European Congress on

Renewable Energy and Sustainable Development

November 16-17, 2023 | Rome, Italy

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Conference Programme

Conference Programme

November 16-17, 2023 | H10 Roma Città, Rome, Italy

Day 1, November 16, 2023

Meeting Hall: CAMPO MARZIO/TREVI

08:00 - 08:40 **Registrations**

08:40 - 09:00 **Introduction**

Keynote Presentations

9:00 - 9:40 **Jakob Albert,** Hamburg University, Germany

Title: Indium-Based Catalysts as Promising Alternative for Sustainable Power-To-Liquid Concepts

09:40 - 10:20 **Frank Kameier,** Duesseldorf University of Applied Sciences, Germany

Title: Blade Tip Vortex Noise of Wind Turbines and Infrasound

Oral Presentations

Session Chair: ***Jakob Albert,*** *Hamburg University, Germany*

Session Chair: ***Frank Kameier,*** *Duesseldorf University of Applied Sciences, Germany*

Sessions: Biofuels & Bioenergy | Renewable Energy & Resources | Geothermal Energy | Energy Conversion and Storage | Nano Energy & Technology | Solar Energy | Wind Energy | Clean Energy | Biodegradable polymers | Bioplastics from natural polymers

10:20 - 10:45 **Faisal Anzah,** Kuwait University, Kuwait

Title: Applying an AHP–GIS Model to Hybrid Wind–Solar Energy Site Selection in A Hot Desert Region: A Case Study of the Kuwaiti Desert

Networking & Refreshments (10:45 - 11:15) @ LOBBY BAR

11:15 - 11:40 **Pawel Michal Slupski,** University of Padova, Italy

Title: Deep U-tube Heat Exchanger Breakthrough: Combining Laser and Cryogenics Gas for Geothermal Energy Exploitation - Laser-Rock Interactions Perspective

11:40 - 12:05 **Celia K. Falkenreck,** University of Kassel, Germany

Title: Influence of Accelerated Aging on Regenerated Cellulose Fiber-Reinforced Bio-Polyamide

12:05 - 12:30 **Viktoriia Betina,** Ernst & Young GmbH, Germany

Title: Establishing Transition Strategies for Countries that are Depending on Gas & Oil Sector with a Focus on Biofuels, Biobased SAF

12:30 - 12.55 **Dorothea Voss,** Hamburg University, Germany

Title: Biogenic Formic Acid from Biomass of First, Second and Third Generation as a Sustainable Hydrogen Carrier and a Source for the Synthesis of Biofuels

Group Photo: 12:55 - 13:15

Lunch (13:15 - 14:00) @ RISTORANTE

14.00 - 14.25 **Andac Kilic,** ADM Electricity Distribution Inc., Turkey

Title: Showcasing Battery Energy Storage for Enhanced Grid Stability: A Case Study

14:25 - 14:50 **Monjurul Hoque,** Teagasc Ashtown Food Research Centre, Ireland

Title: Preparation and Characterization of Pectin/Carrageenan-Based Active Packaging Films

14.50 - 15:15 **Syawaluddin Akbar,** Pupuk Indonesia Holding Company, Indonesia

Title: Accelerating Decarbonization Initiatives for Fertilizer Industry in Indonesia: Case Study of Pupuk Indonesia (State-Owned Enterprise)

15:15 - 15:40 **Silus Kwemboi,** The Uganda Catholic Medical Bureau, Uganda

Title: Solar Energy Systems in Hospitals: Leveraging the Dual Effect of Cost and Carbon Efficiency; A Case of St. Joseph's Hospital- Kitgum in Uganda

15:40 - 16:05 **Baris Çetinkaya,** ADM Electricity Distribution Inc., Turkey

Title: Design and Development of an Autonomous Intelligent Robot for Distribution Centre Operations: A Case Study

Networking & Refreshments (16.05 - 16.30) @ LOBBY BAR

16.30 - 16.55 — **Kerim Kilinc,** Polyteks Textile Industry Research and Education Inc, Turkey

Title: Development of Biopolymer Multifilament Fibers: PBS Multifilament Yarns

16.55 - 17.20 — **Yahya Atilgan,** ADM Electricity Distribution Inc., Turkey

Title: Effects of Boron Electrolyte Materials and Compositions for Electrochemical Supercapacitors

17.20 - 17.45 — **Mohamed R. Gomaa,** Al Hussein Bin Talal University, Jordan

Title: Theoretical Model of Concentrating Photovoltaic/Thermal (CPV/T) System Based on Linear Mirrors

Day 1 Concludes followed by Certificate Distribution

Day 2, November 17, 2023

Meeting Hall: CAMPO MARZIO/TREVI

Keynote Presentations

9:00 - 9:40 — **Suzanna El Massah,** Zayed University, UAE

Title: GVCs and Environmental Sustainability in MENA: Do Digitalization and Institutions Make a Difference?

09:40 - 10:20 — **Zubaida Rukhsana Usha,** Chinese Academy of Sciences, China

Title: Waste Extracted Reinforced Powder Incorporated Biodegradable Chitosan Composite Film

Oral Presentations

Session Chair: ***Suzanna El Massah,*** *Zayed University, UAE*

Session Chair: ***Simona Trandafir,*** *University of Rhode Island, USA*

Sessions: Sustainable Development | Sustainable Agricultural Systems and Technology | Energy Policy | Wind Energy | Biofuels & Bioenergy | Green Energy and Technology | Global Industrial Processes and Sustainable Development | Environmental Impact and Sustainability | Clean Energy | Renewable Energy & Resources | Polyhydroxyalkanoates | Polymer nanotechnology | Bioplastics from natural polymers | Biodegradable Polymers

10:20 - 10:45 — **Laras Wuri Dianningrum,** Pupuk Indonesia Holding Company, Indonesia

Title: Creating and Applying Sustainable Fertilizer Based on Phospogypsum: Nitralite

Networking & Refreshments (10:45 - 11:10) @ LOBBY BAR

11:10 - 11:35 — **Pablo Blanc,** RELP - Global Renewable Energy Mass Adoption Program, Argentina

Title: Unveiling Market Dynamics: Nash Equilibrium and the Evolution of Renewable Energy Auction Markets

11:35 - 12:00 — **Giulio Teodoro MAELLARO,** GECO - Global Engineering Constructions s.r.l., Italy

Title: SEWAT - Sustainable Energy by Waves Trap

12:00 - 12:25 — **Michela Famiglietti,** University of Naples “Federico II”, Italy

Title: Novel Amylose-Argan Proteins-Based Bioplastics: Production and Characterization

12:25 - 12:50 **Bartłomiej Kielasiński,** BWW Legal Office Warsaw, Poland

Title: The Impact of the EPBD Directive Amendment on the Decarbonisation of the Construction Sector

12:50 - 13:15 **Necati Keskin,** ADM Electricity Distribution Inc., Turkey

Title: Developing Virtualized Remote Terminal Unit for Electricity Transmission and Reducing Cost and Error Electricity Transmission and Reducing Cost and Error Rates in Outage Management

Lunch (13:15 - 14:15) @ RISTORANTE

14:15 - 14:40 **Margarita Reit,** University of Kassel, Germany

Title: Influence of Accelerated Aging on Activation Energy of PLA and PLA-Starch Compound

14:40 - 15:05 **Djalila Gad,** Politecnico di Torino, Italy

Title: Energy Assessments of Women-Owned Micro, Small, and Medium-Sized Enterprises Working in Food and Textile Industries in Selected African Countries

15:05 - 15:30 **Thomas Norup From,** Aarhus University & Topsoe, Denmark

Title: Electrified Steam Methane Reforming of Biogas for Sustainable Chemical and Fuel Production

15:30 - 15:55 **Sude Kozalioglu,** ADM Electricity Distribution Inc., Turkey

Title: Artificial Intelligence-Based Attack Detection System for Supervisory Control and Data Acquisition (SCADA) Systems: Studies on Substation Emulator

15:55 - 16:20 **Konrad S. Sobczuk,** West Pomeranian University of Technology, Poland

Title: Differences in Photocatalytic Properties of Copper-Modified Commercial Titanium Dioxide (P25) During the Process of Carbon Dioxide (CO_2) Photoreduction

Networking & Refreshments (16:20 - 16:50) @ LOBBY BAR

16:50 - 17: 15 **Jordão Gheller Junior,** SENAI Innovation in Polymer Engineering Institute, Brazil

Title: Effects of Nanocellulose Addition on Natural Rubbers Compounds

17:15 - 17:40 **Fatima-Zahra El Bouchtaoui,** Mohammed VI Polytechnic University, Morocco

Title: Humic Acid Modified Lignin based Slow-Release Fertilizers Reduce Nutrients Leaching and Boosted Wheat Crop Growth and Productivity

Poster Presentations

PP -01 **Simona Trandafir,** University of Rhode Island, USA

Title: Understanding Public Preferences for Green Rooftops in the United States: A Discrete Choice Experiment

PP -02 **Silvia González Rojo,** Agrarian Technological Institute of Castilla y León, Spain

Title: Biotransformation of Starchy-Based By-Products Into Bioplastics: Valorization of Potato Wastewater to Produce Polyhydroxyalkanoates

PP -03 **Sukanya,** Clausthal University of Technology, Germany

Title: Purification, Regeneration and Reuse of Graphite from Lithium Batteries

PP -04 **Silvie Durpekova,** Tomas Bata University in Zlin, Czech Republic

Title: Bio-Based Hydrogels from Acid Whey as Sustainable Soil Amendments to Improve Soil Quality and Water Retention Capacity

PP -05 **Yu Han Guo,** York House School, Canada

Title: Biological Photovoltaics: Testing Algae for the Optimal Battery

PP -06 **Sara Fuster-Esteso,** University of Alicante, Spain

Title: Lactic Acid as Natural Biocide for Gum Arabic Adhesives

PP -07 **Kurias George,** Universitat Rovira I Virgili, Spain

Title: Assessing Future Offshore Wind Farms in the Gulf of Roses: Insights from Weather Research and Forecasting Model Version 4.2

Video Presentations

VP - 01 **Abderrahim Ait hssi,** Ibn Zohr University, Morocco

Title: Two-step Electrodeposition of Cu_2O/ZnO-NRs Heterostructures for Photovoltaic Applications

VP - 02 **Anastasia Tsoy,** Shanghai Jiao Tong University, Russia

Title: Overview of Current Development in Energy Storage Systems (ESSs) Integration Strategies for Different Building Typologies and the Application Potential in Architectural Field

VP - 03 **Kui Zeng,** University of Göttingen, Germany

Title: Synthesis of Thermoresponsive Pnipam-Grafted Cellulose Sulfates for Bioactive Multilayers via Layer-By-Layer Technique

VP - 04 **Morgan Lecoublet,** UniLaSalle, France

Title: Dielectric Performance of New Biobased Materials by 3D Printing

VP - 05 **Enrico Giarmanà,** Università degli Studi di Catania, Italy

Title: Managing Renewable Electricity within Collective Self-Consumption Schemes: A Systematic Private Law Approach

VP - 06 **Youness Khaddam,** Moulay Ismail University, Morocco

Title: New Small Non-Fullerene Acceptors Based on α-dithiophenetetrathiafulvalene with A-D-A Structure for High-Performance Organic Solar Cells Application

VP - 07 **Mujeeb Khan,** King Saud University, Saudi Arabia

Title: Nitrogen Doped Graphene and Palladium Nanoparticles Based Electrocatalysts for the Sustainable Production of Hydrogen Through Water Splitting

Day 2 Concludes followed by Panel Discussion - Closing Ceremony

Exhibitor

GECO - GLOBAL ENGINEERING CONSTRUCTIONS s.r.l.

GECO - Global Engineering Constructions s.r.l. - the company is developing an innovative project called SEWAT - Sustainable Energy by Waves Trap to produce sustainable energy and green hydrogen by subtracting energy from the erosive action of the waves. In this way the coast is also protected from erosion.

The idea is very simple but brilliant. No risk, dangerous implications, and no CO2 production. The system consists of modular concrete tanks, placed in the sea, partly submerged, placed alongside dams and breakwater barriers exposed to wave motion or distant, parallel to the coastline, at a certain distance to protect the coast itself. The function of the wall of the tub exposed to wave action is to catch the waves. It is equipped to allow waves to enter and to prevent their exit. The accumulated water produces energy during the transfer into the calm sea in the shelter of the tank itself.

The use of antifouling substances or polluting or dangerous substances is not necessary. The electricity produced can be used to produce hydrogen and then managed with consolidated technologies.

Day 1

Energy Trends 2023

Keynote Presentation

INDIUM-BASED CATALYSTS AS PROMISING ALTERNATIVE FOR SUSTAINABLE POWER-TO-LIQUID CONCEPTS

Jakob Albert, Philipp Kampe, Anne Wesner, Nick Herrmann and Sebastian Eller
University of Hamburg, Germany

Abstract:

With intensifying global warming and depleting fossil fuels, it is desirable to convert anthropogenic CO_2 into valuable chemicals. In this respect, methanol is a promising feedstock for producing commodity chemicals such as olefins and formaldehyde, since its demand has been increasing continuously over the past decade. Moreover, the energy generated from renewable sources has to be stored in certain chemical energy carriers before usage. With a high volumetric energy density (4.33 kWh L^{-1}), methanol is an ideal candidate for chemical energy storage, which can be produced from CO_2 and H_2 derived from water electrolysis.

Recently, supported In_2O_3-catalysts have shown excellent long-time stability and higher methanol selectivity compared to traditional Cu/ZnO-based systems.

'However, an important aspect so far not elucidated for the novel In_2O_3/ZrO_2 methanol synthesis catalyst is its tolerance against typical impurities in industrial CO_2 and H_2 sources.

As shown in Table 1, CO_2 from relevant industrial sources contains – depending on its origin - impurities like sulphur- and nitrogen-compounds, hydrogen halides and hydrocarbons.

In a recent publication, the catalytic performance and durability of the highly promising In_2O_3/ZrO_2-catalyst was examined in presence of typical impurities of industrial CO_2 feed stream for CO_2-hydrogenation to methanol. In particular, the influence of SO_2, H_2S, NO_2, NH_3 and hydrocarbons were studied - all having high practical relevance - using a classical fixed-bed reactor and industrially pertinent reaction conditions (225-275°C, 50 bar total pressure, H_2:CO_2 = 3:1). To properly evaluate the sensitivity of the In_2O_3/ZrO_2-catalyst against poisoning the results were compared with a commercial $Cu/ZnO/Al_2O_3$ catalyst after exposure to the same impurities under identical reaction conditions.

CO_2 source	CO_2 concentration / vol.%	Impurities	Refs.
Air	0.04	N_2, O_2, Ar	[19,20]
Coal-fired power plant	12-15	H_2O, SO_x, NO_x, HCl, HF, Hg, particles,	[21,22]
Natural-gas power plant	3-10	H_2O, O_2, NO_x, SO_2	[22,23]
Iron and steel	17-35	SO_x, NO_x, BTEX[a], PAHs[b]	[24,25]
Cement production	14-33	NO_x, SO_2, NH_3, HCl, HF, VOCs[c]	[26,27]
Paper and pulp	7-20	NO_x, SO_2, N_2O, CH_4	[28,29]
Biogas production	15-50	CH_4, H_2S, NH_3, HCl	[30,31]
Wood gas generator	9-36	CH_4, H_2O, NH_3, H_2S, HCl, tar	[32,33]
Ammonia synthesis	~100	H_2O, N_2, H_2, CH_4	[34]

[a]BTEX: Benzene, toluene, ethylbenzene und xylene, [b]PAH: Polycyclic aromatic hydrocarbons [c]VOC: Volatile organic compounds

Table 1: Typical impurities in industrial CO_2-sources for methanol synthesis.

Biography

Jakob Albert is currently working as the head of Institute of Technical and Macromolecular Chemistry in Department of Chemistry at University of Hamburg. He is an expert in Biomass Conversion.

From 2014-2020 he is the group leader of Biomass and Sustainable production of platform chemicals. In 2015 he worked as Co-founder of spin-off company OxFA GmbH. In 2018 he worked as a Guest Researcher at Technical University of Denmark, Lyngby, Denmark.

Since 2020 he is the Professor for Technical Chemistry at University of Hamburg. In 2021 he worked on Habilitation in Chemical Reaction Engineering, FAU Erlangen.

Main Achievements:

- 59Papres, 27 patent applications (h-Index 20, cited 1452 times)
- SIEMENS "Inventor of the year 2019" award in the category of "Open Innovation"
- ERC Consolidator Grant 2022 of the European Research Council

Key Research Activites:

- Polyoxometalates in catalysis
- Catalytic conversion of biomass
- Chemical energy storage
- Scale-up and Process design

BLADE TIP VORTEX NOISE OF WIND TURBINES AND INFRASOUND

Frank Kameier
Duesseldorf University of Applied Sciences, Germany

Abstract:

In sufficient proximity to a wind turbine, one hears noises which are sometimes referred to as a whoosh-whoosh sound. If one takes a closer look this disturbing audibility, aerodynamic generation mechanisms play a role, which are of interest acoustically as well as from point of signal analysis. A so-called blade tip vortex generates pressure fluctuations which, in conjunction with the rotating system of the turbine, can be interpreted as modulation and a Doppler-Effect. Simulation results help further, which is achieved by means of a simple graphical programming DasyLAB. The simulation result provides information of infrasound that a wind turbine may emit.

In Germany, the effect of wind turbines on people is rather conducted in technical terms. By means of a comparison of amplitudes and frequencies, it is whether complaints from people are only based on imagination. Technically it would be obvious that wind turbines cannot be responsible for health consequences – but no one knows, and a proof is nearly impossible.

A controversy among German scientists in 2021 illustrates the positions that on the one hand there would be no danger to the population and on the other hand and that, on the other hand, the findings of those affected do speak for a health relevance. The group that considers the indications of those affected to be valid, formulates a clear need for research, as there are uncertainties in humans. Both "scientifically proven and plausible points of attack" exist for this. Different hypotheses should be pursued and causal chains already formulated should be continued. Evidence is lacking, although arguments are obvious. There would therefore be tasks for future infrasound investigations arising from this state of research.

Biography

Frank Kameier was able to build on the research work of the "Fluid Machinery" department at the Duesseldorf University of Applied Sciences with the "Fluid Mechanics and Acoustics" department from 1998 onwards. In the existing tradition, the experience generated over 40 years in the design of centrifugal fans was supplemented with knowledge of flow acoustics, flow-induced vibrations and measurement technology from aircraft engine technology. He worked for 4 years at BMW-Rolls Royce (now Rolls Royce Germany) as an expert for unsteady aerodynamics. Highlights of his industrial research as a Professor was the noise reduction project of the Boing 787 Dreamliner with a modified outflow valve geometry. Also, he has Patents for devices to reduce axial flow machine noise or for the energy harvesting based on unsteady fluid mechanical effects. In the field of infrasound, he has experience of around 35 years. Frank Kameier has studied Physics at the Oberstufenkolleg as a part of Bielefeld University. He graduated from the Technical University of Berlin in 1988 with a degree in Engineering Science. Supported by the German Aerospace Center he finished his PhD in 1993 also at Berlin Technical University. Since 1998 he is Professor for Fluid Mechanics and Acoustic at Duesseldorf University of Applied Sciences.

Day 1

Energy Trends 2023

Oral Presentations

APPLYING AN AHP–GIS MODEL TO HYBRID WIND–SOLAR ENERGY SITE SELECTION IN A HOT DESERT REGION: A CASE STUDY OF THE KUWAITI DESERT

Faisal Anzah
Kuwait University, Kuwait

Abstract:

The aim of this research is to present how sand encroachment and dust fallout criteria impact the siting of hybrid wind – solar energy in hot desert regions. Analytical Hierarchy Process and Geographic Information System techniques were used to generate a hybrid wind – solar energy suitability map for Kuwait. For siting solar farms, dominant aeolian geomorphic processes like sand encroachment and dust fallout rate, distance to urban areas and farms, proximity to main roads and transmission lines, and slope criteria were used. Wind speed, distance to urban areas and farms, and proximity to main roads and transmission lines were considered for siting wind farms. According to the findings, sand encroachment and dust fallout rate were the top two criteria in terms of weighting for siting solar energy. The lowest hybrid suitability class covers the smallest area, with an area of 19 km^2 of the study area and is located in the south of the study area. The highest hybrid suitability class covers 1349 km^2 and is located in the northeast, midwest, southeast, and south. The sensitivity analysis results demonstrate that sand encroachment and dust fallout rate have a significant role in siting hybrid wind – solar farms in hot desert regions.

Biography

Faisal Anzah has his expertise in arid land geomorphology. This includes applying his expertise in resource management, such as soil and, more recently, the planning of renewable energy projects. Faisal Anzah is a member of the editorial board of the Annals of the American Association of Geographers.

DEEP U-TUBE HEAT EXCHANGER BREAKTHROUGH: COMBINING LASER AND CRYOGENICS GAS FOR GEOTHERMAL ENERGY EXPLOITATION - LASER-ROCK INTERACTIONS PERSPECTIVE.

Pawel Michal Slupski[1], Zampieri E[1], Galgaro A[1], Manzella A[2], Pasquali R[3], Pockéle L[4], Romanowski A[5], Sassi R[1], Steinmeier O[2] and Di Sipio E[1]

[1]*Department of Geosciences, University of Padova, Italy*
[2]*Istituto di Geoscienze e Georisorse, CNR, Italy*
[3]*TERRA GEOSERV LIMITED, Ireland*
[4]*R.E.D. SRL, Italy*
[5]*PREVENT GMBH, Germany*
[6]*Fraunhofer IAPT, Hamburg, Germany*

Abstract:

The technology envisioned in the DeepU project (Deep U-tube heat exchanger) is expected to revolutionize the geothermal energy sector, increasing the accessibility of deep geothermal resources for low-carbon heating and power generation. The ultimate project goal is to create a deep (>4 km) closed-loop connection in the shape of a U-tube exchanger by developing a fast and effective laser drilling technology. A prototype of a drill-head has been realized, combining the laser system with drill strings, sustaining the coupled action of laser and cryogenic gas. The fine particles of drilled rocks are transported to the surface in the gas stream via the borehole annulus. This contribution focuses on the project's activities related to the laser-rock interactions studied in the first experimental laser drilling tests. Three types of lithologies were selected for initial laboratory tests: granite, sandstone, and limestone (slabs with dimensions of 50 x 35 x 15 cm). Constant rates of penetration (ROP) upwards of 20 m/h have been achieved in all lithologies with borehole diameter reaching 18 cm. The petro-thermo-mechanical phenomena occurring during laser drilling, such as spallation, melting, and evaporation, were recognized and described. The laser working parameters and experimental setup were optimized regarding observed phenomena. In the next step, sections of boreholes were cut out and examined. The microscopic observations on the unaffected and affected rocks' thin sections have been performed with use of polarized optical microscopy and scanning electron microscopy (SEM). This innovative and comprehensive approach revealed macro- and micro-scale phenomena occurring during laser drilling, contributing to successful drills.

This research is funded by the European Union (G.A. 101046937). However, the views and opinions expressed are those of the author(s) only and do not necessarily reflect those of the European Union or EISMEA. Neither the European Union nor the granting authority can be held responsible for them.

Biography

Pawel Michal Slupski received his master's degree in field of mining and geology at the AGH University Science and Technology in Krakow, Poland, then he moved to Italy where started his doctorate at the University of Padova, specializing further in petrology and melting processes of geological materials. Currently, he is a young researcher continuing work on melting processes in the DeepU Project (DeepU.eu) at the Department of Geosciences, University of Padova. He is responsible for analyzing and understanding the phenomena occurring between laser and rock. With use of modern state-of -art instruments such as electron microscopy (SEM), X-Ray Computed Tomography (XRCT) or μ Raman Spectroscopy. His work is contributing to the successful development of new laser drilling techniques that will be used for geothermal energy exploration.

INFLUENCE OF ACCELERATED AGING ON REGENERATED CELLULOSE FIREINFORCED BIO-POLYAMIDE

Celia K. Falkenreck
University of Kassel, Germany

Abstract:

With regard to the sustainability and biological origin of plastic components, natural fiber-reinforced bio-based polymers are going to replace glass fiber composites in the future. For use under severe conditions, for example, as a housing in the engine compartment, the resistance of the composites and the impact on the fiber and fiber–matrix adhesion must be investigated. Composites of bio-polyamide with a reinforcement of 20 wt.% RCF were produced and accelerated aged under conditions of high humidity at 90% r. H, a high temperature of 70 °C, and water storage using a water temperature of 23 °C for 504 h. Mechanical tests and optical characterization reveal significant changes in the properties of the composites. The results show that accelerated aging has a significant effect on the mechanical properties of the bio- polymer and an even stronger effect on the fiber. Supplementary notched impact strength tests revealed a further correlation of a decreasing impact strength and the accelerated aging of the RCF-reinforced composites. In addition, it could be verified that the tensile strength also decreases due to the aging effect on the RCF and a lowered fiber–matrix adhesion, which was visible on SEM pictures. The greatest aging impact was shown in the Young's modulus with a decrease of 45%. It could be shown that the strengthening effect with 20 wt.% RCF in bio-polyamide is highly decreased subsequent to the accelerated aging due to hydrolysis and debonding because of the shrinkage and swelling of the matrix and fiber.

Biography

Celia K. Falkenreck is a research associate at the University of Kassel. Subsequent to her master´s degree in mechanical engineering from the University of Kassel in 2022, she started working at the University of Kassel as a research associate in the institute of material engineering in the department of polymer engineering. Her field of research is the aging resistance of cellulose fiber reinforced bio-polyamides.

ESTABLISHING TRANSITION STRATEGIES FOR COUNTRIES THAT ARE DEPENDING ON GAS & OIL SECTOR WITH A FOCUS ON BIOFUELS, BIOBASED SAF

Viktoriia Betina, Daniel Eisenhuth and Matthias Brey
Ernst & Young GmbH, Germany

Abstract:

Countries that heavily depend on gas & oil face several challenges and opportunities, as the global energy landscape evolves. The push towards decarbonization and the increased adoption of renewable energy sources are likely to lead to a decline in demand for fossil fuels. Still high utilization of gas & oil will peak by 2030. After, the demand will dramatically drop, as net-zero goals will limit its use and renewable technologies might become more cost-effective and efficient, also playing a larger role in the global energy mix. Having that in mind, there are number of countries that already look for a transition strategy towards green energy, where the existing gas & oil infrastructure can also be potentially reused. A reduction in the contribution of gas and oil to GDP, especially for developing countries in Africa, will create economic difficulties. These may include reduced government revenues, budget deficits, currency depreciation, and potential fiscal constraints. At the same time, looking at the global southern region, such as Angola, Nigeria can seize the opportunity to clearly define its future potential for the production of biofuels. Saying that, biofuels, compare for example to green hydrogen, have a longer value chain and can create more benefits for locals. In order not to compete with food, the focus of biofuels should be on the second generation using various waste streams into the production pathways. One option could be biobased SAF produced in African regions with dense forests. The use of forest waste can benefit the protection and cleanup of forests by creating a circular waste management, producing attractive SAFs at affordable prices for offtakers in Europe who currently lack of this product for their decarbonization goals. For this a clear strategy with a bankable business case must be created. European regulations, price models and investors risks to be considered. The increase in demand for this type of biofuels can gradually compensate for the loss of GDP from gas & oil and will create a completely new market with stronger intercontinental partnerships.

Biography

Viktoriia Betina has more than 10 years of experience working in a sustainability sector in Europe, Asia and Africa. She implemented number of projects for global financial institutes like EU, EBRD, WB, AfDB, GIZ, KfW etc. Within the last years she was working on the energy sector with a focus on developing strategies, analyzing investors risks, assessing EU regulations and its future needs, infrastructure development, establishing business cases with financial models. She has knowledge in biofuels including not only economic focus, but also understanding various production technology and their impact on a domestic market (ESG). Looking at the African region she led the project for Namibia hydrogen strategy and created financial and political tools in Europe to make Mega projects bankable, and she developed a national biofuels strategy for Angola by 2050 within the last year. Currently she is working on a global EY Study for biobased SAF and synthetic fuels together with Fraunhofer and Lufthansa.

BIOGENIC FORMIC ACID FROM BIOMASS OF FIRST, SECOND AND THIRD GENERATION AS A SUSTAINABLE HYDROGEN CARRIER AND A SOURCE FOR THE SYNTHESIS OF BIOFUELS

Dorothea Voss and Jakob Albert
Hamburg University, Germany

Abstract:

The development of an ecological, sustainable production route for formic acid (FA) as a green hydrogen carrier as well as a source for the synthesis of biofuels using the OxFA process opens an attractive way to achieve more sustainability.

While the production of hydrocarbons by Fischer-Tropsch synthesis (FTS) is a widely recognized, yet technically quite complex way to transform biomass via syngas (mostly from biomass gasification) into liquid fuels, we investigated an alternative route transforming biomass first into FA followed by syngas formation by decomposition of FA and finally FTS.

Formic acid is chemically composed of two hydrogen atoms together with one carbon atom and two oxygen atoms (HCOOH). It can be converted to hydrogen and CO_2 as well as CO and water, therefore FA can be used as a hydrogen storage as well as a syngas equivalent (H_2/CO). FA is liquid at room temperature and atmospheric pressure, non-toxic and accordingly easy to handle. Additionally, FA has a 20% higher energy density than hydrogen (6.4 MJ/L).

The conversion of biomass to FA builds on a selective oxidation using polyoxometalates as homogeneous catalysts, oxygen as the oxidant, and water as the solvent. This method is able to transform a wide range of complex biomass into FA at mild reaction conditions (90°C, 20–30 bar O_2). First, second and even third-generation wet biomass such as algae, waste from the food industry, effluent sludge, and railway sleepers can be efficiently converted to FA and CO_2, offering a very interesting path to make use of these materials.

Biography

Dorothea Voss studied chemical engineering at the Technical University of Dortmund in Germany. She received her master's degree at the TU Dortmund in 2015 and earned her doctoral degree from the Friedrich-Alexander-University Erlangen-Nuremberg in 2020. She is currently a head engineer at the Institute of Technical and Macromolecular Chemistry of the University of Hamburg. Her particular research focus is on catalytic conversion of biomass using polyoxometalate catalysts. Additionally, she focuses on the separation and recycling of polyoxometalate catalysts using membrane separation techniques and process upscaling to miniplant scale.

SHOWCASING BATTERY ENERGY STORAGE FOR ENHANCED GRID STABILITY: A CASE STUDY

Andac Kilic
ADM Electricity Distribution Inc., Turkey

Abstract:

This paper presents the results of a case study showcasing a battery energy storage system designed to enhance grid stability. The showcase was carried out over a period of one year in a substation located in the distribution region of ADM Energy Distribution Company, with the aim of demonstrating the effectiveness of battery energy storage for supporting the overall sustainability of power systems.

The battery energy storage system, with a capacity of 250 kW/224 kWh, was configured to provide various grid services, including peak shaving, reactive support, voltage regulation and microgrid operation. The showcase demonstrated that the battery energy storage system was able to respond rapidly to grid conditions and was effective in smoothing out the variability. The battery energy storage system also provided reliable grid support during peak demand periods, reducing the need for conventional generation resources.

The case study provides important insights into the effectiveness of battery energy storage systems for supporting renewable energy integration and enhancing the sustainability of power systems. The results have important implications for the wider adoption of renewable energy and battery energy storage systems in Europe and around the world.

Overall, this showcase provides a compelling example of how battery energy storage can play a key role in the transition to a more sustainable and renewable energy future. The findings are of interest to a wide range of stakeholders, including policymakers, energy companies, and researchers, and have the potential to inform future investment decisions in renewable energy and battery energy storage.

Biography

Andac Kilic has graduated Electrical and Electronics in Gazi University since 2002. He is still working energy expert of R&D department in ADM Electrical Distribution Co in Turkey. He has been completed many R&D projects including energy efficiency, energy storage, grid analysis, reducing technical and non-technical loses etc. He is also team leader of Technology Development Department and he is developing technical equipment including measuring, controlling from the remote. Andac is a coordinator for ADM Electrical Distribution Company for EU and TUBITAK, which is Turkish R&D institute, projects. He is completed one Horizon 2020 project which name is "Smarter Grid: Empowering SG Market ACtors through Information and Communication Technologies-Smarterm EMC2 and one Solar Era-Net project which name is "Enabling rising penetration and added value of photovoltaic generation by implementation of advanced storage systems-Erigeneia". He is still Turkish coordinator of one Era-Net project which name is "Reliability of Long Term Renewable Energy Provision based on PV Technologies".

PREPARATION AND CHARACTERIZATION OF PECTIN/CARRAGEENAN-BASED ACTIV PACKAGING FILMS

Monjurul Hoque
Teagasc Ashtown Food Research Centre, Ireland

Abstract:

In recent years, a tremendous increase in the development of sustainable, eco-friendly, bio-based food packaging materials has been observed. Moreover, bio-based polymers are known for their compatibility with bioactive ingredients which allows for enhanced functionality in the packaging material and improving the shelf life of the product. In this study, tailored extraction procedure for red seaweed (*Chondrus crispus*) carrageenan was used along with low-methoxy pectin and loaded with geraniol essential oil (GER) to develop an active food packaging material.

Objective: To develop antimicrobial pectin-carrageenan films for food packaging applications.

Materials and Methods: Carrageenan was extracted from red seaweed (*Chondrus crispus*) using an ultrasound-assisted conventional method. Pectin-carrageenan were used at 1:1 concentration and GER was added at 5.0 and 10.0% w/w to develop packaging films by solvent casting method. The developed films were characterized by physical, mechanical, barrier, thermal, and antimicrobial properties.

Results: Visual appearance indicated that the prepared films were smooth, transparent, and without pores and cracks. FTIR spectra showed the formation of new hydrogen bonds between the film components in GER-loaded films. XRD analysis demonstrated that the films developed were predominantly amorphous. The addition of LMP into carrageenan film enhanced the TS from 10.25 to 28.24 mpa but decreased the EAB from 20.42% to 8.75% whereas GER incorporation reduced the TS to 17.38 and increased EAB to 12.24%. However, GER incorporation decreased the oxygen transmission rate of the films from 132.84 (cc/m^2.day) to 16.18 (cc/m^2.day) at 23°C and 0% RH. TGA demonstrated that incorporating GER reduced the film's thermal degradation from 29.48% to 22.22%. The composite films showed strong antimicrobial properties with GER inclusion.

Conclusion: Overall, it was observed that the pectin/carrageenan/GER-based composite film exhibited desirable physical and active properties and has the potential for food packaging applications.

Biography

Monjurul Hoque is a PhD Walsh Scholar at Teagasc Ashtown Food Research Centre and University College Cork, Ireland. He pursued his master's in technology from the National Institute of Technology Rourkela, India, in Food Process Engineering. His area of interest includes bioplastics, biocomposite, polymer extrusion, agro- industrial waste valorization, & circular economy. Currently, he is working on a project called "Eco-Friendly Compostable Pectin-Based Materials Derived from Waste Sources of Fruit Pulp, and its Validation in Bread Packaging" funded by the Ministry of Department of Agriculture, Food, and Marine (DAFM), Ireland. He has 13 research/review publications in international journals of repute to his credit, delivered in more than 10 national/international conferences/workshops.

ACCELERATING DECARBONIZATION INITIATIVES FOR FERTILIZER INDUSTRY IN INDONESIA: CASE STUDY OF PUPUK INDONESIA (STATE-OWNED ENTERPRISE)

Syawaluddin Akbar, Laras Wuri Dianningrum and Handono Rakhmadi
Pupuk Indonesia Holding Company, Indonesia

Abstract:

Indonesia has been working on decarbonization efforts to address climate change and reduce greenhouse gas emissions. Indonesia has taken steps toward decarbonization, including promoting renewable energy and making international commitments to reduce greenhouse gas emissions. Decarbonization programs generally involve strategies and actions to reduce carbon emissions, increase energy efficiency, transition to renewable energy sources, and adopt more sustainable practices. Pupuk Indonesia has been exploring and implementing decarbonization initiatives to align with global climate goals and regulations for instance biomass or ammonia co-firing technology in existing coal boilers as well as integrating clean hydrogen technology into existing ammonia plants. Based on the joint study between Pupuk Indonesia and McKinsey, 30% of greenhouse gas emissions of scope 1 come from coal boiler facilities. To reduce the emission, biomass or ammonia can typically replace coal up to 20% as boiler input without any modification of the boiler unit. Therefore, we are now performing a CFD simulation study to determine the maximal thermal share of biomass and/or ammonia with combustion performance and biomass availability near to coal boiler area as limiting factors.

Biography

Syawaluddin Akbar works in the field of Combustion and biogenic energy technologies. He studied Mechanical Engineering in Indonesia, holds a PhD in Energy and Process Engineering, and graduated from Stuttgart University, Germany in 2011. From 2012 to 2017, he worked for Bilfinger Power System, Oberhausen Germany as Simulation Process Engineer. Since July 2017, he is a Senior Technology Researcher at Pupuk Indonesia Holding Company.

MULTI-INPUT NONLINEAR PROGRAMMING BASED DETERMINISTIC OPTIMIZATION FRAMEWORK FOR EVALUATING MICROGRIDS WITH OPTIMAL RENEWABLE-STORAGE ENERGY MIX

Yousef Al-Humaid
SABIC, Saudi Arabia

Abstract:

Integration of renewable energy sources (RES) in a distribution network facilities the establishment of sustainable power systems. Concurrently, the incorporation of energy storage system (ESS) plays a pivotal role to maintain the economical significance as well as mitigates the technical liabilities associated with uncontrollable and fluctuating renewable output power. Nevertheless, ESS technologies require additional investments that imposes a techno-economic challenge of selection, allocation and sizing to ensure a reliable power system that is operationally optimized with reduced cost. In this paper, a deterministic cost-optimization framework is presented based on a multi-input nonlinear programming to optimally solve the sizing and allocation problem. The optimization is performed to obviate the demand-generation mismatch that is violated with the introduction of variable renewable energy sources. The proposed optimization method is tested and validated on an IEEE 24-bus network integrated with solar and wind energy sources. The deterministic approach is solved using GAMS optimization software considering the system data of one year. Based on the optimization framework, the study also presents various scenarios of renewable energy mix in combination with advanced ESS technologies to outline a technical as well as economical framework for ESS sizing, allocation, and selection. Based on the optimal results obtained, the optimal sizing and allocation were obtained for lead-acid, lithium-ion, nickel-cadmium and sodium-sulfur (NaS) battery energy storage system. While all these storage technologies mitigated the demand generation mismatch with optimal size and location. However, the NaS storage technology was found to be the best among the given storage technologies for the given system minimum possible cost. Furthermore, it was observed that the cost of hybrid wind-solar mix system results in the lowest Overall cost.

DESIGN AND DEVELOPMENT OF AN AUTONOMOUS INTELLIGENT ROBOT FOR DISTRIBUTION CENTER OPERATIONS: A CASE STUDY

Baris Çetinkaya
ADM Electricity Distribution Inc., Turkey

Abstract:

Electric distribution companies regularly conduct maintenance, repairs, and troubleshooting operations in their distribution centers to ensure uninterrupted power supply and maintain technical quality standards. Technical personnel use detectors for fault detection. However, some of these fault detection and repair operations carry a high risk of accidents, including arc formation or explosions. In this paper, an autonomous intelligent robot has been designed and built for remote monitoring and control operations in distribution centers. The robot is capable of detecting high temperatures arising in faulty points while they are energized by applying thermal imaging. It provides technical personnel with the ability to remotely intervene using an integrated robotic arm. The performance of the robot in real operating switchgear has been tested, and the results show that it can properly detect faults and increase the efficiency of distribution systems.

Biography

Baris Çetinkaya graduated from Türkiye Isparta University of Applied Sciences Mechatronics Engineering. During his undergraduate education, he made electronic circuits, embedded system software and smart system projects. He is working as a technology development engineer at ADM Electricity Distribution Inc. R&D Center. He develop projects to provide electricity transmission, distribution, efficiency, and sustainability in the workplace.

DEVELOPMENT OF BIOPOLYMER MULTIFILAMENT FIBERS: PBS MULTIFILAMENT YARNS

Kerim Kılınç
Polyteks Textile Industry Research and Education Inc, Turkey

Abstract:

Polybutylene succinate (PBS), which is the bio-based member of the polyester family, has remarkable properties such as biodegradability, compostability, chemical resistance, thermal resistance and melt processability. Even though PBS attracts attention in both academia and industry, there are limited studies and information in the literature on the production of the PBS multifilament yarn, especially with higher winder speed on industrial scale melt spinning machine. In this study, PBS multifilament yarns were produced at different winder speeds by using the industrial scale melt spinning machine. Our aim was to investigate the effect of the winder speed on the textile properties of the PBS multifilament yarns. The winder speeds on the melt spinning machine gradually increased from 2500 m/min to 3000 m/min to produce partially oriented yarn (POY) from PBS raw material. The physical, mechanical, morphological, and thermal properties of PBS filaments were determined to understand effects of changing process speed and the microscope analysis were carried out to observe their cross- sectional shape. It has been observed that the elongation at break of the PBS multifilament yarns decreases with increasing winder speed. However, it has been observed no change in the tenacity of the PBS multifilament yarns. It was determined that PBS multifilament yarns have smooth round cross-sections. Additionally, morphological, and thermal properties of PBS multifilament yarns were examined with DSC analysis. The results show that PBS multifilament yarns can be produced with winder speeds similar to conventional polyester yarn production and have acceptable textile values. Moreover, it has been understood that PBS yarns have better mechanical and physical properties by producing at lower winder speeds.

Biography

Kerim Kılınç is a Metallurgical and Material Engineer, MSc. He has worked as a POY/FDY Production Specialist at Polyteks Company for 6 years. Recently, he has been working as a Research and Development Specialist at R&D Center of the same company. He is in his final year of PhD education in the Department of Polymer Materials at Bursa Uludag University. His PhD thesis includes production of biopolymer PBS multifilament yarns, and examination of their mechanical, thermal, and morphological properties. He has two projects funded by The Scientific and Technological Research Council of Türkiye (TUBITAK). His fields of specialization are synthetic yarns, polymer materials, biopolymers, and bio-composites. He has two articles about biopolymers published in international SCI journals. Additionally, he has made approximately ten presentations in different symposium/congress/conference.

EFFECTS OF BORON ELECTROLYTE MATERIALS AND COMPOSITIONS FOR ELECTROCHEMICAL SUPERCAPACITORS

Yahya Atilgan
ADM Electricity Distribution Inc., Turkey

Abstract:

Connectors are an important component of supercapacitors as they provide the chemical bond between the electrodes and electrolytes and provide mechanical durability. Polymeric and inorganic materials are generally used as release materials. Polymeric binders are durable and provide high mechanical strength but can have high internal resistance. Inorganic binders provide high conductivity and low resistance but are generally more expensive. In this study, research has been done on the use of boron as an electrolyte in supercapacitors. Boron-based binders with high conductivity and mechanical strength are also widely used in supercapacitors. boron-doped multicomponent gel polymer electrolytes composed of host polymer and the additives; ionic liquid, alcoholmethy PPA. these gel electrolytes were studied by Log analyzer within the temperature from −20 to 50°C.

Biography

Yahya Atilgan graduated from Pamukkale University, Turkey, mechatronics engineering undergraduate education. In my undergraduate education, I developed projects on embedded system design and software. I started to work as a technology development engineer at ADM electricity distribution company in the R&D center management. In the R&D center, I work on the efficiency, storage, and production of energy in the electricity distribution sector.

THEORETICAL MODEL OF CONCENTRATING PHOTOVOLTAIC/THERMAL (CPV/T) SYSTEM BASED ON LINEAR MIRRORS

Mohamed R. Gomaa
Al Hussein Bin Talal University, Jordan

Abstract:

The performance study of the low concentrating photovoltaic/thermal collector and its efficiency for production thermal and electric energy under different operating conditions were carried out. The study covers the detailed design and analysis description of CPV/T system, using water as a working fluid and Linear Fresnel reflector mirror. The CPV/T system is characterized by the conventional PV systems by producing more electrical energy due to the concentration of solar radiation as well as thermal energy that can be used in domestic applications. During the system analysis, at fixed ambient condition and solar radiation 1000 W/m^2, it was found that the maximum electrical and thermal energy obtained was 340W and 1170W, respectively, at solar concentration ratio 3 and the flow rate of the cooling water 1.5 L/min. This amount of electrical and thermal energy is approximately three times the amount produced when using a standard module without concentration and coolant flow rate of 0.1 L/min, which is estimated at 130W and 330W, respectively, and also the amount of electrical energy approximately three times the amount produced by standard modules without concentration and cooling which is estimated around 120W.

Biography

Mohamed R. Gomaa holds a Ph.D. in Thermo-Fluid and Renewable Energy from State Engineering University of Armenia (Polytechnic), obtained in 2011. Dr. Behiri's specialization lies within Energy and Renewable energy system. He is currently an Assistant Professor of Mechanical Engineering at Al-Hussein Bin Talal University, Maan, Jordan. He has previously published on merging Tubular Daylight Device with Solar Water Heater, Concentrating solar energy system and alternative and renewable energy sources. His research interests lie in Energy, Renewable Energy System, Solar Energy Systems (PV, Concentrating, Hybrid Solar System, Water and air Heater, Environmental Impact, and Solar bonds), Wind Energy systems, Absorption System and Thermal Power System.

SOLAR ENERGY SYSTEMS IN HOSPITALS: LEVERAGING THE DUAL EFFECT OF COST AND CARBON EFFICIENCY; A CASE OF ST. JOSEPH'S HOSPITAL- KITGUM IN UGANDA

Silus Kwemboi, Ronald M. Kasyaba, Pamela Atim, Solome Najjingo and Sam Orach
The Uganda Catholic Medical Bureau, Uganda

Abstract:

Hospitals in Uganda derive their energy sources for day-to-day operations from either of the 3 sources—National Grid (Hydroelectric power), Diesel-powered Generators and/or Solar Power. Energy from the national grid costs annual average of USD. $ 823,173 per annum and accounts for averagely 42% of utilities expenditure for health facilities in the Catholic Health Network, yet Diesel prices have increased by 34.86% in the past 3 years—moreover the carbon foot-print associated with utility of Diesel-powered generators is high. A hospital requires stable supply of energy in order to refrigerate vaccines and medicines, provide light, and running medical equipment such as X-Ray Machines, autoclaves, and Ventilators—while minimizing its carbon foot-print.

St. Joseph's Kitgum Hospital in Uganda, a 288-bed capacity health facility—which attends to approximately 10% of the outpatients attended to in the entire Kitgum District of Northern Uganda and also admits an average just over 36% of all yearly admissions demonstrates a case for carbon and cost efficiency through its proactive utilization of solar energy sources.

In the 3 years before to the installation and utility of Solar energy by the hospital—which was installed in 2018, the average annual National Grid Electricity Cost USD. $ 24,889 accounting for averagely 65% of the total utilities' expenses. With financial support from DKA Austria and technical support of BBM—an Austrian Engineering Company the hospital installed 200 Solar Panels including 32 Gel batteries and 3 Uninterruptible Power Systems which produce up to 50KW of energy. This is utilized in the hospital for sterilization, lighting, running computers and printers, as well as other hospital equipment use.

As a result of solar energy installation, the hospital significantly reduced its national grid expenditure and in the 3 years after to the installation and utility of Solar energy by the hospital, the average annual National Grid Electricity Cost USD. $ 14,889 accounting for averagely 49% of the total utilities' expenses. There has been a 40.2% reduction in recurrent expenditure on national grid electricity. Diesel Fuel utility for the Hospital Generator has reduced by 7.1% in the period—from averagely 12,822 litres per annum 3 years before solar energy installation to averagely 11,911 litres per annum in the 3 years after solar panel installation.

The above is consistent with Uganda's Renewable Energy Policy to reduce carbon emission to the environment through the adoption of clean and renewable energy sources—which also demonstrates carbon emissions reduction and improved cost efficiencies.

Biography

Kwemboi Silus is a Program Coordinator with nine years of experience in the sectors of WASH and Energy, coordinating and working alongside technical departments of Catholic Founded Hospitals in Uganda, East Africa, including supporting the institutions to optimize renewable energy resources.

Day 2

Energy Trends 2023

Keynote Presentations

GVCs AND ENVIRONMENTAL SUSTAINABILITY IN MENA: DO DIGITALIZATION AND INSTITUTIONS MAKE A DIFFERENCE?

Suzanna Elmassah
Zayed University, UAE

Abstract:

Currently, the advent of digitalization has profoundly altered the structure of Global Value Chains (GVCs), with implications for environmental sustainability (ENS). Notwithstanding its importance, the dynamics of participation in GVCs, ENS, and digitalization have not been thoroughly investigated in empirical literature; prior researches have primarily focused on two or three of these variables and they are quite rare. On the other hand, despite its rapid evolution and growing popularity, GVCs participation is rarely considered when analyzing factors influencing ENS in the Middle East and North Africa (MENA) region. Extending this research line, the analysis scrutinizes the impact of GVCs participation on ENS in 15 countries in MENA between 1996 and 2018. The study further investigates the moderating impacts of two major policy variables, namely Institutional Quality (IQ) and Digitalization (DIGI). SYS-GMM panel method and Random Effects are employed. The empirical investigation indicates that GVCs participation is environmentally beneficial in the MENA region. The findings remain robust/similar when considering forward value participation linkages and oil-importing countries; whereas backward linkages deteriorate the ENS. The findings further reveal that the environmental impact of GVCs is modulated through IQ and DIGI. IQ and GVCs are particularly complementary in promoting ENS in MENA and across both oil importing and exporting groups. Nonetheless, the GVC interaction with DIGI produces a negative net effect. This negative effect is mitigated beyond a particular threshold of 10.23%, necessitating complementary policies related to the link between GVC participation and ENS below this threshold. Additionally, the findings affirm that FDI improves the environment, whereas natural resource rents degrades it, supporting the resource curse hypothesis for the region. The study findings provide insights into achieving improved integration in GVC while maintaining sustainable environment.

Biography

Suzanna Elmassah is an Associate Professor of Economics and Sustainability with 22+ years of experience in academia and industry. She is passionate about circular economy practices and developing Eco-Industrial Parks in the MENA region. Suzanna is an Economic Research Forum (ERF) Fellow and Higher Education Academy (HEA) Fellow. She received her Ph.D. in Sustainable Development (2009) and MSc in Finance (2004) from Cairo University. She has 20+ years of experience in research, policy, and teaching in the Middle East. Suzanna has a multidisciplinary interest in the research areas of Economics, Finance, Sustainable Development, Economics of Education, and Behavioural Economics. She has published several scholarly papers in top-ranked journals and worked on government and private sector consultancy projects. She sits on the Editorial Review Board for several peer-reviewed journals and the advisory board of the "THE SURPLUSS" start-up.

WASTE EXTRACTED REINFORCED POWDER INCORPORATED BIODEGRADABLE CHITOSAN COMPOSITE FILM

Zubaida Rukhsana Usha
Chinese Academy of Sciences, China

Abstract:

Chitosan (CS) is widely used as a natural biopolymer because of its semi-crystalline structure, good film-forming properties, and easy availability. CS-based composite films are widely used in industry, particularly in the food sector as active food packaging. Despite all these advantages, their wide range of applications are constrained by poor mechanical properties. Therefore, this work introduced refined bamboo cellulose powder (RBCP), a reinforcing material that is extracted from waste bamboo pulp and applied to CS composite films to enhance their mechanical and physicochemical properties. The chemical composition and crystallinity properties of CS composite films with RBCP addition were observed by ATR-FTIR and XRD. The homogeneous and heterogeneous surfaces of the RBCP incorporated films before biodegradation and after biodegradation (20 days) were observed by scanning electron microscopy (SEM). The increase in reinforcing RBCP materials from 0.00 to 5.00 % resulted in an increase in tensile strength for CS/RBCP films from 2.9 to 8.3 Mpa. The application of the CS/RBCP/5 composite film as red grapefruit storage was also investigated, which performed much better than commercial plastic and control CS films with 92.8 and 88.6 % viability of S. aureus and E. coli bacteria. Overall achieved properties demonstrated strong potential for usage as active packaging materials to preserve and lengthen the shelf life of red grapefruits.

Biography

Zubaida Rukhsana Usha is currently serving as postdoctoral researcher at Institute of Solid-State Physics, Hefei Institutes of Physical Sciences, Chinese Academy of Sciences. She completed her doctoral program from the National Synchrotron Radiation Laboratory, University of Science and Technology of China, Hefei, China. She was the awardee of Chinese Academy of Science (CAS)- The World Academy of Science (TWAS) president fellowship to pursue her PhD program. Currently she is focusing on extracting valuable recycling waste products to enhance the food shelf life. Till now she has published a total of 10 high-impact factor research papers.

Day 2

Energy Trends 2023

Oral Presentations

PRESENTATION TITLE: CREATING AND APPLYING SUSTAINABLE FERTILIZER BASED ON PHOSPOGYPSUM: NITRALITE

Laras Wuri Dianningrum, Yazid A. Rahman and Josua D. Siregar
Pupuk Indonesia Holding Company, Indonesia

Abstract:

Phosphogypsum is the main and the most significant by-product of the chemical NPK production. The utilization of phosphogypsum as a raw material is strictly limited due to its status as hazardous waste in Indonesia. We proposed a new fertilizer formulation using phosphogypsum as a multi-nutrient fertilizer containing additional nitrogen sources. We investigated the performance of this product in different types of crops, with the best results seen in horticultural crops such as potatoes with a productivity increase of up to 25%, onions by 10%, and green vegetables by 14%. Nitralite has been tested in 28 locations covering Indonesia, from Aceh, South Sumatra, Java Island, East Kalimantan, and Papua. It could increase the farmers profit up to 16 % and increase the with terms of sustainability in agriculture practice, Nitralite application has been found to release more slowly in the soil and it might improve the Nitrogen-use efficiency and reduce green-house gas emission in the long run.

Biography

Laras Wuri Dianningrum are the working fields of Hydrogen and clean energy technologies . She studied Chemical Engineering in Institut Teknologi Bandung, Indonesia and holds a M.Eng in Clean Energy and Chemical Engineering from Korea University of Science and Technology, in 2013. From 2011 to 2013, she worked as a research assistant at the Korea Institute of Science and Technology. Since 2014, she has worked across various fields as an R&D and product analyst at Pupuk Indonesia Holding Company.

UNVEILING MARKET DYNAMICS: NASH EQUILIBRIUM AND THE EVOLUTION OF RENEWABLE ENERGY AUCTION MARKETS

Pablo Blanc, Juan Pablo Pinasco, Nicolas Saintier and Martin Kind
RELP - Global Renewable Energy Mass Adoption Program, Argentina

Abstract:

Auctions have become a prevalent method for procuring renewable energy globally. They play a crucial role as a price discovery method contributing to the affordability and scalability of clean energy. We compute the Nash equilibrium strategy for bidders. This provides valuable insights into the market's development level, as we anticipate the market to converge towards this equilibrium.

We consider a sealed-bid auction where projects are allocated according to a pay-as-bid pricing rule. The projects are awarded until the target volume is reached. A bidding strategy for a participant is a bidding value that is given as a function of the cost of production. When the participants bid maximizing their expected profit, we derive a differential equation for the bidding function. By employing the solution to the equation, we can simulate the auction.

We examine the solar PV auction conducted in Germany. In the first round in 2015 the mean awarded price was 9.17 ct/kWh, whereas our model estimated a price of 6.58 ct/kWh. As the auction rounds progress, we observe the mean awarded price moving closer towards the estimated price predicted by the model. For instance, in 2019, our model estimated a price of 4.62 ct/kWh, while the actual mean awarded price stood at 4.8 ct/kWh.

The difference between the price predicted by the model and the actual price offers valuable insights into the development level of the market. This understanding of the speculative component of the price can aid decision-makers in making informed and strategic choices.

Biography

Pablo Blanc specializes in the fields of game theory and partial differential equations. He works in the Department of Technology and Innovation at RELP. His primary focus lies in developing models for renewable energy auction, aiming to enhance our comprehension of these complex systems. RELP is a nonprofit organisation aimed at scaling up cheaper and faster renewable energy deployment in emerging economies. We seek to expand reliable, affordable, and sustainable energy, thereby mitigating climate change. Our mission is to accelerate the transition to clean energy in emerging and developing countries by unlocking renewable energy markets to scalable private investments at low prices, promoting sustainable economic development for the people.

SEWAT - SUSTAINABLE ENERGY BY WAVES TRAP

Giulio Teodoro MAELLARO
GECO - Global Engineering Constructions s.r.l., Italy

Abstract:

The primary objective of the project is to produce sustainable energy, in high volume and with high power, harnessing the energy possessed by the waves of the sea even if they are small. The secondary objective, linked to the particular geometry of the system, is to protect the coast from erosion and allow effective nourishment of the shores.

The idea is very simple but brilliant. It is the only existing process to produce energy in a positive environmental impact during construction, operation and decommissioning. No risks, dangerous implications and no production of CO_2. The goal is to harness energy from a source until now considered marginal and analyze environmental impact. The system consists of modular concrete tanks, placed in the sea, partly submerged, located on the side of seawalls and breakwater barriers exposed to the waves or far away, parallel to the coastline, at a certain distance to protect the coast itself. The function of the tank wall exposed to the action of waves is to capture the waves. It is equipped to allow the entry of the waves and to prevent their exit. So, the water in the tank collects, up to a height greater than that of "calm sea" which is located on the sheltered side of the dam. The water collected in the tank has, therefore, potential energy, which can be exploited pouring the water in the calm sea. The transformation of the potential energy is made possible by water turbines working thanks to the water flow. Each turbine sets in motion the electrical generator which is coupled to produce electrical energy. It is not necessary to use antifouling substances. The produced electrical energy can feed the electrical grid after stabilization or can be used for hydrogen production to be then managed using consolidated technologies.

Biography

Giulio Teodoro MAELLARO is an engineer, teacher of marine machinery and on-board technical systems, mechanics, mechanical technology, energy expert and energy transformations

NOVEL AMYLOSE-ARGAN PROTEINS-BASED BIOPLASTICS: PRODUCTION AND CHARACTERIZATION

Michela Famiglietti
University of Naples "Federico II", Italy

Abstract:

Bioeconomy has the challenging aims to look for new sources for materials production and valorize unused byproducts. This work exploited amylose, obtained by RNA interference technique from barley plants, and proteins, extracted from argan oil cake, to produce novel blended bioplastics. Amylose is a biopolymer that provides added-value functionalities to the normal starch for bioplastics production, reducing the need for subsequent chemical modification or blending with synthetic polymers. Argan oilcake is a byproduct of argan oil extraction that until now was used for animal feeding or disposed of. Here it was recovered to obtain high-added value products such as proteins. This work aimed to investigate the production of novel hydrocolloid-based bioplastics, blending amylose and argan proteins, and characterize them for their mechanical, barrier, and thermal properties. Moreover, it was verified that the films were completely digested during in vitro oral and gastric digestion to use them as edible films for food packaging applications. Amylose is digested by amylase in a simulated oral digestion process and the proteins are digested by simulated gastric digestion in the presence of pepsin. Finally, the biodegradability of the films was studied by the burial test method using soils deriving from three different local areas. The films showed suitable performance for application in the bioplastic industry.

Biography

Ms. Michela Famiglietti is currently a PhD Student in Biotechnology with a project titled "Production and Characterization of novel active polysaccharides/proteins blended bioplastics". She is working on her research in the group of Biochemical Biotechnologies and Enzymology coordinated by Professor Loredana Mariniello at the Department of Chemical Sciences of the University of Naples "Federico II". The research line of the group focuses on the exploitation of natural polymers, such as proteins extracted from wastes and byproducts or polysaccharides like starch, cellulose, and chitosan to produce edible films destined mainly to food packaging. The long and relevant expertise of the group in enzymology allowed them to exploit the enzyme microbial transglutaminase as a tool to modify and improve the performance of proteins-based bioplastics. In this context, Ms. Michela Famiglietti is working specifically on the production of hydrocolloid-based bioplastics made up of polysaccharides, such as amylose and chitosan, and proteins extracted from argan oil cake. This field of research is in line with her background: the master's degree in industrial and environmental biotechnology at the University of Rome Sapienza, and the specialization in Green Chemistry and Production of Materials from Biomasses at the Polytechnic of Milan.

THE IMPACT OF THE EPBD DIRECTIVE AMENDMENT ON THE DE-CARBONISATION OF THE CONSTRUCTION SECTOR

Bartłomiej Kielasiński
BWW Legal Office Warsaw, Poland

Abstract:

One of the most important proposals submitted within the Fit for 55 package is the proposal to revise the Directive on the energy performance of buildings (EPBD). The main objectives of the EPBD Directive are to significantly reduce greenhouse gas emissions and energy consumption in the EU's building sector by 2030 and to make it climate-neutral by 2050. In particular, the proposed amendments aim to reduce energy consumption and increase the use of renewable energy in the building sector. On the other hand, an important element of the revision of the EPBD is the introduction of a comprehensive building renovation plans. The EPBD proposal is being processed in the Council, while the European Parliament has already adopted some amendments.

Autumn 2023 is the right time for an in-depth analysis of the shape of the legislation to be introduced and, above all, of the effects it will have on the renewable energy sector. The EPBD's scope of application is very broad, covering both public and private buildings. Thus, the majority of Europeans will be affected by those changes. Appropriate support mechanisms must therefore be put in place to ensure the effectiveness of the reforms implemented and to combat energy poverty. The changes being introduced represent an undoubted opportunity for producers of renewable energy sources. Familiarising with the proposed changes and adapting to them will allow to participate efficiently and cost-effectively in the energy transition of the construction sector, which will receive significant founds under support programmes.

During the presentation, I will point out the most significant changes introduced by the EPBD and present the time horizon over which they will be introduced. The analysis will cover both the need to modernise buildings and replace existing heat sources with low-carbon or renewable sources. Based on available statistical data, I will indicate the scale of change we can talk about (e.g. number of buildings and estimated cost of modernization). I will also present the support mechanisms that will be put in place to support such ambitious reforms and the categories of energy sources that will be able to benefit from this support (e.g. PV installations, heat pumps). The presentation will be prepared on the basis of legislative proposals and data up to date at the date of the conference (the EPBD procedure is still ongoing).

Biography

Bartlomiej Kielasinski graduated with honours from the Faculty of of Law and Administration of the University of Warsaw. I work in the energy & infrastructure department of BWW Law Firm for over two years. At work, I deal with topics related to environmental law, waste management, RES investments (PV, wind farms, biogas plants, hydrogen) and EU regulations on RES, decarbonization and sustainable development.

DEVELOPING VIRTUALIZED REMOTE TERMINAL UNIT FOR ELECTRICITY TRANSMISSION AND REDUCING COST AND ERROR RATES IN OUTAGE MANAGEMENT

Necati Keskin, Sude Kozalıoğlu and Oğuzhan Elbil
ADM Electricity Distribution Inc., Turkey

Abstract:

In today's world, large and complex systems such as power plants and industrial applications need a central control system to monitor and control their operations. SCADA, a popular control system, is often used with remote terminal units (RTUs) or programmable logic controllers (PLCs) for this purpose. However, these systems present various difficulties, including programming difficulties and errors due to the use of different communication protocols. To overcome these difficulties, a new solution called Virtual RTU software has been developed. This software significantly reduces error rates by collecting data from the field on a single platform. It also simplifies the programming of RTUs, enabling more efficient operation. As a result, data collection and monitoring from the field becomes faster and more accurate, while operational efficiency is increased with the integration of features such as fault prediction. In addition, the digital platform of Virtual RTU software offers additional benefits by working with distribution systems such as OMS and DMS. It enables remote adjustments to the system it uses. The developed software makes use of artificial intelligence and machine learning technologies to predict errors in the system, reducing operational costs for energy companies. With this, it increases the overall efficiency and reliability of the power distribution, increasing customer satisfaction. As a result, the development of Virtual RTU software has been a breakthrough in the power distribution industry. The capabilities of the software, including the integration of artificial intelligence and machine learning technologies, help meet the challenges faced by large and complex systems such as power plants and industrial applications.

Biography

Necati Keskin was born in Denizli, Turkey in 1995. He graduated from the Mechatronics Engineering department at Pamukkale University in 2017. During his university education, he worked on automation systems, computer technologies, and computer-aided designs, and participated in projects in the field. He began his professional career after graduation. In 2020, he started master's degree in Mechatronics Engineering at Pamukkale University to further support his professional and academic development. Currently, he works as an R&D Engineer on projects at ADM Electric Distribution Company. These projects involve innovative solutions to increase efficiency in electrical distribution systems. He specializes in technology and software development and leads projects in these areas. Throughout his career, he has published academic studies on national and international platforms and delivered presentations at numerous conferences and seminars, accumulating extensive experience in the field. He continues to work towards providing innovative solutions in electrical distribution and control systems and contributing to the industry.

INFLUENCE OF ACCELERATED AGING ON ACTIVATION ENERGY OF PLA AND PLA STARCH COMPOUND

Margarita Reit
University of Kassel, Germany

Abstract:

To encourage the use of biopolymers, it is necessary to obtain reliable data on the long-term behavior and the associated aging behavior of the material. The most fundamental equation for describing the aging behavior of a material is the Arrhenius equation. Based on the activation energy, this equation describes in which energy levels and thus how rapidly chemical reactions and the associated aging occur. Within the scope of the investigations, pure PLA Luminy® L130 was examined as well as a 50 wt.% starch compound. Samples were aged in a temperature storage at 70°C and 10% r. H. and a humidity storage at 23°C and 50% r. H. As a reference aging for this, samples were also aged in a standardized climate at 23°C and 50% r. H. Thermal and mechanical characterization were done in a freshly molded state and after 168 h and 504 h storage. The Flynn-Wall-Ozawa and Kissinger-Akahira-Sunose methods, based on thermogravimetric analysis, were chosen to calculate the activation energy. The activation energy results revealed a higher activation energy for the pure PLA than the compound with starch over the course of the experimental period in the standardized climate. The temperature and humidity stored samples showed a much faster increase in activation energy compared to the standardized climate stored samples. Thus, the use of starch has a pronounced effect on the activation energy. In summary, starch compounds showed a more resistant material behavior regarding humidity or temperature effects than pure PLA. Further results and correlations will be considered in more detail in the presentation.

Biography

Margarita Reit is a research associate at the University of Kassel. Subsequent to her master´s degree in mechatronics engineering from the University of Kassel in 2022, she started working at the University of Kassel as a research associate in the institute of material engineering in the department of polymer engineering. Her field of research is the aging resistance and modelling of biopolymers.

ENERGY ASSESSMENTS OF WOMEN-OWNED MICRO, SMALL, AND MEDIUM-SIZED ENTERPRISES WORKING IN FOOD AND TEXTILE INDUSTRIES IN SELECTED AFRICAN COUNTRIES

Djalila Gad
Politecnico di Torino, Italy

Abstract:

In 2021, 600 people across the African continent did not have access to electricity, and 970 million lacked access to clean cooking fuels. Local enterprise development can play a crucial role in improving energy access challenges in Africa given that productive use potentially increases capacity utilization and end users' ability to pay, and can result in a more solid revenue stream, for both energy and electricity providers and consumers.

The role of women-owned or -led enterprises in that regard is, however, not well documented yet despite recent research highlighting the significance of a gendered approach in a range of energy interventions. In view of these data and knowledge gaps, the presented research project investigates how renewable energy access can promote women entrepreneurs in Africa and identifies technological innovations, regulatory frameworks, and business models for micro-, small-, and medium-sized enterprises.

To identify African countries (Egypt, Ghana, Kenya, Malawi, Tanzania, and Tunisia) and industrial sectors with high research potential (food and textile sectors), the MSME Economic Indicators Database 2019 as well as literature suggestions were used respectively. Furthermore, women's entrepreneurial activity and representation in leading positions across the six focus countries have been mapped using the International Energy Agency (IEA) database. Electricity and fuel prices have been assessed based on data from each country's energy and electricity authority, serving as baseline to develop regulatory frameworks and business models. At this stage, the research project has also evaluated the electricity and energy consumption, costs spent, energy sources used, and services provided of more than 30 women-owned and -led enterprises. The current research phase foresees acquiring further data based on in-depth energy audits of selected case studies across the six focus countries.

Biography

Djalila Gad has a double degree M.Sc. in renewable energies and energy efficiency from Kassel University and Cairo University, and a background in social & political science. Currently Djalila is pursuing a Ph.D. at Politecnico di Torino in the field of productive use of energy of women entrepreneurs in Africa. Djalila has over 3 years of work experience in international development across the MENA region, Eastern & Sub-Saharan Africa: Between 2017-2018, Djalila worked for the German International Cooperation Agency (GIZ) promoting renewable energy and energy efficiency in Madagascar. From 2019-2020, Djalila worked in a solar PV rural electrification project in Zambia. From 2021-2022, Djalila worked at Infinity Power, a leading renewable energy company in Egypt, and managed bid proposals for utility scale solar and wind projects in Morocco, Tunisia, Egypt, South Africa, Niger, Ivory Coast and Botswana.

ELECTRIFIED STEAM METHANE REFORMING OF BIOGAS FOR SUSTAINABLE CHEMICAL AND FUEL PRODUCTION

From Thomas Norup[1,2], Mortensen Peter Mølgaard[2], Partoon Behzad[1], Rautenbach Marené, Østberg Martin[2] and Bentien Anders[1]

[1]*Aarhus University, Denmark*
[2]*Topsoe, Denmark*

Abstract:

The production of synthesis gas is the main building block of various bulk chemicals and fuels including hydrogen, ammonia, methanol, and synthetic fuels. The most common synthesis gas production method remains steam-methane-reforming (SMR) process, which has a substantial CO_2 footprint as the necessary reaction heat is supplied by combustion of fossil fuels. Electrification of the conventional SMR process therefore has a significant CO_2 reduction potential, especially if renewable electricity is used. This work shows first operational experience with electrified steam methane reforming (eSMR) technology at pilot scale, where biogas is used as a sustainable carbon feedstock to produce synthesis gas. Since the catalytic system is electrically heated in an eSMR design, it completely removes the combustion section and associated carbon emission. As a result of the intimate contact between electric heat source and the catalyst, the eSMR design exceeding temperature that of conventional SMR with great stability and control, leading to better overall process performance. The eSMR-biogas configuration tested in this work, providing a first-hand experience that could lead to attractive plant designs for sustainable and renewable production of chemicals and fuels.

Biography

Thomas Norup From is working for Topsoe A/S and enrolled as an industrial PhD student (2022-2025) at Aarhus University, Denmark. His PhD project is focused on electrified steam methane reforming of biogas to methanol, where he is involved in the research and development of a pilot-scale electrified reactor utilizing biogas. The reactor is installed in a Power-to-X process hall at the biogas research facility belonging to Aarhus University, Campus Viborg, Denmark. Thomas' expertise lies within process engineering and syngas manufacturing, particularly from a sustainable and renewable perspective.

ARTIFICIAL INTELLIGENCE-BASED ATTACK DETECTION SYSTEM FOR SUPERVISORY CONTROL AND DATA ACQUISITION (SCADA) SYSTEMS: STUDIES ON SUBSTATION EMULATOR

Sude Kozalıoğlu, Necati Keskin and Oğuzhan Elbil
ADM Electricity Distribution Inc., Turkey

Abstract:

The use of artificial intelligence (AI) techniques in the development of next-generation security products and research studies significantly improves protection against cyber-attacks targeting Supervisory Control and Data Acquisition (SCADA) systems. However, with the continuous development of attack methods and strategies, it becomes insufficient to rely solely on publicly available datasets for AI model training. In this study, a substation emulator was developed, and normal and abnormal datasets were collected, followed by data cleaning, integration, and discretization. AI models were trained using the NSL-KDD dataset and feature detection studies were conducted to improve model performance. Success rates of models were compared through validation and the model was deployed on the AWS Sagemaker platform, providing continuous learning opportunities for further improvement. The developed learning application allows users to classify packets collected from SCADA networks as normal or abnormal. This innovative approach provides an effective solution to protect critical infrastructure and assets from possible cyber-attacks, ensuring the stability and reliability of SCADA systems. The use of a substation emulator allowed the collection of real-world data, enabling the training of artificial intelligence models that accurately mimicked the behaviour of SCADA systems under different scenarios, including normal and abnormal operations. The results of this study demonstrate the application of AI techniques in protecting SCADA systems against cyber-attacks is a promising and innovative approach with excellent results. The use of a substation emulator, combined with data cleaning, integration and discretization processes, and feature detection studies, has significantly improved model performance by ensuring packets are correctly classified as normal or abnormal. The continuous learning opportunities provided by the AWS Sagemaker platform further enhance the capabilities of the model, providing effective protection against potential cyber threats to critical infrastructure and assets.

Biography

Sude Kozalıoğlu was born in Denizli, Turkey in 1995. During her university education, she participated in projects supported by TUBITAK and was selected as one of the top 20 entrepreneurs by the 'Turkey Covid19 Common Mind Platform' due to her work during the pandemic period. In 2021, she graduated from Eskişehir Osmangazi University with a thesis titled 'Portable AC Power Supply with Solar Energy'. She previously held various positions in companies working on the installation and infrastructure of renewable energy sources, and currently works as an R&D engineer at ADM Electricity Distribution Company. She conducts research on machine learning, artificial intelligence, deep learning, and computer vision. Throughout her career, she has published academic studies on national/international platforms. In these studies, she focuses on developing innovative and sustainable solutions to contribute to sustainable growth, and increasing energy efficiency in the use, transmission, and distribution of energy sources by leveraging current trends.

DIFFERENCES IN PHOTOCATALYTIC PROPERTIES OF COPPER-MODIFIED COMMERCIAL TITANIUM DIOXIDE (P25) DURING THE PROCESS OF CARBON DIOXIDE (CO_2) PHOTOREDUCTION

Konrad S. Sobczuk, Iwona Pełech, Piotr Staciwa, Daniel Sibera and Urszula Narkiewicz

West Pomeranian University of Technology, Poland

Abstract:

Commercial titanium dioxide (AEROXIDE® TiO_2 P25) was modified with copper nitrate ($Cu(NO_3)_2$) in such a way as to obtain samples with a copper content in the range of contribution of 0.1%-14.0% by weight. All samples were prepared via the hydrothermal method using a microwave reactor, which allowed for the permanent introduction of copper compounds into the sample, as confirmed by X-ray powder diffraction analysis (XRD).

The obtained samples were characterized by scanning electron microscopy (SEM), low- temperature nitrogen adsorption using Brunauer–Emmett–Teller (BET) method, X-ray powder diffraction analysis (XRD), and their photocatalytic activity in the carbon dioxide (CO_2) photoreduction process. Carbon dioxide photoreduction processes were carried out in a gas-phase system in a glass reactor equipped with a quartz cooler continuously fed with fresh water. A 150 W mercury lamp emitting UV-C light was placed in the cooler. The composition of the gas phase after the process was analyzed using a gas chromatograph.

Experimental results showed that the photocatalysts modified with copper exhibited higher photocatalytic activity in the process of carbon dioxide reduction to both hydrogen and methane under UV-C light than the reference material P25. It was found that the curve representing photocatalytic tendency changes its shape depending on the amount of copper introduced to a sample. The sample showing the highest photoactivity under UV-C irradiation had 1.0% wt of copper content (with a surface area equal to 51 m^2/g and the average crystal size of 20.9 nm) which allowed to improve the amount of obtained hydrogen by approximately 8 times.

Acknowledgement: The research was partially funded by the EEA Financial Mechanism/Norway Financial Mechanism 2014-2021 through the National Center for Research and Development under Grant No. NOR/POLNORCCS/PhotoRed/0007/2019-00

Biography

Konrad S. Sobczuk is a chemical engineering PhD student at the West Pomeranian University of Technology in Szczecin. His background in research includes a bachelor's degree in nanotechnology engineering (where he researched electrocatalysis) and a master's degree in inorganic chemical technology (where he researched activated carbon spheres), which both he obtained at the West Pomeranian University of Technology in Szczecin. His current thesis in the Doctoral School of ZUT in Szczecin describes the photocatalytic activity of variously doped (with both metals and non-metals) titanium dioxide in the process of carbon dioxide photoreduction.

EFFECTS OF NANOCELLULOSE ADDITION ON NATURAL RUBBERS COMPOUNDS

Jordão Gheller Junior
Instituto SENAI de Inovação em Engenharia de Polímeros, Brazil

Abstract:

In recent years, the study of nanocellulose (NC) applications has received significant attention due to its renewable and environmentally friendly nature, as well as its potential to enhance the properties of polymer materials. Added to this issue, the incorporation of nanofillers in rubber compounds has also received considerable interest for their ability to improve mechanical and rheological properties.

In this study we investigate the impact of adding 0.5 and 3 parts per hundred rubber (phr) of NC on the viscosity, curing characteristics, and mechanical properties, including hardness and tensile strength, of natural rubber compounds. The addition of NC led to changes in the rheological behavior of rubber compounds. An increase in NC content resulted in higher viscosity, indicating its potential as a reinforcing filler, although this also raised concerns about processability. The presence of NC did not significantly alter the curing times of the rubber compound but increased the maximum torque of the uncured samples. Regarding to mechanical properties, no significant improvements were observed. Tensile strength and elongation at break decreased with higher content of NC. This effect suggests that NC particles were not uniformly distributed in the natural rubber matrix at higher concentrations, likely due to a phase separation occurring between the fillers and the polymer matrix.

This research contributes to a better understanding of how NC can be applied in natural rubber formulations, opening doors for the development of high-performance and eco-friendly rubber products. Additional studies are in progress looking for a better understanding of the interfacial bonding between the hydrophilic NC fiber and the hydrophobic rubber matrix.

Biography

Jordão has been working with polymers science since 1997, with a focus on research and development of new additives for polymers, elastomeric blends, vulcanized thermoplastic elastomers, dynamic-mechanical performance evaluation of polymers, numerical simulation, and polymer service life prediction.
Previously has been worked as a professor in engineering programs at the University of Vale do Rio dos Sinos (UNISINOS) and the Lutheran University of Brazil (ULBRA). Worked also as a Technical Coordinator in the Innovation and Technology Management of SENAI Rio Grande do Sul and as an Operations Manager at the SENAI Institute of Technology in Petroleum, Gas, and Energy.Reviewer for international journals and for projects funded by the Financier of Studies and Projects (FINEP) and the Foundation for Research Support of the State of Rio Grande do Sul (FAPERGS), currently Jordão holds the position of Operations Manager at the SENAI Innovation Institute in Polymer Engineering.

HUMIC ACID MODIFIED LIGNIN BASED SLOW-RELEASE FERTILIZERS REDUCE NUTRIENTS LEACHING AND BOOSTED WHEAT CROP GROWTH AND PRODUCTIVITY

Fatima-Zahra El Bouchtaoui
Mohammed VI Polytechnic University, Morocco

Abstract:

Background: To obviate adverse effects from the non-biodegradability of certain polymer-based slow-release fertilizers (SRFs) and to offset higher operational costs, the use of biopolymers as coating material has recently caught interest in the research circles. Lignin-based composites, blends, or mixtures represent a new category of environmentally friendly materials for newer applications, owing to its abundancy, renewability, hydrophobicity, nontoxicity, low cost, and biodegradability.

Objective: Retarding the release of nutrients from water-soluble fertilizers using lignin-based coatings.

Methods: Lignin was initially extracted from Moroccan alfa plant and then modified using a simple and green process. The developed coating material was then characterized and applied onto Di- ammonium Phosphate (DAP) water-soluble fertilizer in a rotating pan machine. The designed slow- release fertilizers were then evaluated, especially in terms of their mechanical resistance, slow-release behavior, water retention capacity, in addition to their effect on wheat crop growth and productivity.

Results: Experimental results showed an improved morphology and hardness of DAP fertilizer granules after coating (up to 3 times) as well as a positive impact on the water retention capacity of the soil. Nutrients leaching (P and N) in soil was monitored for 100 days and substantial reduction of nutrients leaching up to 80 % was successfully achieved using coated DAP fertilizer. Furthermore, the gradual concentrations released were essential and high enough to stimulate the growth of wheat crop, including leaves evolution and roots architecture, in addition to the physiological parameters.

Conclusion: The designed coating material may effectively have a great potential for large-scale applications to satisfy the increasing demand for fertilizers because it is economical and environmentally friendly.

Biography

Fatima-Zahra El Bouchtaoui, 26 years old, is currently a PhD student at Materials Science, Energy and Nano-engineering department, Mohammed VI Polytechnic University, Benguerir, Morocco. She received in 2019 her master's degree in Polymer Materials & Environment from Faculty of Sciences and Technologies, Cadi Ayyad University, Marrakech, Morocco. She is currently working on the extraction and functionalization of lignin biopolymer and its exploitation for the development of eco-friendly coatings for water-soluble fertilizers, in order to achieve effective nutrients delivery to plants and ensure sustainable agriculture.

Day 2

Energy Trends 2023

Poster Presentations

UNDERSTANDING PUBLIC PREFERENCES FOR GREEN ROOFTOPS IN THE UNITED STATES: A DISCRETE CHOICE EXPERIMENT

Simona Trandafir and Natalie Meyer
University of Rhode Island, USA

Abstract:

Green rooftops have emerged as a promising solution for fostering sustainable urban development, offering numerous environmental and societal benefits. These advantages include heightened energy efficiency, promotion of urban agriculture, integration of biosolar technologies, and facilitation of community engagement. Despite the extensive research on green rooftops in recent years, there remains a significant knowledge gap regarding community perceptions, preferences, and willingness to invest in this innovative technology, especially concerning rooftop designs accommodating rooftop farms and biosolar installations. Accurately quantifying this information is crucial for urban planners and decision-makers, enabling them to make informed choices for sustainable and resilient urban landscapes through green rooftops. To address this knowledge gap and the need for spaces to accommodate solar panels and local farms, this study conducts an empirical assessment of the preferences and willingness to invest of residents in Rhode Island, USA (n = 632), in commercial extensive green rooftops featuring rooftop farms and solar installations using a contingent choice survey. Preliminary findings reveal that 42% of Rhode Island residents are aware of green rooftops. Desired features for green rooftop installations include flowers (76%), seating areas (75%), shaded areas (61%), and space designated for rooftop farms (61%). Impressively, 72% of respondents express strong or general support for green rooftops dedicated solely to agricultural production, even if it means foregoing other desired features. Analysis using random parameters mixed logit models in the choice experiment shows statistically significant preferences for rooftop spaces designated for both community agriculture and local farmers. Respondents also exhibit a distinct preference for spaces earmarked for solar panels compared to configurations lacking solar infrastructure. The insights from this study are vital for decision-making processes regarding the installation of public commercial green rooftops in urban areas. These decisions are of global significance as cities grapple with climate change mitigation and food security enhancement.

Biography

Simona Trandafir is an Associate Professor in Environmental and Natural Resource Economics at URI. She holds a Bachelor of Science in Environmental Engineering and a master's in environmental management from the Polytechnic University of Bucharest, Romania, and a PhD in Environmental Economics from University of Rhode Island in the United States. Her research focuses on non-market valuation and renewable energy.

BIOTRANSFORMATION OF STARCHY-BASED BY-PRODUCTS INTO BIOPLASTICS: VALORIZATION OF POTATO WASTEWATER TO PRODUCE POLYHYDROXYALKANOATES

Silvia González-Rojo
Agrarian Technological Institute of Castilla y León, Spain

Abstract:

Biodegradable biopolymers have emerged as an alternative to petrochemical-based plastics to overcome the negative impact these last ones promote on the environment and human health. On this matter, polyhydroxyalkanoates (PHAs), intracellular-produced microbial polyesters, appear as promising candidates, displaying interesting thermoplastic characteristics, which determine their multiple applications. The present work is aimed to analyze PHA's production based on the biotransformation of potato-processing wastewater, a renewable feedstock.

Initially, the enzymatic hydrolysis conditions for the feedstock were optimized. Afterwards fermentation conditions by cultivating Cupriavidus necator DSM 545 in shake flasks containing the previous hydrolysate were optimized. PHA recovery was assayed by two strategies: a chloroform-based method and a non-halogenated solvent.

Results revealed a 95.5 ± 0.7% hydrolysis yield under the optimal conditions evaluated, which allowed to reduce the incubation time in almost fifty times regarding the initial approach. Moreover, to determine optimal conditions for PHA production using the starchy-base hydrolysate, an experimental design based on response surface methodology (RSM) were accomplished, adjusting three variables: hexoses concentration (carbon source), the nitrogen concentration using $NaNO_3$ and the pH. Under this situation it was obtained 88.68 ± 2.0% of PHB accumulation and a biomass production of 6.18 ± 0.2 g/L, a production rise in 1.5 times regarding initial conditions. These values are higher than others reported after fermentation of starchy by-products by the same microorganism in shake flasks. Polymer extraction by non-halogenated solvent yields a significant increase of extracted PHA in relation to the chloroform methodology, without altering PHA purity neither PHA recovery.

In conclusion, the present work demonstrated the potential valorization of starchy-based by-products by biotransformation into PHAs, a high added-value product. Moreover, it demonstrated that a non-halogenated methodology, more ecofriendly than the traditional treatment, could be applied for PHA recovery.

Biography

Silvia González-Rojo is currently a researcher at the Biofuel and Bioproduct Center of the Agricultural Technological Institute of Castilla y León in Spain, specialized in the production of polyhydroxyalkanoate-type biopolymers from renewable by-products. She is also Associate Professor of the Chemical Engineering area at the University of León (Spain). She holds a B.Sc. in Biotechnology (ULe, Spain), a M.Sc. in Research in Fundamental Biology and Biomedicine (ULe, Spain), a M.Sc. in Teacher Training for Secondary Education, Vocational Training and Language Teaching (UVa, Spain), and is currently enrolled in a M.Sc. in Bioinformatics and Biostatistics (UOC, Spain). She received her Ph.D. in Molecular Biology and Biotechnology in 2018. Based on the health consequences of plastics, Dr. González-Rojo studied the genetic and epigenetic effects promoted by toxic compounds derived from traditional plastics. Since 2021, she is part of ITACyL and studies new biotechnological strategies for the production of health-safe biopolymers from agro-industrial wastes.

PURIFICATION, REGENERATION AND REUSE OF GRAPHITE FROM LITHIUM BATTERIES

Sukanya
Clausthal University of Technology, Germany

Abstract:

Li-ion batteries (LIBs) demand and sales have had exponential growth in 2021, nearly 10% of global car sales were electric. This scenario generates critical problems for producers, i.e., waste management of end-of-life LIBs and scarcity of primary materials. Therefore, developing a circular battery production and recycling chain is crucial to meet the climate and sustainability goals. LIBs recycling processes reported in the literature combine mechanical, thermal, and chemical treatments, leading to desired recycling targets and decreased impurity contents. In most LIBs recycling routes, discharged and deactivated modules are crushed in the early stage, leading to significant impurities in the recovered black mass. However, the key processes focus on recovering the metals from the cathode side due to their scarcity and economic value. On the other hand, graphite, as the active material in the anode, is also crucial, signifying 12 to 21 wt% of the battery.

Within this context, this work proposes a deep dismantling process up to the anode level. Wet mixing step is added to the classical dry mechanical route (shredding, drying, and sieving). The aim is to increase the quality of the recovered black mass by gaining benefit of the water-based binders, decreasing the impurities, and reducing the efforts or even eliminating the hydrometallurgy. To achieve an even higher quality of the recovered graphite and optimally reduce the amount of impurities, the material is acid leached and oxidized on the surface by treating it with a mixture of H_2SO_4:HNO_3 (3:1). The exfoliated graphite is then used to investigate the electrical conductivity for ORR.

Biography

Sukanya has her expertise in evaluation and passion in improving the climate and sustainability goals. Her open and contextual evaluation model based on responsive constructivists creates new pathways for improving sustainability. She has built this model after years of experience in research, evaluation, teaching, and administration in educational institutions.

BIO-BASED HYDROGELS FROM ACID WHEY AS SUSTAINABLE SOIL AMENDMENTS TO IMPROVE SOIL QUALITY AND WATER RETENTION CAPACITY

Silvie Durpekova
Tomas Bata University in Zlin, Czech Republic

Abstract:

In recent years, there has been a growing interest in the application of soil additives to improve soil water retention, especially in arid and semi-arid regions. Hydrogels are crosslinked polymers capable of retaining a large amount of water and releasing it when the soil around plants roots starts to dry out. However, the most of hydrogels are low-biodegradable materials based on acrylates, which are considered as a potential soil contaminant. In this context, the research was focused on the development of renewable and biodegradable hydrogels for agriculture application. Acid whey is a dairy by-product for which the industry has long struggled to find a sustainable application, as it is largely disposed of as waste. Nevertheless, whey has shown the potential to act as a nutritive agent for boosting the growth and quality of crops due to high content of organic compounds. Therefore, it offers the possibility of using acid whey as a material for the preparation of hydrogel, leading to a reduction in the cost of hydrogel production and the consumption of water, which is commonly used in the synthesis of hydrogels. This work deal with the preparation and characterization of a novel hydrogel based on acid whey, cellulose derivatives, and polyvinyl alcohol/poly (lactic acid) intended as a soil amendment to improve soil quality and water retention capacity. The physico-chemical properties and biodegradability of the hydrogel were characterized in order to evaluate its suitability for agriculture use. It was found that the addition of polyvinyl alcohol or poly (lactic acid) to the hydrogel increased stability of the material in the soil environment, with the advantage of raising water retention in soil by up to 30%. Employing acid whey in the production of such hydrogels is a promising alternative that could advance fertilization practices.

Biography

Silvie Durpekova is a researcher at Centre of Polymer Systems, Tomas Bata University in Zlin, Czech Republic and her main attention is focused on developing biodegradable renewable materials for sustainable applications. Her primary research is the development of environmentally friendly soil conservation materials based on renewable resources. Since 2019 she has been involved in the development of biopolymer hydrogels for agricultural applications. She is author of 9 publications in field of food microbiology and polymer science indexed in Web of Science and active participation in projects financed by Ministry of Education, Youth and Sports of the Czech Republic and Ministry of Agriculture of the Czech Republic.

BIOLOGICAL PHOTOVOLTAICS: TESTING ALGAE FOR THE OPTIMAL BATTERY

Yu Han Guo
York House School, Canada

Abstract:

Energy generation and battery waste are growing issues that are essential to tackle, so this project develops a sustainable alternative to conventional batteries in order to provide a solution to the energy crisis. Global energy generation is predicted to increase from ~700TWh in 2023 to ~900TWh in 2027, with the global energy sector contributing to 73.2% of global emissions. Fifteen billion batteries are thrown away each year, and global battery demand is predicted to increase significantly from 555GWh in 2023 to 2035GWh in 2030. This means that battery waste will only increase, as traditional batteries–such as lithium-ion batteries– do not always have a long-life cycle. Other issues include their use of non-renewable resources and toxicity to the environment. This project expands on the previous project by testing a different algal strain, different wavelengths of light, type of electrode, and type of electrolyte. The project also uses a light bulb instead of coloured paper, and a spectrophotometer to detect each algae's absorbance of light. Unlike conventional batteries, biological photovoltaics (BPVs) utilize algae to last longer, have a greater power output, and the batteries use environmentally friendly materials. This project discovered the optimal type of algae, the concentration of algae, and the wavelength of light shone on the BPV to improve energy efficiency. The hypothesis was that the spirulina algae in the greatest concentration under blue light would produce the greatest amount of power. This project tested twenty-one BPVs with two types of algae and three concentrations of each set of seven BPVs cycled under three different wavelengths of light for over two weeks. There were 47 million datasets collected by measuring each one-hundredth of an hour, and 630 trials were collected in total. The optimal operating conditions of the BPV were Spirulina algae at the highest concentration under blue light. For the results previously listed ($p < 0.05$), suggesting that it was a statistically significant experiment. The results highlight the long-lasting nature and the realities of the light reactions of photosynthesis in BPVs. Using renewable and abundant materials, such as aluminum and carbon electrodes, made the BPV more environmentally friendly. By comparing the optimization factors of BPVs, one can dive deeper into creating a greener battery, which will benefit further research in renewable energy, paving the way for BPVs to become the future energy storage.

Biography

Yu Han Guo has her passion in tackling environmental issues, specifically by finding sustainable methods to improve energy efficiency. Since being introduced to the world of research three years ago in Grade 7, she began exploring different solutions to the energy crisis. Her inspiration came from the University of Cambridge's paper, titled "Powering a microprocessor by photosynthesis." After reading more papers about biological photovoltaics (BPVs), she became captivated in testing these batteries to produce an environmentally friendly energy source. Her manipulation of variables and statistical analysis provide novel insights into how to optimize BPVs, providing a renewable alternative to conventional batteries.

LACTIC ACID AS NATURAL BIOCIDE FOR GUM ARABIC ADHESIVES

Sara Fuster-Esteso[1,2], Rocío Torres-Vera[1], Jesús Martínez-Ruiz[1] and José Miguel Martín-Martínez[2]

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[2]Adhesion and Adhesives Laboratory. University of Alicante. 03080 Alicante, Spain

Abstract:

In the development of sustainable adhesives, natural polymers are good candidates, due to their versatility, lack of toxicity, biodegradability, and easy formulation. Particularly, the natural gums have a high potential for use in biotechnology, food industry, and medicine.

Among the natural gums, gum Arabic has been known for more than 5,000 years as an adhesive for embalming mummies. Gum Arabic is obtained from different species of acacia trees that grow mainly in arid and semi-arid areas of Africa and Asia. It is multifunctional branched hydrocolloid based on arabin-galactan protein of calcium, magnesium, and potassium salts.

The growing interest of the industry to achieve materials with low or zero carbon footprint and to reduce production and waste pollution, makes the development of adhesives formulated from natural compounds and sustainable synthesis processes of great interest for the biotechnology industry and agriculture.

Waterborne gum Arabic-based adhesives were prepared, but after a few days they show the proliferation of fungi and bacteria. Different biocides were tested and the results obtained by adding up to 1 wt.% natural lactic acid (LAc) as biocide were successful. Gum Arabic+LAc mixtures were surface tension, Brookfield viscosity, gel permeation chromatography, infra-red spectroscopy, and thermal gravimetric analysis. The adhesion was measured by T-peel test, and the proliferation of fungi was monitored for 100 days.

The addition of LAc changed the structure of the gum Arabic causing the hydrolysis of the polymeric chains, resulting in more chains with lower molecular weights. Furthermore, the addition of LAc slightly decreased the adhesion of the gum Arabic adhesives, but the overall adhesion capacity remained acceptable. Whereas the gum Arabic adhesives showed microbial growth after 63 days of preparation, the addition of LAc increases their durability up to 100 days at least.

Biography

MS. Sara Fuster-Esteso graduated in Chemistry in 2017 at the University of Alicante (Spain) and finished a Master on Materials Science in 2019. Her Master Thesis dealt with the development of active carbons for liquid contaminant adsorption. In 2019, Sara joined the Adhesion and Adhesive Laboratory of the University of Alicante in Spain, and from 2021 she is a research assistant at Symborg (Murcia, Spain). Currently, Sara is a PhD student working on the development of natural-based adhesives for potential application in biotechnology. She got a scholarship from University of Alicante for getting an industrial PhD degree. She filed two European Patent applications.

ASSESSING FUTURE OFFSHORE WIND FARMS IN THE GULF OF ROSES: INSIGHTS FROM WEATHER RESEARCH AND FORECASTING MODEL VERSION 4.2

Kurias George, Ildefonso Cuesta Romeo, Clara Salueña Pérez and Jordi Sole Olle
Universitat Rovira I Virgili, Spain

Abstract:

With the growing prevalence of wind energy there is a need, for modeling techniques to evaluate the impact of wind farms on meteorology and oceanography. This study presents an approach that utilizes the WRF (Weather Research and Forecasting) with that include a Wind Farm Parametrization model to simulate the dynamics around Parc Tramuntana project, a offshore wind farm to be located near the Gulf of Roses off the coast of Barcelona, Catalonia. The model incorporates parameterizations for wind turbines enabling a representation of the wind field and how it interacts with the infrastructure of the wind farm.

Current results demonstrate that the model effectively captures variations in temperature, pressure and in both wind speed and direction over time along with their resulting effects on power output from the wind farm. These findings are crucial for optimizing turbine placement and operation thus improving efficiency and sustainability of the wind farm. In addition to focusing on atmospheric interactions, this study delves into the wake effects within the turbines in the farm. A range of meteorological parameters were also considered to offer a comprehensive understanding of the farm's microclimate.

The model was tested under different horizontal resolutions and farm layouts to scrutinize the wind farm's effects more closely. These experimental configurations allow for a nuanced understanding of how turbine wakes interact with each other and with the broader atmospheric and oceanic conditions. This modified approach serves as a potent tool for stakeholders in renewable energy, environmental protection, and marine spatial planning. environmental protection and marine spatial planning. It provides a range of information regarding the environmental and socio-economic impacts of offshore wind energy projects.

Biography

Kurias M. George is a mechanical engineer currently pursuing a PhD in Mechanical Engineering at Universitat Rovira I Virgili in Spain, funded by Marie Curie COFUND Fellowship. His research focuses on the study of Offshore Wind Energy, particularly the parametrization of offshore wind farms. He holds a strong interest in understanding how wind farm configurations affect local and regional climates. Kurias has experience in presenting his research at conferences and has co-authored one journal article. At this conference, he will present a poster discussing his findings from his latest research on the mesoscale modelling of a prospective offshore wind farm in the Gulf of Roses.

Day 2

Energy Trends 2023

Video Presentations

TWO-STEP ELECTRODEPOSITION OF Cu_2O/ZnO-NRs HETEROSTRUCTURES FOR PHOTOVOLTAIC APPLICATIONS

Abderrahim Ait hssi, A Soussi, N labchir, A Elfanaoui, A Ihlal and K Bouabid
Ibn Zohr University, Morocco

Abstract:

In this study, Cu_2O/ZnO-NRs heterostructures were synthesized and characterized. A simple two-step electrodeposition method was used to deposit Cu_2O nanostructures onto ZnO nanorods (NRs). The structural, morphological, optical, and electrical properties of both ZnO NRs and Cu_2O films were analyzed using various techniques, including X-ray diffraction (XRD), scanning electron microscopy (SEM), UV-vis transmittance, and Mott-Schottky (M-S) analysis. The XRD patterns revealed that the Cu_2O film was highly crystalline and oriented along the (111) plane, while the n- ZnO nanorods were oriented along the (002) plane. The SEM images showed that the ZnO nanorods were well-covered by cubic Cu_2O nanostructures in just 15 minutes. The optical band gap energies of ZnO-NRs, Cu_2O, and Cu_2O/ZnO-NRs were measured and found to be 3.32 eV, 2.1 eV, and 1.9 eV, respectively. The carrier concentrations and conductivity types were determined using Mott-Schottky analysis. These findings are expected to lead to the development of more efficient solar cell devices based on Cu_2O\ZnO nanomaterials.

OVERVIEW OF CURRENT DEVELOPMENT IN ENERGY STORAGE SYSTEMS (ESSS) INTEGRATION STRATEGIES FOR DIFFERENT BUILDING TYPOLOGIES AND THE APPLICATION POTENTIAL IN ARCHITECTURAL FIELD

Anastasia Tsoy
Shanghai Jiao Tong University, Russia

Abstract:

Energy storage systems (ESSs) are rapidly gaining recognition as a significant component in renewable energy management and sustainable development field. Researchers and engineers are actively investigating new materials, innovative designs, and storage mechanisms to enhance the performance, reliability, safety, and longevity of ESSs. Widespread integration of ESSs into the built environment is a logical and promising next step for optimizing energy usage, decreasing dependence on traditional power sources, and achieving greater efficiency. This paper provides a review of the current state of ESSs integration strategies and existing research on applicable integration frameworks for built environment. First, key ESSs characteristics, relevant advancements, and recent challenges are briefly summarized by conducting a review of existing literature. Subsequently, application potential in the architectural field and current design frameworks for various building typologies are outlined. The findings indicate that a lack of comprehensive integration guidelines creates limitations for more widespread ESSs usage in the built environment. Despite an undeniable rapid progress in ESS research, the technical advancements have received an unproportionally larger amount of attention compared to real-life application strategies. An insufficient number of comprehensive guidelines or standardized approaches leaves an untapped potential for effective ESSs integration into various building typologies. Improving integration strategies and architectural design frameworks holds great potential for benefiting both industries. By providing architects with a viable solution to sustainability and energy efficiency issues, improved integration strategies can also create larger- scale research opportunities for ESS engineers. This cooperation between the architectural and ESS industries can facilitate a widespread adoption of renewable energy systems, ensuring a more sustainable and efficient built environment.

Biography

Anastasia Tsoy is a second-year master's degree student at Shanghai Jiao Tong University, specializing in architectural studies. With a background in public and commercial building design acquired during her bachelor's degree training program at Moscow Architectural Institute (MArhI), she possesses a comprehensive understanding of the architectural projects' design process. Currently, her primary focus lies in research on energy efficiency within the field of architecture. With a prominent interest in sustainable development, she aspires to contribute to the creation of environmentally conscious and energy-efficient architectural solutions. Being an international student, Anastasia Tsoy is seeking to further widen her perspective and cross-cultural understanding, enhancing her ability to adapt to diverse contexts and collaborate effectively with individuals from different backgrounds. By combining theoretical knowledge with practical experience gained through design projects, she aims to leverage master's degree education, specialization in architectural studies, and dedication to energy efficiency research to advance sustainable architectural practices.

SYNTHESIS OF THERMORESPONSIVE PNIPAM-GRAFTED CELLULOSE SULFATES FOR BIOACTIVE MULTILAYERS VIA LAYER-BY-LAYER TECHNIQUE

Kui Zeng
University of Göttingen, Germany

Abstract:

The robust Thermoresponsive and bioactive surfaces for tissue engineering by combining poly-N-isopropylacrylamide (PNIPAM) and cellulose sulfate (CS) remain highly in demand but not yet realized. Herein, PNIPAM-grafted cellulose sulfates (PCSs) with diverse degrees of substitution ascribed to sulfate groups (DSs) are synthesized for the first time. Higher sulfated PCS2 generally forms larger aggregates than lower sulfated PCS1 at their cloud point temperatures (Tcp) of around 33 °C, whereas PCS1 leads to larger aggregates at body temperature (37°C). Via the layer-by-layer (LbL) technique, biocompatible polyelectrolyte multilayers (PEMs) composed of PCSs as polyanions in combination with poly-L-lysine (PLL) or quaternized chitosan (QCHI) as polycations were fabricated. The resulting surfaces contained a more intermingled structure of polyanions with both polycations, while higher sulfated cellulose derivatives (CS2 and PCS2) displayed greater stability. Studies on toxicity and biocompatibility of PEM using 3T3 mouse fibroblasts showed a lower cytotoxicity of PEM with PCS2 and CS2 than PCS1 and CS1. Furthermore, the PEM using PCS2 particularly in combination with QCHI demonstrated excellent biocompatibility that is promising for new bioactive, thermoresponsive coatings on biomaterials and substrata for culturing adhesion-dependent cells.

Background: The conventional methods for the production of cell sheets are application of enzymes or physical cell scrapers that could damage cells and the integrity of confluent cell monolayers. Stimuli-responsive surfaces constructed from thermoresponsive polymer like poly-N-isopropylacrylamide (PNIPAM) can be used for the production of cell sheets for simple detachment by changing the environmental temperature below the specific lower critical solution temperature (LCST). On the other hand, the sulfate group in bioactive polysaccharides like glycosaminoglycans (GAGs) plays a crucial role in their bioactivity for interaction with a plethora of proteins with regulatory function in humans, which allows their use as building blocks for implant materials and tissue engineering scaffolds. However, GAGs from different sources have variable biological activities, which can result in unpredictable side effects and dilute the target effects during the application.

Objective: Combination of poly-N-isopropylacrylamide (PNIPAM) and cellulose sulfate (CS) to engineer robust thermoresponsive and bioactive surfaces to examine the effect of DSs of PNIPAM-cellulose sulfate on the growth behavior, stability, and surface properties of polyelectrolyte multilayers (PEMs).

Methods: The final products PNIPAM-CSs were synthesized with multi-step. The thermoresponsive properties of PNIPAM-CSs were studied. They are used as polyanions to cross link with polycations via ionic bonds to form polyelectrolyte multilayers. Their growth behavior, stability, and surfaces properties were studied.

Results: PNIPAM-grafted cellulose sulfates PCS1 (DSs 0.41) and PCS2 (DSs 0.93) as GAG-mimetic compounds with thermoresponsive properties were successfully synthesized via two synthetic strategies. Their

thermoresponsive properties were found to be affected by parameters such as DSs, pH, and ionic strength. Higher sulfated PCS2 generally shows a higher Tcp than PCS1 and the presence of NaCl slightly decreases the Tcp. PCS2 generally forms larger aggregates than PCS1 at Tcp, whereas lower sulfated PCS1 leads to larger aggregates at body temperature (37°C). PCSs and precursor CSs were used as polyanions for constructing PEMs and for cell cultures. It can be concluded from zeta surface potential and SPR measurements of PEMs that PCS2 with a higher DSs is related to the fabrication of stable, bioactive multilayer systems that promote the adhesion and growth of cells, particularly if QCHI is used as the polycation during multilayer formation. In contrast, PCS1 with low DSs is not sufficient to form stable multilayers.

Conclusion: PEMs of QCH/PCS2 are promising for future studies to investigate the potential of these coatings to be used as reservoirs for growth factors and their thermosensitive properties for the generation of cell sheets for tissue engineering.

Biography

Kui Zeng obtained his master's degree in the field of Organic Synthesis at Hunan University in Shuangfeng Yin's group. During 2018-2022, followed by his PhD work at the University of Goettingen in Kai Zhang's group, he focuses on developing synthesis methods in carbohydrate, and preparation of thermo-responsive biomaterials using polysaccharide. From 2022 to 2023, he starts his postdoctoral work at University of Oxford focusing on development of redox-responsive polymer for electrochemical anion sensing. In 2023, He starts postdoctoral fellow in University of Wisconsin-Madison in carbohydrate chemistry. Kui Zeng has his expertise and passion in the field of carbohydrate chemistry, including development of chemical synthesis strategies for the preparation of bioactive molecules, and preparation of stimuli responsive materials for the healthcare and environment.

DIELECTRIC PERFORMANCE OF NEW BIOBASED MATERIALS BY 3D PRINTING

Morgan Lecoublet
UniLaSalle, France

Abstract:

3D printing is a prototyping technology widely used in various fields, however, research is lacking in terms of pertinence in key dielectric areas such as low-k materials. The aim of this study was to develop new biobased materials made with polylactic acid (PLA) and cellulosic materials, using a FFF (Fused Filament Fabrication) process. The focus was on the influence of cellulose on viscoelastic and dielectric properties, and how the 3D printing process influences dielectric properties. Microstructural analysis revealed a heterogeneous morphology of the materials. The presence of cellulose significantly increased PLA viscosity at 180°C, with a steady increase in complex viscosity with the addition of cellulose. The addition of cellulose also increased the dielectric constant (ε'), dielectric loss (ε'') and AC electrical conductivity (σ_{AC}). According to infrared analyses this increase in dielectric properties was associated with the presence of polar functions on the surface of the cellulose samples. The dielectric increase induced by the cellulose material was significant, but the materials obtained still had values compatible for low-k application. Porosity was measured at 12% for neat PLA and between 15 and 20 % for the biobased composites. A direct relation between dielectric properties and infill density of the samples was highlighted, showing that it is possible to control the dielectric constant of the final material with a keen design. These results demonstrated the value of FFF technology for processing PLA-CA blends with controlled dielectric properties, favoring the integration of these new materials in key dielectric domains.

Biography

Morgan Lecoublet is a PhD student in engineering and environmental science, working under the joint supervision of the Unité de Recherche Transformation et Agro-Ressources, VAM2IN at Unilasalle (Fr) and the Laboratoire Biomatériaux at UQAT (CA). His research focuses on the dielectric performance of bio-based materials. His skills are mainly focused on polymers processing and characterization.

MANAGING RENEWABLE ELECTRICITY WITHIN COLLECTIVE SELF-CONSUMPTION SCHEMES: A SYSTEMATIC PRIVATE LAW APPROACH

Enrico Giarmanà
Università degli Studi di Catania, Italy

Abstract:

The Clean Energy for all Europeans package (CEP) created new opportunities for citizens to be involved in market dynamics as 'active customers'. A new set of rules empowers people to collectively produce and self-consume electricity on the basis of renewable energy sources. This can also imply that electricity is consumed off-site (beyond the own premises) by using the public grid. Whenever two or more grid users cooperate to produce and consume electricity within a limited perimeter of the public grid a collective self-consumption scheme (or CSC scheme) is formed. However, what this scheme entails is often not clear.

According to the EU Directives 2019/944 on common rules for the internal market for electricity (IMED) and 2018/2001 on the promotion of the use of energy from renewable sources (REDII), electricity exchanges executed within a CSC scheme can either be classified in terms of sharing or peer-to-peer trading (P2P). Both concepts are relatively new legal forms of providing electricity, yet EU law does not offer strong indications on their distinction. That there is no common understanding of P2P trading and sharing of electricity is also apparent from the literature. From a legal perspective, however, clarifying those terms is essential because it impacts the rights, duties and benefits of individuals involved in such schemes.

My research develops a private-law approach to examine sharing and P2P trading as structural components of CSC schemes to understand how these schemes operate and interact in the context of the electricity market. The goal of the analysis is to (i) identify the emerging private relations, and (ii) to assess the extent to which national transposition measures unnecessarily add complexity that limits private autonomy, and, consequently, interfere with CEP goals.

NEW SMALL NON-FULLERENE ACCEPTORS BASED ON A-DITHIOPHENETETRATHIAFULVALENE WITH A-D-A STRUCTURE FOR HIGH-PERFORMANCE ORGANIC SOLAR CELLS APPLICATION

Y. Khaddam1, R Kacimi[1], D Tlamsamani[2], A Azaid[1], S Sarfaraz[3], M Bouachrine[1.4] and H Maghat[1]

[1]*Moulay Ismail University, Morocco*
[2]*Moulay Ismail University, Morocco*
[3]*COMSATS University, Pakistan*
[4]*Sultane Moulay Slimane University, Morocco*

Abstract:

In this work, we designed five new non-fullerene acceptor molecules (D1-D5) by end-group modification of the A-D-A type reference molecule DTTTF-T(C11) which used as donors in organic solar cells (OSCs). Different parameters like planarity, frontier molecular orbitals (FMOs), light-harvesting efficiencies electron and hole reorganization energies, binding energies, dipole moments, open-circuit voltage (Voc), transition density matrix (TDM) analysis, absorption properties and fill factors (FF), etc. of reference and proposed derivatives were calculated using Density Functional Theory (DFT) and time-dependent DFT (TD-DFT) based computational methodologies. Shorter bandgaps, redshifted absorption, lower excitation and binding energies, decreased reorganization energies, and shorter bandgaps all highlight the improved charge transfer capabilities of the designed structures relative to R. Additionally; they showed good dipole moment and light-harvesting efficiency (LHE). Higher LHE values of developed molecules indicated that they were more effective at capturing light to create charge carriers. Therefore, using these newly created compounds in the active layer of organic solar cells may be the best option (OSCs).

NITROGEN DOPED GRAPHENE AND PALLADIUM NANOPARTICLES BASED ELECTROCATALYSTS FOR THE SUSTAINABLE PRODUCTION OF HYDROGEN THROUGH WATER SPLITTING

Mohammed Rafi Shaik[1],Syed Farooq Adil[1], Muhammad Nawaz Tahir[2] and Mujeeb Khan[1]

[1]King Saud University, Saudi Arabia
[2]King Fahd University of Petroleum and Minerals (KFUPM), Saudi Arabia

Abstract:

Heavy dependence on fossil fuel puts severe strain on economy, increase global warming and other environmental pollution. Therefore, development of suitable alternatives to the fossil fuels involving alternative renewable resources is desirable. Out of several alternatives, development of hydrogen (H_2) based energy infrastructure offers a clean and secure energy future. Some of the important elements for maintaining feasible H_2 economy are the efficient production and effective storage of H2. Therefore, the development of sustainable processes is an essential requirement for the long-lasting and economic production of hydrogen (H_2). In this context, renewable resources driven electrolysis of water through electrocatalytic processes are favourable techniques for the sustainable H_2 evolution. Recently, tremendous efforts have been directed towards the development of a variety of electrocatalysts for water splitting reactions. Graphene-palladium nanocomposites have been considered as viable alternatives, which offer excellent physicochemical properties contributed by the components involved. For instance, high electrical conductivity offered by graphene, highly active metallic sites by the nanoparticles, and enhanced electrocatalytic properties due to the synergistic interactions between the metals and graphene substrate. Besides, these nanocomposites also offer excellent opportunity for the customization of chemical compositions and structures. So far, a variety of metallic NPs/doped graphene nanocomposites have been investigated as electrocatalysts in H_2 evolution, still, the development of high-performance electrocatalysts remains a great challenge and is of utmost priority. Herein, we proposed the synthesis of nitrogen doped graphene and palladium nanoparticles-based nanocomposites, which has been applied as electrocatalyst in water splitting reaction for clean H_2 production. Both the doping of graphene and the synthesis of nanocomposite has been performed by efficient hydrothermal process. In this approach, the doping with heteroatom is exploited to enhance the electronic properties of the electrocatalysts, and are utilized as stabilizing ligands for the homogeneous growth and distribution of metallic NPs on the surface of graphene. The as-prepared nanocomposite exhibited excellent capacitance at optimum current density with high energy and power density.

Biography

Mujeeb Khan is a professor in the Department of Chemistry at King Saud University, Kingdom of Saudi Arabia. He received his M.Sc. degree in materials chemistry (2005) and Ph.D. degree (2008) from Johannes Gutenberg University, Germany. Later, he worked as a postdoctoral fellow at the Max Planck Institute for Polymer Research, Germany. His current research interests are in the areas of synthesis and potential applications of advance nanomaterials in various fields. He is an editorial board member of the Arabian Journal of Chemistry.

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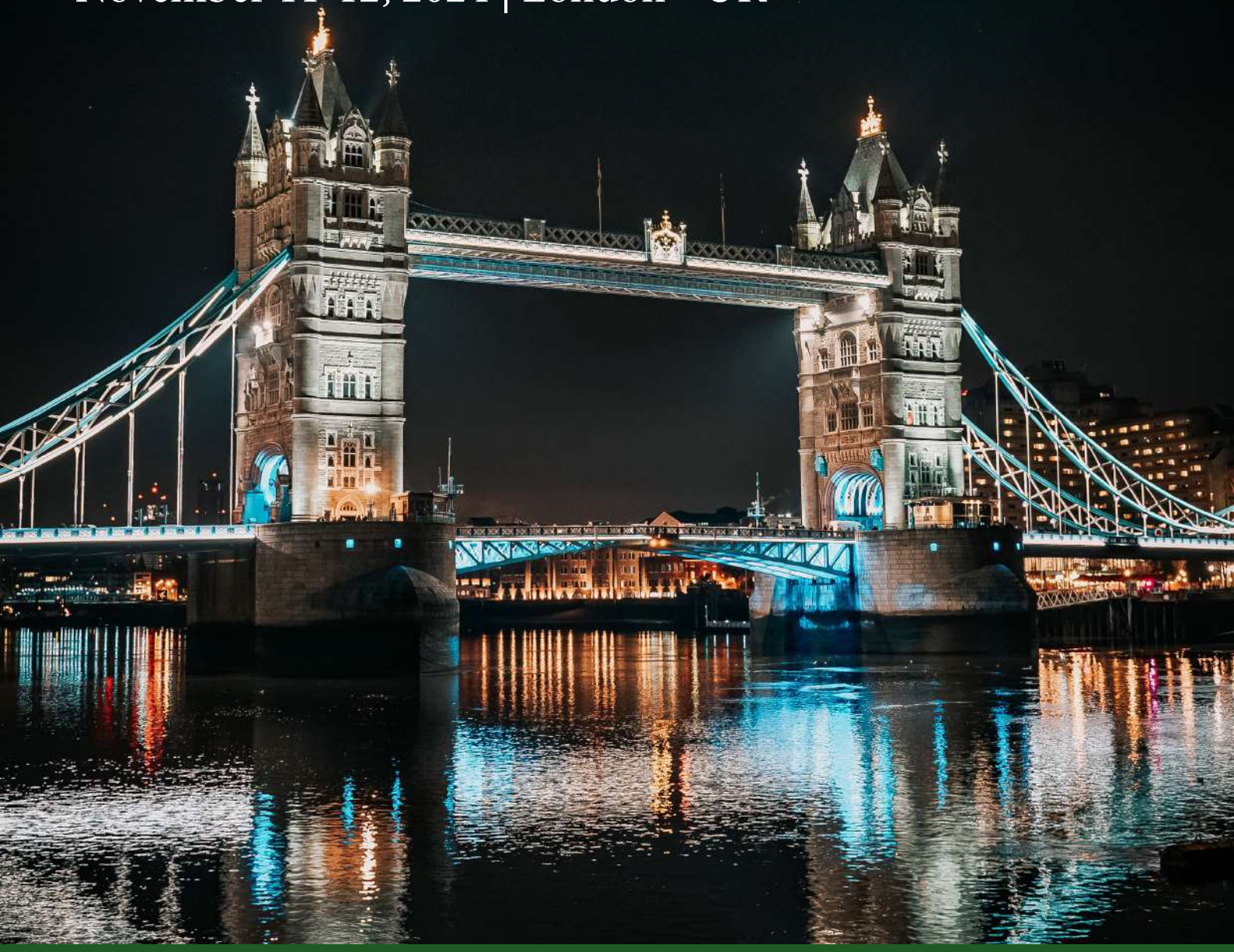

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