial boards for several IEEE and SCI journals.

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Thermoelectric Materials Modified by Graphene

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Abstract

The need for clean and sustainable energy sources to meet the exponentially rising energy demands of the world has compelled scientists to look for new power generation strategies. Thermoelectric (TE) energy conversion has the advantage to harvest widely distributed waste heat, and is also proved as an alternative route to convert solar/thermal energy into electric power economically.

Oxide materials are of current interest as high-temperature TEs in the manufacturing energy-harvesting sectors due to high chemical robustness, low toxicity and low cost. Driven by a need to improve TE performance of n-type oxides, ceramics and composites based on donor-doped SrTiO3 are considered as a promising material.

Within this context, Nb-doped SrTiO3 was mixed with graphene oxide (GO) and conventionally sintered in atmosphere of H2/N2 to reduce both Nb-doped SrTiO3 and GO. Addition of reduced GO (rGO) in combination with introduction of Sr vacancies provides a synergistic effect of fastening charge transport and thereby increasing electrical conductivity and suppressing the thermal conductivity. These factors, together with a moderate Seebeck coefficient, result in a high power factor PF □1.98 mW/(K2m) and figure of merit ZT up to 0.29. Such findings offer further prospects for seeking high performance SrTiO3-based TEs by modification with rGO.

Keywords:
graphene, thermoelectric properties, energy harvesting

Acknowledgements:
This work was supported by TEMA integrated projects UID/EMS/00481/2013-FCT and CENTRO-01-0145-FEDER-022083.

Biography:

Dr. O. Okhay completed her PhD in Materials Science and Engeneering in 2009 and is working in University of Aveiro, Portugal. She has published more than 40 papers and several book chapters. Her current research area is materials for energy harvesting and storage.

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November 23-24, 2023 | Lisbon, Portugal

Cyclodextrins-Threaded Conjugated Polyrotaxanes, an Approach to Control the Intermolecular Interactions of Organic Semiconductors

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Abstract

Interest in the area of organic semiconductor materials for optoelectronics has been intensified during the past few decades, as a consequence of their numerous advantages over conventional inorganic materials. Unfortunately, the use of these materials is often affected by several limitations including their low solubility in common organic solvents associated with high intermolecular interactions, which limits the process ability and therefore the applicability [1]. To overcome this drawback, a wide variety of structural changes have been adopted toward processable organic semiconductor materials. Even if the synthetic availabilities provided improvements on the solubility in most of the cases, the final results are questionable due to the undesirable intermolecular interactions, which affect the electronic properties. The past decade has witnessed remarkable innovations and progress in polymer science, including the field of supramolecular science as a complementary field, which offers great opportunity for new concepts, new materials with unique properties, and novel practical applications. The construction of mechanically interlocked molecules such as rotaxanes and polyrotaxanes has been employed as an alternative to achieve the control of intermolecular interactions and to improve the photophysical and morphological characteristics of these organic semiconductor materials. The construction of polyrotaxane architectures has an impact on the conjugated polymer-chain behavior and subsequently generates smart functional polymeric materials. Native cyclodextrins and their permodified derivatives are by far the most intensively investigated macrocyclic molecules in the synthesis of such supramolecular architectures. Here, we explore the photophysics of a class of organic semiconductor materials that are engineered at a supramolecular level by threading a conjugated backbone, such as poly(azomethine), polyfluorene or poly[2,7-(9,9-dioctylfluorene)-alt-(5,5·-bithiophene)] through native or permodified β-cyclodextrin rings, in order to reduce intermolecular interactions. The photophysics of these supramolecular compounds were compared to those of the non-threaded counterparts. The better solubility in organic solvents, the film-forming ability combined with the lower aggregation tendency provides an insight of these supramolecular architectures to be used as electron-transporting materials for optoelectronics.

Keywords:

Supramolecular chemistry; cyclodextrins; energy band gaps; fluorescence lifetimes; surfaces;

Acknowledgement:
This work was supported by a grant of the Ministry of Research, Innovation and Digitization, CNCS – UEFISCDI, project number PN-III-P4-PCE-2021-0906.

Biography:

Aurica Farcas has a background in organic chemistry and leads a research group focused on the development of supramolecularorganic semiconductors useful as optoelectronic materials. She received a doctorate degree in Polymer Chemistry from Petru Poni Institute of Macromolecular Chemistry (ICMPP) Iasi-Romania in 1998. Afterwards she was a post-doctoral fellow in the group of Professor Silvia Janietz at Fraunhofer Institute for Angewandte Polymerforschung, Golm-Germanyin semiconducting organic materials (2001). Then, she continued her training with Professor Harry W. Gibson at Virginia Polytechnic Institute& State University Blacksburg–USA, and Professor Helmut Ritterat Heinrich Heine University Düsseldorf-Germany, where the work was focused on the synthesis of supramolecular conjugated materials. Since 2006, she has been invited professor/collaborator at the University d'Evry(France), Jacobs University (Germany) and CYCergy Paris Université (France). Her interests also include solution-based synthesis of supramolecular conjugated polymers and their interactions with biological entities, activities that are instrumental for future applications in the field of nanobiotechnology. She is senior-author of more than 70 research articles published in ISI-indexed journals, and is also author of two books on conjugated polyrotaxanes, and six book chapters. She has been the recipient of 40 national and international research grants, and has submitted 21 patent applications, out of which three are employed in industry.

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Reinforcement Learning for Smart Energy Grid

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Abstract
With the increasing integration of renewable energy sources and flexible loads in smart grids, the resulting power system exhibits heightened complexity and uncertainty, posing significant challenges to efficient grid operations. Traditional optimization methods, reliant on accurate mathematical models and parameters, struggle to adapt to this evolving landscape. Fortunately, the widespread deployment of advanced meters enables the collection of vast datasets, creating opportunities for data-driven artificial intelligence (AI) methods to address optimal operation and control challenges. Among these methods, deep reinforcement learning (DRL) has garnered widespread attention due to its exceptional performance in managing operational problems characterized by high uncertainty. This article presents a comprehensive literature survey on DRL and its applications in the realm of smart grid operations. The exploration begins with an in-depth overview of DRL, spanning from fundamental concepts to advanced models. Subsequently, various DRL techniques and their extensions are reviewed, specifically tailored to address emerging issues in the smart grid context. These encompass optimal dispatch strategies, operational control mechanisms, electricity market dynamics, and other nascent areas within the smart grid domain.Furthermore, the survey delves into application-oriented analyses of DRL in smart grids, shedding light on existing challenges and laying the groundwork for future research endeavors. The concluding sections of the article address essential challenges, propose potential solutions, and outline future research directions pertaining to the application of DRL in smart grid operations.

Keywords:
Smart Grid, Deep Reinforcement Learning, Optimization, Operational Control, Renewable Energy, Electricity Market, Data-Driven Methods;

Biography:
I am an energy engineer with a remarkable academic background and a wide range of skills. As an alumni of Erasmus Mundus master in Decentralized Smart Energy Systems (DENSYS), I am deeply passionate about smart grid, energy digitalisation, energy economics, green buildings, artificial intelligence, and smart cities. My ultimate goal is to contribute to the energy transition and help build sustainable, smart communities. In addition to my technical expertise, I possess strong emotional intelligence, communication, negotiation, decision-making, and planning skills. I believe that these qualities make me a valuable asset to any team, and I always strive to take the lead in challenging initiatives and boost the motivation and performance of my colleagues.

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Strategic Engineering to address the Supply Chain Challenges on a Changing World

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Abstract

This paper proposes the use of the Strategic Engineering to address Energy Sector with special attention to the Supply Chain Management and Service of Power Infrastructures. Indeed, Strategic Engineering is a new discipline that combine the use of Data Analytics, Modeling, Simulation and Artificial Intelligence in closed loop with the reality to support Decision Making; this discipline is born less than a decade ago, therefore Strategic Engineering is turning very popular for supporting Decision Making over modern Complex Systems being able not only to analyze the data, but also to evaluate the impact of different alternative decisions by Simulation and to introduce self learning capabilities by Machine Learning. In addition it is evident that to use these techniques in combined way and to have Decision Makers to adopt suggestions from these new Solutions it is necessary also a Mind Set change in Management and availability of Strategic Engineers in supporting the process. In facts, the Energy represents a major Challenge, today, in terms of Strategies to adopt and Decisions to take at high, medium and low Levels. The Authors focus especially in this case on the capability to improve efficiency and effectiveness of Energy Infrastructures by optimizing Service and Supply Chain Management thanks to the use of Strategic Engineering; indeed in this field, this new approach has a big Potential due to the evolution of the context along last years: the authors remind that even over 30 years ago it was possible to collect data from Power Plants all around the globe (e.g. Equivalent Operating Hours, EOH of Gas Turbines), however this was happening in the ’80 to evaluate how an Unit operated and when it to inspect it or to conduct revision, while the values were transmitted daily (e.g. fax): this was a number per day, while nowadays we receive thousands values each second, being able to evaluate vibrations, identify potential sources of failures, checking the consumption and generation dynamics, etc.

Theoretically, today we are plenty of data to analyze, but these data are often inconsistent, incomplete, not homogeneous and we need intelligence to extract information; in addition, the Data Analytics to support all this and Predictive Maintenance is just a part of the problem; as soon as Symptoms are identified, it is necessary to decide how to react: stop and inspect/ correct, anticipate next inspection, wait next inspection; eventually it could be necessary to readapt the Plan of a pool of Machines to compensate Power Need and even to guarantee that Supply Chain of spare parts is ready to support the decisions in combination with availability of Resources and respect of all Constraints (e.g. technical, commercial, market, user, site

issues defining hard and soft logic of stop). These aspects turn to be very crucial in the sector of Gas Turbine Power (GPC) and Combined Cycle Powe Plants (CCPP) where the high level of thermal-mechanical stress of the Machines and the high Capability to Generate Power in pretty Clean and Reliable way result critical today; so all this creates a very challenging and profitable Service Opportunity; nowadays this means to combine Corrective, Preventive, Risk-based and Condition-based Maintenance. The authors propose a new Architecture used for pools of CCPP and GPC that using Strategic Engineering was able to support collaborative use of preventive, reactive and predictive to improve the Performance for Users and Providers; this Solution is capable to self-adapt to mutations in boundary conditions, market solicitations and machine characteristics. The proposed approach considers how to optimize the whole Service and Supply Chain addressing many aspects, from blade scrapping and refurbishments to strategic and revision kit consumptions and considering the inventory, scheduling and operations as a common playfield to improve the overall performance.

Biography:

Dr. Agostino G. Bruzzone began his engineering studies at the Italian Naval Academy with the Faculty of Pisa. After successfully completing this phase, he transferred to the University of Genoa and achieved his doctorship in Mechanical Engineering. Since early '90, he has taught "Theories and Techniques of Automatic Control" and in 1992 he became member of the industrial simulation work group at the ITIM University of Genoa. Currently he is Full Professor in DIME, University of Genoa. He has written more than 250 scientific papers in International Journals and Conferences, in addition to books, technical/professional reports in partnerships with major companies (e.g. IBM, ENI, Contship, Solvay, CSC, Ford) and agencies (e.g. NASA, European Defence Agency, NATO, National Center for Simulation, Italian MoD, Italian Navy, US Army, DGA).

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Enhancement of Segmented-in-Series Solid Oxide Fuel Cell Performance by using Transfer Method with Transfer Sheet on Ceramic Support

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Abstract
Solid Oxide Fuel Cells (SOFCs) represent the third generation of fuel cells that utilize the solid oxide capable of permeating oxygen or hydrogen ions as the electrolyte. They have garnered consistent interest and research due to their simple structure, high efficiency and operating temperature, and the absence of issues related to electrolyte loss and corrosion. Specifically, segmented-in-series type SOFCs (SIS-SOFCs), which connect multiple cells in series, offer advantages such as a light and compact design, short current paths, and high volumetric energy density to minimize ohmic loss and enhance portability. However, compared to other SOFCs, SIS-SOFCs have a more complex structure, making process optimization essential. The screen-printing technique facilitates the rapid and straightforward manufacturing of desired pattern by applying pressure through the squeeze on patterned mesh or metal mask. Nonetheless, this method presents challenges in controlling the precise thickness of the produced SIS-SOFC layer. To address this issue, the transfer method was employed in which the ink or paste was layered on a transfer sheet and subsequently transferred onto the desired substrate. This approach not only enabled thickness control but also prevented the slurry from diffusing into the porous layer during screen printing process. This technique was applied to SIS-SOFCs, and the cells were constructed by stacking transfer sheets of anode, AFL (anode functional layer), electrolyte, CFL (cathode functional layer), and cathode materials on a ceramic support. The electrochemical properties were measured and analyzed based on the stacking thickness of each layer. Results indicated that increasing the cathode thickness from 45 μm to 95 μm led to a 40% increase in output power density, reaching 368 mW/cm2. Moreover, when the electrolyte thickness was adjusted from 9.7 μm (with 5 stacks) to 22.3 μm (with 6 stacks), the OCV value increased by 12% to 0.9V, and the power density doubled to 379.7 mW/cm2.

Keywords:
SIS SOFC, SOFC, Screen printing, Transfer sheet;

Jian Cheng Biography:

BI JIAN CHENG was born in Qingdao, China, in 1996. He received a bachelor's degree in electrical engineering and a master's degree in electrical and computer engineering, both from Korea university in Seoul, Republic of Korea. From 2020 to 2022, he worked as research assistant at Korea Electronics Technology Institute, Seongnam, and Republic of Korea. He is currently a second-year Ph. D. student at the Display and Nanosensor laboratory in Korea university. His research interests are the improvement efficiency and lifetime through light extraction in organic light-emitting diodes (OLEDs), and the development of multifunctional thin film encapsulation (TFE) and thermal conductive films with higher thermal conductivity, flexibility, and mechanical stability through material and structural advancements.

Byeongwoo Kang Biography:

Byeongwoo Kang was born in Suwon, Korea, in 1996. He earned a bachelor's degree with a double major in Food Bioscience and Technology and Electrical Engineering from Korea university in Seoul, Republic of Korea. He is currently in his second year of the Integrated Master & Ph.D. Course at the Display and Nanosensor laboratory in Korea University. His research interests include the development of low-power and highly efficient devices for automotive applications and IoT (Internet of Things) platform, as well as improving the thermal stability in magnetic tunnel junction (MTJ) and developing technology for the measurement of high temperature characteristics of MTJ thin film in magnetoresistive random-access memory (MRAM).

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High Power Density Motor & Invertor for Advanced Air Mobility

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Abstract
Currently Advanced Air Mobility become to be focused and various Aircraft developed in the world, especially in United State, Europe and Japan. At the same time these vehicle needs suitable motor which have optimal Power and light weight. Authors are developed during this several years the High Power Density Motor & Invertor for Advanced Air Mobility collaborating Air Craft OEM funded NEDO (New Energy and Industrial Technology Development Organization). The future of Motor & Invertor are the magnet arrangement, optimal construction design, high efficient thermal conductive material, heat management system, low noise power amplifier, model based software design for certification and additive manufacturing using unique 3D printer. Finally the power weight ratio was established to be 6KW/KG while being Air cooling system.
After completion this development, the Unit should be applied the aircraft environment requirement testing based on ASTM F3338-21(Standard Specification for Design of Electric Engines for General Aviation Aircraft), the presentation was prepared for the consideration of most favorited Specification for Advance Air Mobility.

Keywords:
High Power Density; Motor & Invertor; Advanced Air Mobility; Model Based Design;

Biography:
Hideo Kumagai was born in 1959 and graduated from Tokyo University of Science in 1982 with a bachelor's degree and started working at Tamagawa Seiki Co., LTD. He specializes in inertial navigation Systems, and has developed many types of inertial navigation system, including mechanical, optical, and MEMS Types. In 2000, he received a doctorate Ritsumeikan University, and in 2019, he became a senior managing director at Tamagawa Seiki Co., Ltd. and currently focusing on the development of air craft equipment.

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Future Perspectives of the 5G Network Energy-Efficiency

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Abstract

The radio part of mobile cellular networks is known as a major consumer of electrical energy, having a significant share in the total energy consumption of telecom operators. As a consequence, mobile network operators become one of the largest energy consumers on the national level in countries where their mobile telecommunication services are offered. The large energy consumption of mobile networks is further challenged with the implementation of the fifth generation (5G) mobile network, which in comparison with previous network generations, has set operating goals related to ensuring significantly larger user data rates, lower transmission delays, higher traffic capacities and improved energy efficiency. Improving energy efficiency is particularly demanding, since achieving such predefined 5G network operating goals comes with the cost of installation of a large number of new 5G base stations in the radio part of the cellular access network.

Although 5G BSs are generally more energy efficient when compared with previous BS generations, the physical deployment of new BSs of different sizes and capacities has a strong contribution to the increase of telecom operator's energy consumption. Consequently, this will further contribute to the increase of carbon dioxide emissions which are currently estimated for the mobile telecommunication industry at 0.4% of the total global carbon emissions. The physical allocation of 5G BSs will be significantly denser than those of previous BS generations, because 5G BS will need to serve a large number of user devices which, according to predictions, will continuously increase in the upcoming decade.

The impact of this increase of 5G user devices and corresponding capacity demands on 5G network energy efficiency in the period from 2020 to 2030 will be presented in the invited speech. Presentation will be given for the mobile networks allocated in the two European countries, on the level of national cellular network coverage. Modeling of user device increase and 5G BSs capacity with corresponding allocation in different user density regions during the period from 2020 to 2030 will be presented. Also, the standardized energy efficiency metrics used for long-term estimation of mobile network energy efficiency will be explained. Based on the modeled user device and 5G BSs density changes in the period 2020-2030, the results presenting energy-efficiency metrics for rural, urban, suburban and urban dense user density areas in two countries will be discussed. The discussion will also present how different

5G BS allocation and radio resource management models impact the 5G network area and data energy-efficiency metrics in the period 2020-2030. The last part of the presentation will give concluding remarks dedicated to the overall 5G network energy consumption and energy efficiency trends in the period 2020-2030, with recommendations for long-term improvements of 5G network energy efficiency.

Keywords:
5G; energy-efficiency; base station, radio; access; mobile; network; user device, capacity; power;

Biography:

Josip Lorincz received a B.Sc. (M.S. equivalent) and a Ph.D. degree in telecommunications engineering and computer science from the University of Split, Croatia in 2002 and 2010, respectively. In 2003 he joined the Department of Electronics and computing at the Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture, University of Split, Croatia. He was a visiting researcher at the Advanced Network Technologies Laboratory of the Politecnico di Milano, Milan, Italy. As a project leader or researcher, he participated in more than twenty scientific and professional projects funded by the public or private sector. He is the founder and co-chair of the Symposium on Green Networking and Computing, organized in the frame of the International Conference on Software, Telecommunications and Computer Networks (SoftCOM). He also serves as the technical program committee member for many international scientific conferences and reviewer for top scientific journals. His current research interests include energy-efficient wireless and wired networks, optimization in telecommunications, advanced design, the management and analyses of computer heterogeneous networks, and performance evolution of routing protocols. He has authored more than 50 research papers published in different scientific conferences and journals. He is a senior IEEE member, a senior ACM member, a Croatian Academy of Engineering member and the first president of the Croatian ACM chapter. Since 2004, he has owned Cisco CCNA, CCAI, and BCMSN certificates. He was awarded in 2023 with a Science award from his home University of Split and an outstanding young researcher award by the Croatian Academy of Engineering in 2013.

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Sustainable Supply Chain Management in Marine Renewable Energy: A Fuzzy Delphi Approach

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[2]*Department of Environment and Planning*

Abstract

The CXCR4 receptor upon binding its ligands triggers multiple signaling pathways that orchestrate cell migration, hematopoiesis, cell homing, and retention in the bone marrow. The RANTES chemokine ligand binds to CCR5 in the brain and the canonical ligand of CXCR4 is CXCL12, also known as stromal cell-derived factor 1 (SDF-1). These alfa and beta chemokines (metal accumulation in patients (Hg or Al). Thus, chemokines can predict the progression of dementia and are targets of neuroprotective and neuroplastic drugs in neurological diseases independently of its classical role as HIV-1 coreceptors.

Bibliography

This study presents a fuzzy Delphi approach to prioritize the key sustainability indicators for the Marine renewable energy (MRE) supply chain. MREs including wind, waves, tidal range, tidal currents, ocean currents, ocean thermal energy conversion and salinity gradients are promising sources of clean energy with the potential to help mitigate the effects of climate change. The sustainable development of the MRE industry requires careful consideration of the environmental, social, technical, and economic impacts of the supply chain. This study systematically assesses and evaluates various indicators within the supply chain management of marine renewable energy, emphasizing the significance of these 4 sustainability sectors implications. The research conducted a comprehensive analysis of key sourcing, delivery, distribution, consumption, and recycling considerations associated with marine renewable energy supply chain management. These considerations were evaluated based on the perspectives of a panel of experts from academia, industry, and government to rate the importance of a set of sustainability indicators for the MRE supply chain. The results of the fuzzy Delphi process showed that Marine energy production to the local environment, Facility cost of energy production and social acceptance of energy consumption are of highest importance. These three indicators are critical to the sustainable development of the MRE industry. This research serves as a valuable guide for policymakers, industry stakeholders, and researchers aiming to enhance the sustainability and viability of marine renewable energy supply chains. It

provides crucial insights into the multifaceted considerations and implications associated with the adoption and management of marine renewable energy technologies, thereby contributing to the advancement of sustainable energy practices on a global scale.

Keywords:
Sustainable Supply chain, Marine Renewable Energy, Fuzzy Delphi method;

Biography:

SeyedAsghar BayatGhiasi is a Ph.D student in Industrial Engineering and Management at the University of Aveiro, Portugal. He received his Bachelor's and master's degrees in industrial engineering. His Ph.D. thesis title is "Sustainable development of Marine renewable energies supply chain management in Portugal." His research interests include sustainable supply chain management, marine renewable energy, and decision science. He has published several papers in peer-reviewed journals and conferences. SeyedAsghar is excited to present his research on Sustainable Supply Chain Management in Marine Renewable Energy: A Fuzzy Delphi Approach at this conference. He believes that this research is important because marine renewable energy has the potential to play a major role in the transition to a clean energy future. SeyedAsghar is looking forward to sharing his research with the conference attendees and learning from other researchers in the field.

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Pump Operation for High COP Operation of a Hydrothermal Heat Pump System

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Abstract
For hydrothermal cooling and heating systems, a large number of pumps are usually used to provide the heat source of water, and to deliver cold and hot water to indoor heat exchangers such as FCU (fan coil unit) and AHU (air handling unit). In order to operate the cooling and heating system with high efficiency, it is necessary to select the appropriate pump for the operation control scheme of the hydrothermal heat pump. When a compressor inside a heat pump operates at a constant speed and the operating load is constant, it is common for the pumps to supply a constant flow rate through constant speed operation. On the other hand, if multiple compressors are installed inside a heat pump and variable speed operation is used, the number of pumps and pump rotational speed should be controlled to supply water flow according to the heat pump operation load. In general, maintaining a constant heat exchange temperature difference of 4~5 degrees is required to operate a heat pump system at a high system COP (coefficient of performance) which is the ratio of the cooling and heating output to the total power consumption of the heat pump and pumps, etc. When a heat pump is operating at partial load and the flow rate of the pumps is not reduced, the heat exchanger temperature difference is reduced by even less than 1 degree. In this case, the system COP of the heat pump system decrease because the heat pump's cooling and heating output and power consumption decrease but the pumps' power consumption is not decrease. Therefore, during partial load operation of a heat pump, the number of pumps and rotational speed should be adjusted to reduce the flow rate to maintain the heat exchanger temperature difference of 4~5 degrees. As a result, the pumping system should be configured for proper operation under partial load as well as full load in order to ensure high system COP of a hydrothermal heat pump system.

Keywords:
Hydrothermal energy; Heat pump; Part load, Pump operation;

Biography:

Hyun-Dong Kim is an associate researcher of the water energy laboratory at K-water Institute in Korea Water Resources Corporation. His research interests are Hydrothermal energy and Optimal use of energy with AI. He received a bachelor's degree in Materials Science and Engineering at Dankook University, Cheonan, South Korea. His research interests are Hydrothermal energy and Optimal use of energy with AI

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Development of an Eco-friendly River Water Source Heat Pump Heating and Cooling System

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Abstract
As part of the low-carbon energy transition, building cooling and heating systems are being converted to systems using eco-friendly renewable energy. Hydrothermal energy systems using river water are suitable for large-scale systems, have high efficiency, and can improve the urban heat island phenomenon, so applied technologies are being developed. In the study, the existing heating and cooling system of an office building, which mainly uses LNG gas, was replaced with a hydrothermal heat pump heating and cooling system using river water. Based on river water temperature data for more than 10 years, a 500 RT-class large-capacity heat pump with two-stage centrifugal turbo compressors had been developed, and an eco-friendly heat pump has been developed by replacing the existing high GWP (global warming potential) R-134a refrigerant with low GWP eco-friendly refrigerant of R-1233zd. The cooling and heating system consist of a hydrothermal heat pump, a heat recovery system using a river water heat source, a thermal storage tank in which hot and cold water is stratified and stored, and a pumping system for partial heating and cooling loads. A heat source compensation system is added to prevent freezing of the heat exchanger when the river water temperature drops below 5 degrees in winter. All systems were installed in an office building, and the cooling demonstration operation began in the summer. It is confirmed that the system can operate with high-efficiency of COP (coefficient of performance) 6.5 or more in cold storage operation, and can operate well under partial load in direct cooling operation. The demonstration operation will continue in winter.

Keywords:
Hydrothermal energy; River water; Heat pump; Cooling and heating system;

Biography:
Yong-Chae Jeong received the Ph.D. degree in water resource engineering from Sungkunkwan University, Suwon, South Korea, in 2019. He is currently working as a General Director of Water Energy Research Center with K-water Research Institute, Daejeon, South Korea. His research interests include renewable energy, hydrothermal, water resource, diagnostics, and green hydrogen.

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