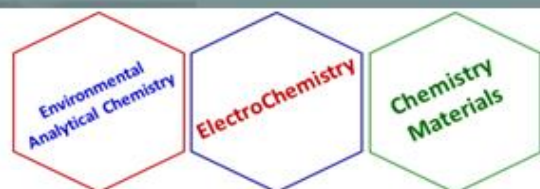


6th INTERNATIONAL SYMPOSIUM ON MATERIALS, ELECTROCHEMISTRY & ENVIRONMENT

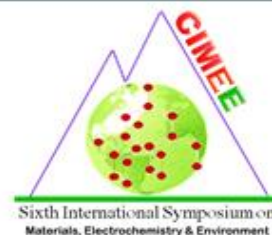
24 – 26 October 2024, LEBANON



BOOK OF ABSTRACTS



cimee-science.org



BOOK OF ABSTRACTS, SIXTH INTERNATIONAL SYMPOSIUM, CIMEE24



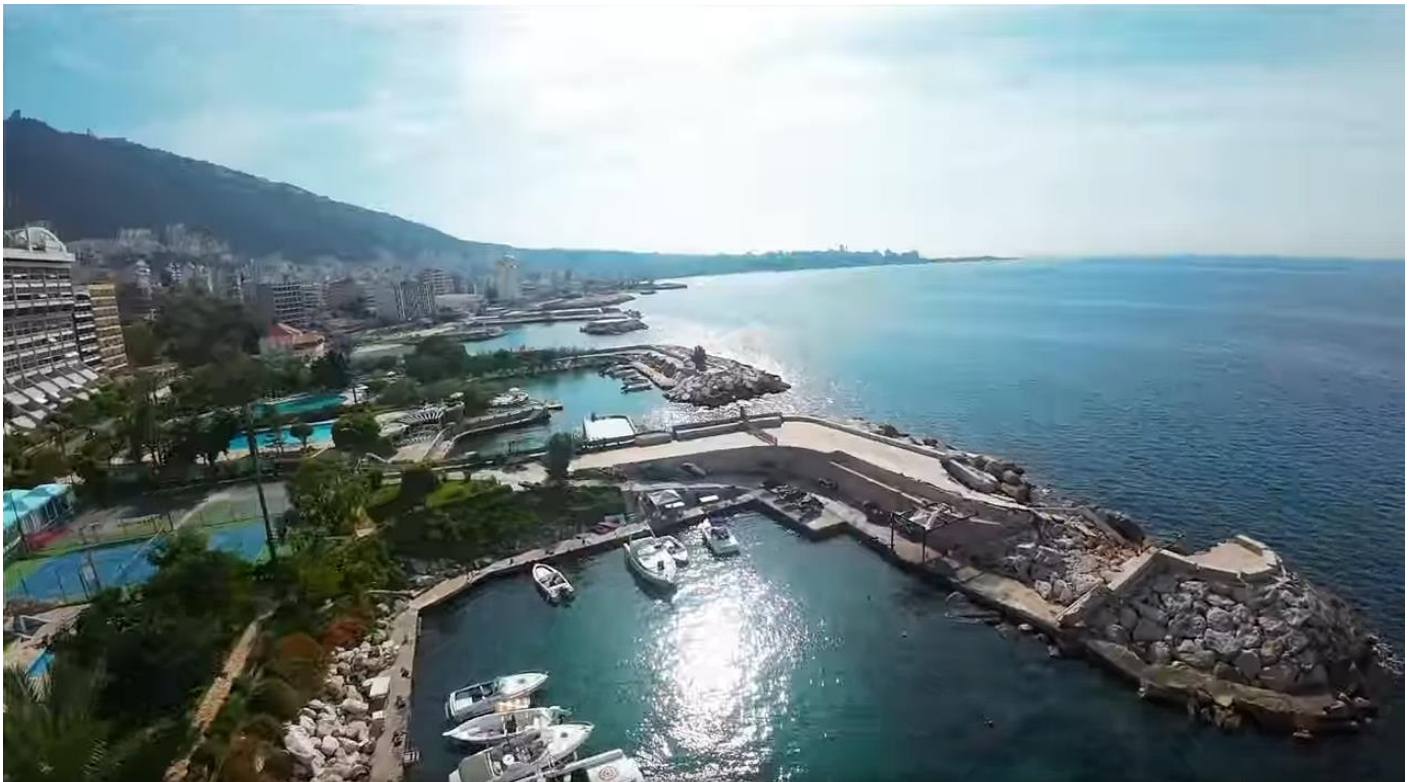
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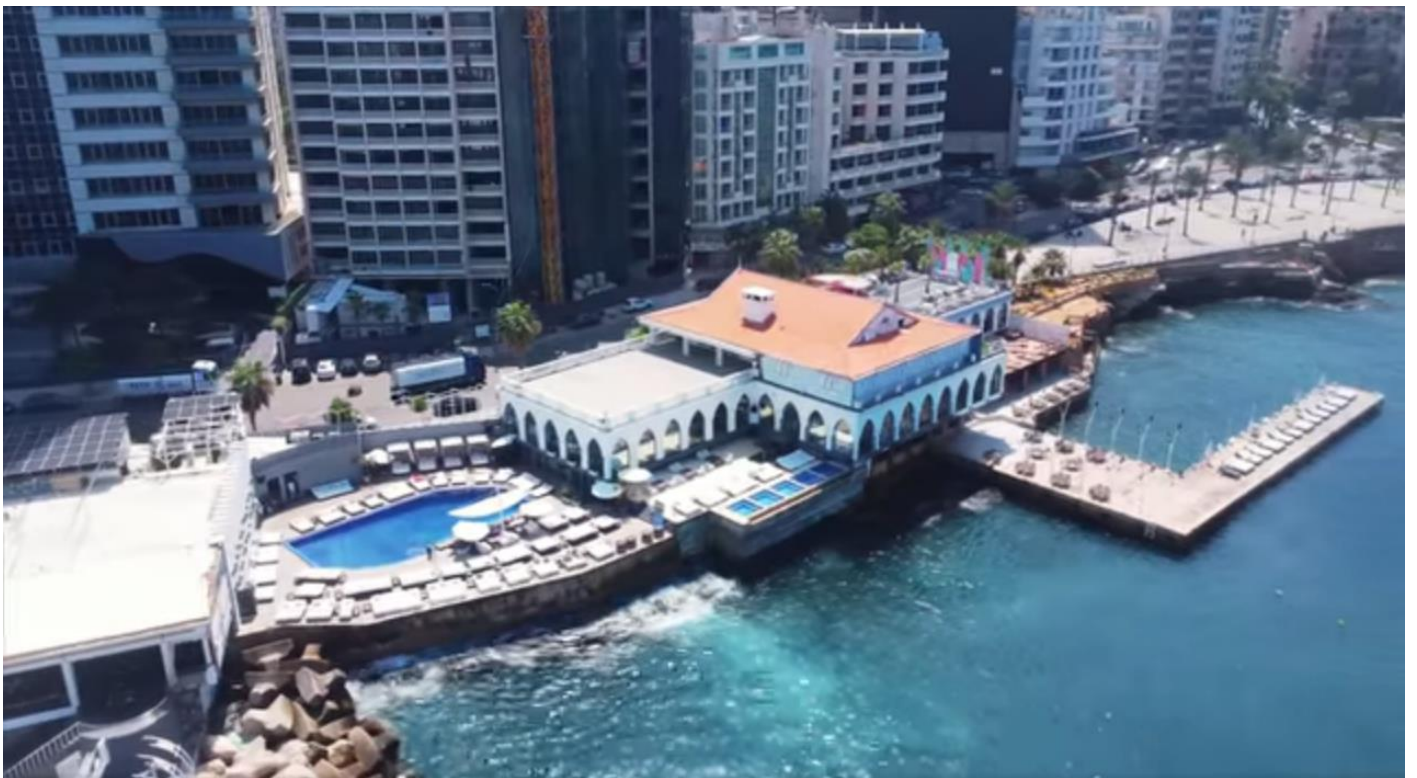
INTERNATIONAL SYMPOSIUM ON MATERIALS, ELECTROCHEMISTRY & ENVIRONMENT



C I M E E

INTERNATIONAL SYMPOSIUM ON MATERIALS, ELECTROCHEMISTRY & ENVIRONMENT





MATERIALS, ELECTROCHEMISTRY & ENVIRONMENT

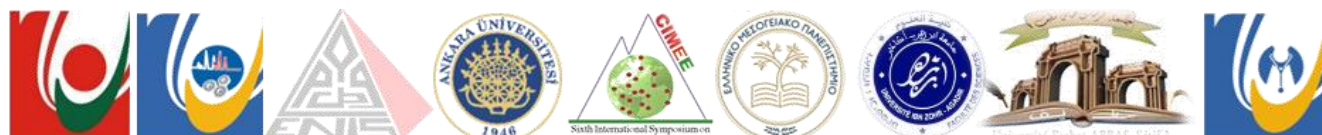


CIMEE'24 OCTOBER 24-26, 2024, LEBANON





THE WORLD EVENT IN INNOVATION CHEMISTRY & SUSTAINABLE ENVIRONMENTAL REMEDIATION



CIMEE24, THEME: ENVIRONMENTAL SUSTAINABILITY THROUGH GREEN CHEMISTRY AND RENEWABLE ENERGY

SYMPOSIUM PARTNERS



Laboratory of Electrochemistry, Molecular Engineering & Redox Catalysis, Faculty of Technology, University of F. Abbas Sétif-1, Algeria

Lab. of Environmental Engineering and EcoTechnology, National School of Engineering of Sfax, ENIS, University of Sfax, Tunisia

Center of Technology and Photonics, Mediterranean University, Heraklion, Crete, Greece

Materials and Hellenic School of Applied Sciences, ENSA, University of Ibn Zohr, Agadir, Morocco

Department of analytical Chemistry, Faculty of Pharmacy, Tandogan, Ankara University, Turkey

•With the support of Agence Universitaire de la Francophonie, AUF

Welcome Message from Chairs

WELCOME MESSAGE FROM THE SCIENTIFIC COMMITTEE CHAIR

CIMEE24, SCIENTIFIC PROGRAM

Scientific Committee Chair

THEME: ENVIRONMENTAL SUSTAINABILITY THROUGH GREEN CHEMISTRY AND RENEWABLE ENERGY

Dear all,

We are very pleased to invite all participants from all over the world to the new edition of the International Symposium on Materials, Electrochemistry and Environment, CIMEE 24, from September 24-26, 2024 in Tripoli, Lebanon.

The congress will focus on "Environmental Sustainability through Green Chemistry and Renewable Energy".

Recently, the importance of environmental sustainability has greatly increased, leading to a global shift towards greener practices in various areas of modern society. The applications of green chemistry are revolutionizing several industrial sectors such as agriculture, material science, pharmaceuticals and energy production. In fact, green chemistry focuses on the efficient use of resources such as energy and water. It promotes the development of energy-efficient processes, reduces greenhouse gas emissions and limits the overall carbon footprint. Innovative chemistry that focuses on sustainability considers waste as a resource and maximizes the use of materials throughout their life cycle.

By adopting green chemistry and exploring the frontiers of sustainability, researchers and policy makers working closely together to introduce and promote innovative solutions can certainly pave the way for a cleaner planet.

Scientific communities around the world have recognized that the application of green chemistry not only leads to a cleaner and more sustainable Earth, but is also economically beneficial. These benefits are encouraging researchers to support the development of sustainable products and processes

WELCOME MESSAGE FROM THE PROGRAM CHAIR

Message from the Program Chairperson

It is with great pleasure that I welcome you to the 6th International Symposium CIMEE24. A total of 94 research papers were submitted for the technical program. Twelve were withdrawn, 18 were rejected without further formalities, leaving 64 papers/abstracts for review. I would like to thank all the authors who submitted abstracts and/or papers. High quality submissions are the starting point for an excellent symposium.

In addition to the technical program of these proceedings, the symposium is enriched by many other elements. These include the high quality of the keynote and invited speakers throughout the three-day program and the series of different sessions.

To make a long story short: Given the current conflicts in the 3 continents of Asia, Europe and Africa, the number of wars has multiplied this year. These conflicts have indeed led to a major environmental catastrophe and the destruction of ecosystems. Unfortunately, this is a real handicap for the worldwide efforts to curb global warming. This prompts us all to make an appeal to all researchers to show solidarity and contribute to improving this situation. This edition, CIMEE24, provides an excellent platform for a fruitful research exchange focusing on the application of physical chemistry, biological chemistry, geochemistry and agrochemistry in interdisciplinary research and innovation. During this edition of CIMEE24, a number of invited internationally recognized scientists will shed light on the topics. In addition, a large number of papers will be presented in the focus sessions.

The conference will consist of an opening session with a panel discussion, thematic sessions with keynote speeches and oral contributions, poster sessions and side events. Each session begins with a keynote address that sets the framework for the intended message, followed by presentations from relevant and knowledgeable experts, and concludes with a roundtable or panel discussion.

The closing session will be structured as a plenary session highlighting the main conclusions of the conference. It will be chaired by the Conference Chair, with concluding remarks from the Technical Program Committee.

I am pleased to thank the committee for managing the submission system and the conference website. It is a pleasure to work with you and all the experts from 23 countries.

I hope you enjoy the symposium as much as I have enjoyed being involved in its realization.

Program Committee Chairperson
ELMOLL Ahmad

WELCOME MESSAGE FROM THE CONFERENCE CHAIR

Dear Distinguished Colleagues,

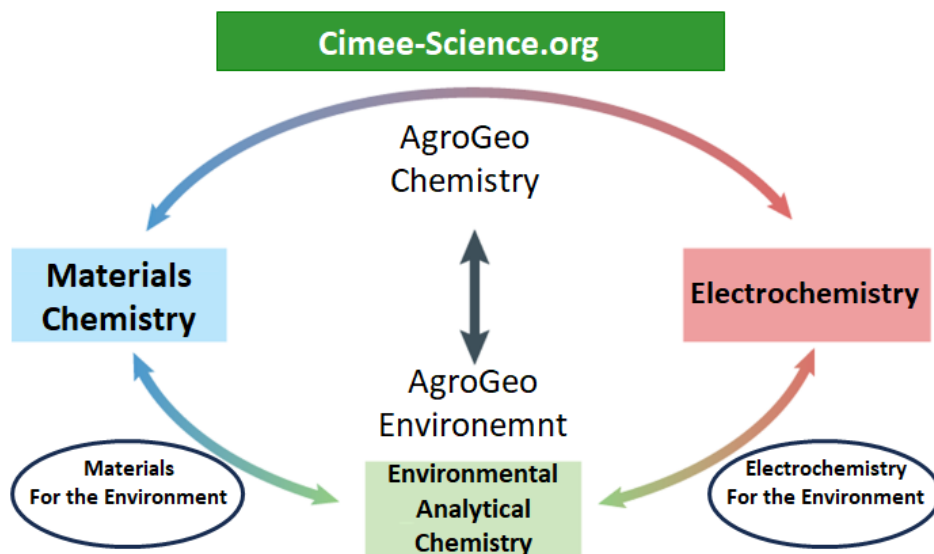
The conference theme “Green chemistry and innovative technology for a more sustainable environment” has been carefully chosen in order to save resources of raw materials and energy and to protect the environment and the well-being of consumers. In this edition we will try to explore all possibilities to develop plant chemistry both as a raw material and energy source, as well as the development of biotechnological tools and sustainable and bio-based processes. We will also explore the prevention of waste, the use of non-toxic substances and renewable raw materials, and the reduction of environmental impact.

At this conference we will hear guest speakers who will mainly address topics related to the treatment and recovery of waste, the use of advanced electrochemical processes and materials for the environment. This conference will also allow us to share our thoughts and ideas on how we can continue our journey to reach new heights in the field of chemistry and environmental chemistry. We have put together an exciting program with outstanding speakers from around the world. This conference will allow participants to reflect on and explore current and future research directions together, renewing friendships and expanding networks.

We hope that you will have a productive and enjoyable time at this very special conference. Hosting a conference of this magnitude is no small task and the success of the conference ultimately depends on the many people who have worked tirelessly with us in planning and organizing both the technical program and the accompanying social events.

We would like to thank all the supporting organizations for taking on the responsibility and acting as co-organizers of this conference.

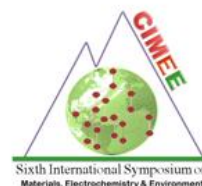
Our sincere thanks go to all our valued partners who have contributed to the preparation of this edition.





Slim Abdelkafi

Director of ENIS,
University of Sfax, Tunisia



6th International Symposium On
Materials, Electrochemistry and
Environment October 24-26 2024,
Lebanon

WELCOME MESSAGE

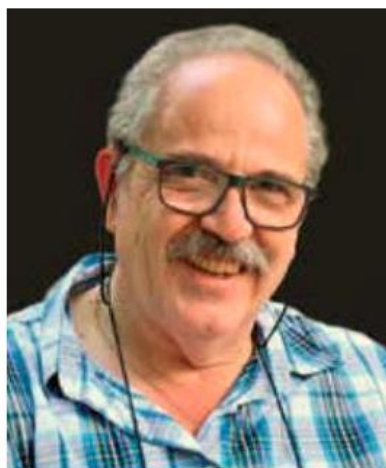
Happy to host this edition of the flagship CIMEE conference which will be held online in Lebanon. With the organizing committee, we are honored to host the CIMEE24 conference, as a partner, with participants from all over the world including researchers from the University of Sfax, a potential partner of this symposium. The theme of this edition, CIMEE24, Environmental Sustainability through Green Chemistry and renewable Energy, explores a variety of current topics related to pollution treatment.

This 6th edition of the CIMEE symposium, a high-quality international conference, with the main theme of CIMEE24 promoting the creative synergy between bio materials and the environment as well as the Innovation in biomaterials to reduce environmental impact.

Biomaterials such as Microalgae and cyanobacteria have nanobiotechnological potential. These biomolecules such as microalgae and cyanobacteria are rich in compounds with a wide variety of biological activities that can be used to create new products with promising applications and their potential applications

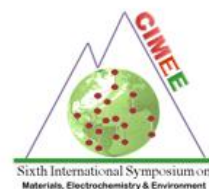
Indeed, microalgae and cyanobacteria extracts are rich sources of bioactive products and compounds for the cosmetic industry, with many antioxidant or anti-inflammatory properties, whose potential is far from being fully explored.

In the comprehensive technical program with more than 30 oral and poster sessions, complemented by plenary and perspective talks, tutorials and panels. These sessions present all the latest developments in research and technology for materials chemistry, electrochemistry, analytical chemistry and its applications. Numerous networking opportunities further facilitate interactions with friends and colleagues, as well as with scholars and researchers.



Emmanuel Koudoumas

Professor at the Depart. of Electrical and Computer Engineering at the Hellenic Mediterranean University, HMU, Greece



6th International Symposium On Materials, Electrochemistry and Environment October 24-26 2024, Lebanon



Department of Electrical & Computer Engineering
Hellenic Mediterranean University

WELCOME MESSAGE

Its great pleasure to share through this edition, Sixth International Symposium, CIMEE24 the latest discoveries and research and reconnect with colleagues from around the world, in a convivial symposium atmosphere. We expect contributions on interdisciplinary research including material science, chemistry, and physics.

Recently carbon nanostructures i.e. graphene and its derivatives, carbon nanotubes (CNT) and fullerene combined with different metal oxides have provided researchers a lot of opportunities for the sensing of pollutants as well as Carbon-metal oxide nanocomposites for selective detection of water pollutants. In addition, low cost and environmental friendly techniques for the growth of thin films, nanostructure layers, nanomaterials and nanocomposites, based on pure or doped metal oxides or carbon allotropes has an important applications in different sectors. These applications include the use of this material as membrane for the detoxication and purification of water

Happy to host this edition of the CIMEE conference which will be held online in Lebanon. With the organizing committee, we are honored to host the CIMEE24 conference, as a partner, with participants from all over the world.

Short bio

Prof. Emmanuel Koudoumas is a Professor in the Department of Electrical and Computer Engineering at the Hellenic Mediterranean University, Greece. His research efforts are concentrated in the use of simple, low cost and environmental friendly techniques for the growth of thin films, nanostructure layers, nanomaterials, nanocomposites and suspensions, based on pure or doped metal oxides, metals or carbon allotropes, exhibiting properties suitable for control light transmission, photo-catalytic/antifouling/antibacterial action, self-cleaning windows, Li ion batteries, electromagnetic shielding, nanodielectrics, food packaging etc. He has 140 publications in peer review journal, with 3.200 citations and an h-index of 33, while he has been involved in a large number of funded projects as coordinator or member of the research team.



CERTH
CENTRE FOR
RESEARCH & TECHNOLOGY
HELLAS



Ahmad El Moll

General Chair
Lebanese university, Lebanon



Konstantinos K. Plakas

General Co-chair
CERTH, Greece

CIMEE24 Partners



- Laboratory of Electrochemistry, LEIMCR, Faculty of Technology, University of Ferhat Abbas Sétif-1, Algeria
- Laboratory of Environmental Engineering & Ecotechnology, ENIS, University of Sfax, Tunisia.
- Laboratory of Applied Chemistry & Environment, ENSA, University of Ibn Zohr, Morocco
- Department of analytical Chemistry, Faculty of Pharmacy, Ankara University, Turkey.
- Center of Materials Technology and Photonics, Hellenic Mediterranean University, Heraklion, Crete, Greece

On behalf of the Organizing Committee, it is our great pleasure and honor to invite you to the CIMEE 2024, International Symposium on Materials, Electrochemistry and Environment (CIMEE 2024) from October 24-26, 2024. Tripoli, Lebanon.

The CIMEE conference is a comprehensive technical conference focusing on Materials chemistry, Electrochemistry, Analytical chemistry and their applications. It offers a comprehensive technical program that showcases the latest developments in research and technology in the industry.

The theme of this edition, CIMEE24, Environmental Sustainability through Green Chemistry and Renewable Energy, explores a variety of topical issues related to addressing pollution and waste management, climate change, depletion of natural resources, and the reduction of carbon emissions and transition to renewable energy.

The aim of the conference is to gather new research contributions from scientists in all areas of Materials Chemistry, Electrochemistry and Environmental Science. We hope and believe that our international conference CIMEE 2024 will be a great learning opportunity and an enriching experience for all participants. So mark your calendar and join us as we are full of anticipation for this flagship conference and hope that you will attend the various sessions with valuable presentations and innovative topics with world-renowned speakers, along with great networking opportunities with industry pioneers and leading researchers.

CIMEE Publication Opportunity

We have the honor to invite all participants to submit manuscripts to the Conference Publications Committee. Publications in partner journals provide the perfect opportunity to collaborate with an internationally renowned publisher and thus increase the worldwide visibility and recognition of the CIMEE group's scientific research. Partner publications serve as a publication hub that connects and strengthens the work of researchers from one or more universities, research centers and institutions.

Partner publications enable participants to achieve a wide range of goals, whether it is supporting CIMEE's young researchers, gaining an international reputation in a specialized field, or contributing to global initiatives.

CIMEE24 partner journals invite all participants to submit manuscripts to be published in these scientific journals. Manuscripts must be submitted for the special issue or the regular issue of the journal according to the instructions in the invitation letter. Each manuscript will then be reviewed according to the journal's guidelines. Authors are required to inform the conference of the status of their submission in the manner specified in the invitation letter. We ask all participants to consider this carefully:

- submit an original research manuscript
- write in correct scientific language
- follow the instructions for authors according to the journal.

We hope you will enjoy the program and wish you a very fruitful symposium.

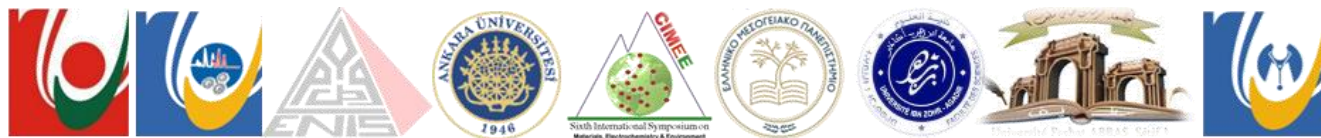
In the meantime, if you have any questions, please do not hesitate to contact us. cimee16@ul.edu.lb

We look forward to welcoming you soon!

The organizing committee,
Ahmad A. ElMoll
CIMEE24 Chairman



CONFERENCE SCOPE & TOPICS



The scientific scope will cover a wide range of fundamental and applied chemistry topics:

The 6th International Symposium, CIMEE24 will cover the following general topics:

T 1. MATERIALS & THE ENVIRONMENT

- 1.1. Nanomaterials, Nanostructures & Environment.
- 1.2. Nanomaterial-based biosensors for pollutants detection
- 1.3. Nanotechnology & Nanobiotechnology for Environmental Remediation
- 1.4. Carbon Nanotubes-Based Nanomaterials & Their Applications
- 1.5. Advanced Textile Materials for Composite Applications

Energy, Developing new materials to clean energy cycles

T 2. ELECTROCHEMISTRY, BIOELECTROCHEMISTRY & ENVIRONMENT

- 2.1. Electrochemistry for the Environment
- 2.2. Electrochemical and environmental sensors, Biosensors technology
- 2.3. Organic electrochemistry & Bioelectrochemistry
- 2.4. Electrochemical nanosensors and their application.

T 3. ATMOSPHERIC CHEMISTRY & ENVIRONMENTAL POLLUTION

- 3.1. Aerosols, Air Pollution and Meteorology
- 3.2. Atmospheric aerosols and their role in climate change

T 4. STRUCTURAL, ANALYTICAL & PHYSICAL CHEMISTRY

- 4.1. Environmental chemistry, Analytical chemistry
- 4.2. Air quality, Pesticides & environmental monitoring,
- 4.3. Bioremediation & Phytoremediation of environmental Pollutants.
- 4.4. Remediation Technologies Applied in the Environment

T 5. AGRO GEOENVIRONMENT, AGROCHEMISTRY & BIOGEOCHEMISTRY

- 5.1. AgroGeoenvironment & Geomaterials
- 5.2. Biomaterials, Waste & biomass valorization
- 5.3. Atmospheric Chemistry, air pollution, Geochemistry & Earth Materials
- 5.4. Agro-materials, & Environmental geochemistry
- 5.5. Agroecology and soil biology, Geochemistry & Earth Materials.

T 6. CLIMATE CHANGE, COASTAL & MARINE ECOSYSTEMS

- 6.1. Blue Carbon Ecosystems & Climate Change Mitigation
- 6.2. Role of Blue Carbon in Climate Change Mitigation

C I M E E

INTERNATIONAL SYMPOSIUM ON MATERIALS, ELECTROCHEMISTRY & ENVIRONMENT



PROGRAM AND BOOK OF ABSTRACTS

OCTOBER 24 - 26, 2024 | TRIPOLI, LEBANON

Technical programme committee members

Confirmed technical programme committee members

Najla Fourati, CNAM, Paris, France

Konstantinos Vasilios Plakas, Senior Researcher, CERTH, Thessaloniki, Greece

Tadeusz Szumiata, Dept of Physics, Kazimierz Pulaski University of Radom Poland, Poland

Dalila Hammiche, Lab. of Advanced Polymeric Materials, University A. Mira- Bejaia, Algeria

El Moll Ahmad, Faculty of Public Health, Faculty of Science, DSST, Lebanese University, Lebanon

Ridha Djellabi, Depart. of Chemistry, Alfaisal University, Al Maather, Al Takhassusi Road, Riyadh, Saudi Arabia

Message from Technical Program Committee

On behalf of the technical program committee, a warm welcome to all of our delegates from around the world to the 6th International Symposium, CIMEE24. We are very grateful to the all members of the team for their efforts in putting together a rich program, diverse in content and format, that promises to engage all of us in interdisciplinary, cross-cultural and international dialogues on Chemistry and Environment.

The theme of this year's conference, Green chemistry and innovative technology for a more sustainable environment, invites all of us to examine critically the trends in chemistry and environmental chemistry. Each of us has a role to play in this process and we look forward to sharing the diverse perspectives all of us bring to this conversation.

The organizing committee is very pleased to share this scientific program with more the 20 sessions. Green chemistry is an important tool in achieving sustainability. The implementation of green chemistry, the design of chemical products and processes that reduce or eliminate the use and generation of hazardous substances, is essential if the expanding global population is to enjoy an increased standard of living without having a negative impact on the health of the planet. Cleaner technologies will allow the chemical enterprise to provide society with the goods and services on which it depends in an environmentally responsible manner. Green chemistry provides solutions to such global challenges as climate change, sustainable agriculture, energy, toxics in the environment, and the depletion of natural resources. A collaborative effort by academia, and government is needed to promote the adoption of the green chemistry technologies necessary to achieve a sustainable and green society.

Glad to host this edition of the CIMEE conference which will be held online in Lebanon. With the organizing committee, we are grateful to host the CIMEE24 conference with participants from all over the world.

We have been able to put together a very interesting technical program with assistance of an excellent Technical Program Committee. Among the topics receiving the largest numbers of papers for Conference were clean and green materials for sustainable energy.

We hope you will enjoy the program and wish you a very fruitful symposium.

Technical program committee chair



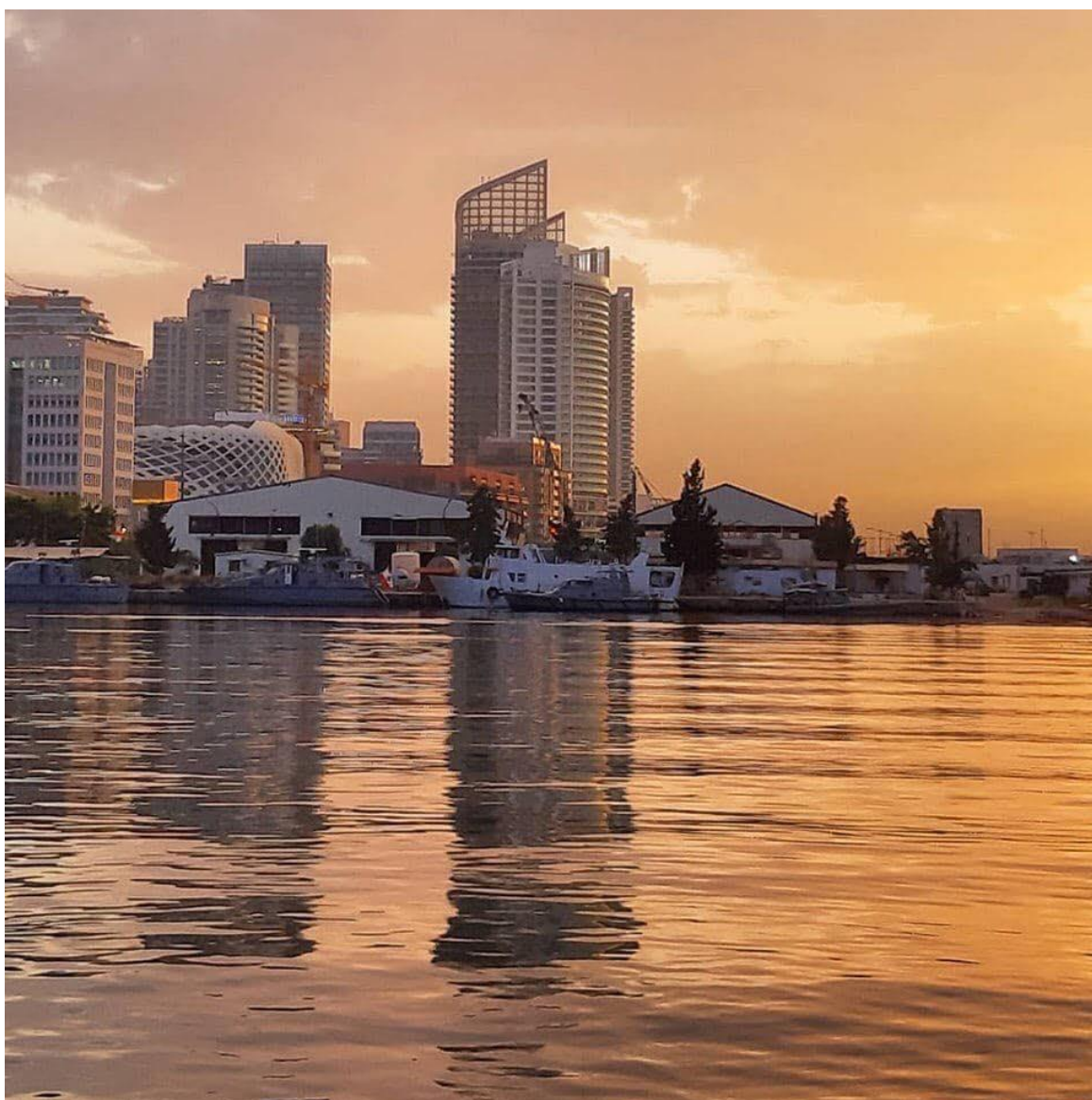
CIMEE24 Scientific Program

Day 1 – Thursday 24 October 2024
(Morning session)

Opening Session (Lebanon time (GMT+3))

08h30 – 09h00	Registration
09h00 – 10h20	<p>Official Opening Ceremony: Lebanese National Anthem and LU anthem</p> <p>Opening plenary session & welcome Speech from the Conference Chair, Assoc. Prof. Ahmad El Moll, Lebanese university, Lebanon</p> <p>Opening address by Pr. Slim AbdelKafi, ENIS, Sfax Tunisia</p> <p>Opening Keynote session, Advanced denitrification of ground water by a low cost photovoltaic by electro dialysis system</p> <p>Assoc. Prof. Konstantinos V. Plakas, Senior researcher, Centre for Research & Technology Hellas, CERTH, Thessaloniki, Greece</p>
Keynote Session I: Waste & Biomass valorization, Chair/Co-chairs A. El Moll, K. Plakas	
10h20 – 11h00	<p>KL 1: The waste-to-wealth concept: advanced solutions for a more sustainable future Pr. Rafael Luque, Chemistry Department of KSU, Riyadh, Saudi Arabia</p> <p>KL 2: Lignin Valorization to Monomeric Phenols & High Value Chemicals through catalysis Pr. Vinu Ravikrishnan, Indian Institute of Technology, Madras, India</p>
11h00 – 11h30	Break Networking, Roundtable Discussion, Photography
Afternoon Session	
Keynote Session II : Waste management and Circular Economy, Chair/Co-Chairs: K. Plakas, A. El Moll	
11h30 - 13h00	<p>KL 3: Green transition in wastewater treatment plants - analysis of challenges and opportunities Pr. Marzena Smol, Head of the Division of Biogenic Raw Materials, Polish Academy of Sciences, Poland,</p> <p>KL 4: Sustainable passive solar seawater desalination: concepts and system configurations Pr. Ridha Djellabi, Depart. of Chemistry, Alfaisal University, Al Maather, Al Takhassusi Road, Riyadh, Saudi Arabia,</p> <p>KL 5: Sustainable Agri-food industrial Sewage sludge management and Circular Economy Pr. Aida Ben Hassen Trabelsi, LMEEVED, Research & Technology Centre of Energy, CRTEn, Technopôle Borj-Cédria, Hammam-Lif, Tunisia, (Not presented)</p> <p>KL 6: Circular economy and waste management in the Mediterranean region: From innovation to upscaling Pr. Krim Louhab, Environmental Genius Depart., Engineering Sciences Faculty, Univ. M'Hamed Bougara Boumedes, Boumedes, Algeria. (Not presented)</p>
13h00 – 13h30	Light Lunch Break, Photography, Roundtable Discussion
Keynote Session III A: Natural Product Chemistry, Toxicity Assessment and potential applications, Chair/Co-Chairs: K. Plakas, A. El Moll	
13h30– 13h50	<p>KL 7: Evaluation of the neurobiological effect of natural phenolics from in vitro, in silico, and in vivo perspectives Pr. Ilkay Erdogan Orhan, Dean at Lokman Hekim University, Faculty of Pharmacy, Ankara, Turkey</p>
Keynote Session III B: Structural, analytical & physical chemistry Chair/Co-Chairs: K. Plakas, A. El Moll	
13h50 – 14h30	<p>KL 8 Exploration of metallic iron in dust from ventilation system using Mössbauer spectrometry, synchrotron radiation and magnetic methods Pr. Tadeusz Szumiata, Casimir Pulaski Radom University, Poland</p> <p>KL 9: From biomass and plastics waste to hydrogen: the benefits of co-pyrolysis/gasification technology Pr. El Moll Ahmad, Faculty of Public Health, Faculty of Science, DSST, Lebanese University, Lebanon</p>
Oral session I, Biotechnology, Biopesticide and environmental sustainability, Ilkay Erdogan Orhan, Ridha Djellabi,	
14h30 – 15h30	<p>OP 1: Harnessing Halophilic Microbiomes for Sustainable Polyhydroxyalkanoate (PHA) Production: A Path Towards Eco-Friendly Plastics Dr. Fatma Karray, laboratory of Environmental Bioprocesses, Centre of Biotechnology of Sfax, Tunisia (Not presented)</p> <p>OP 2: Genomic Insights into a Sustainable Tunisian Biopesticide based on Bacillus thuringiensis Dr. Raida Zribi Zghal, Biopesticides Laboratory, Centre de Biotechnologie de Sfax, Sfax, Tunisia (Not presented)</p> <p>OP 3: Whole-genome shotgun sequencing of Streptomyces cyaneofuscatus CTM50504 expands understandings of extremozymes: New attractive biochemical properties for the phospholipase D Dr. Sondes Mechri, Lab. of Microbial and Enzymatic Biotechnologies and Biomolecules, LMEBB, Centre of Biotechnology of Sfax (CBS), University of Sfax (USF), Sfax, Tunisia</p> <p>OP 4: High-precision genome sequencing of the chitinolytic Nocardopsis halophila strain TN-X8 by combining long Nanopore and short accurate Illumina reads (Not presented) Dr. Sondes Mechri, Lab. of Microbial and Enzymatic Biotechnologies and Biomolecules, LMEBB, Centre of Biotechnology of Sfax (CBS), University of Sfax (USF), Sfax, Tunisia (Not presented)</p>
15h30 – 16h00	Roundtable Discussion, Refreshment Break
Keynote Session IV : Structural, analytical & physical chemistry Chair/Co-Chairs, K. Plakas, A. El Moll	
16h00 – 17h30	KL 10: Enzyme immobilisation for the removal of xenobiotic compounds from wastewater: a laccase-focused study

	<p>Pr. Susana Rodriguez-Couto, Dept. of Separation Science, Lappeenranta-Lahti University of Technology, LUT, Finland KL 11: Harnessing microalgal capacities for bioremediation of contaminated waters: Insights from ex-situ phycoremediation</p> <p>Dr. Jihen Elleuch, Lab. de Génie Enzymatique et Microbiologie, Ecole Nationale d'Ingénieurs de Sfax, ENIS, Université de Sfax, Sfax, Tunisia KL 12: Analysis of Polychlorinated biphenyl and identification of biphenyl metabolizing microbes in e-waste contaminated soils from Pakistan</p> <p>Dr. Muhammad Zaffar Hashmi, Depart. of Civil and Environmental Engineering, Michigan State University, USA (Not presented)</p>
Training Courses & Workshop: Materials Chemistry and environmental sustainability	
17h30 – 18h30	<p>Workshop/Training Course on Materials Chemistry and environmental sustainability Theme: Carbon Nanotube-Based Electrochemical Biosensors & environmental Applications Session A-: Nanotechnology in Agriculture: Effects of Engineered Nanomaterials (ENPs) on Plants Session B-: Carbon Nanotubes-Based Electrochemical Sensing for monitoring of environmental pollutants Theme: Advanced Nanomaterials for Environmental Applications Session: The potential Role of Nanotechnology in Environmental Applications Theme: Green Chemistry & materials science: towards a sustainable Environment Session: chemical processes, fostering a more sustainable and circular economy. Session: Recent advances in Functional Nanotechnologies for Energy Conversion Session: Nanotechnology and their applications in renewable energy https://cimee-science.org/index.php/2024/12/01/training-courses-workshops-cimee24/</p>
18h30 – 19h00	Chair's Closing Remarks & End of Conference Day One




Day 2: Friday 25 October (GMT + 3)

08h30 – 09h00	Registration
Morning Sessions	
Plenary Session II: Electrochemistry and the Environment , Chair/Co-Chairs: R. Djellabi, A. El Moll, K. Plakas,	
09h00 – 09h30	PL 2 : Cutting-Edge Electrochemical Sensors for Endocrine-Disrupting Chemicals Detection Pr. Najla Fourati , CNAM, Paris, France
Keynote Session V: Nanomaterials and the environmental applications N. Fourati, A. El Moll, K. Plakas,	
09h30 - 11h40	KL 13: Advancing Sustainable Graphene-Based Nanomaterials for Environmental Solutions Pr. Muhammad Akhyar Farrukh , Fac. of Science & Technology, Univ of Central Punjab, Lahore, Pakistan, KL 14: Efficient Hydrogen production with methanolysis on catalysts derived from waste materials Pr. Hilal Demir Kivrak , Eskişehir Osmangazi University, Faculty of Engineering & Architectural Sciences, Eskişehir, Turkey. (Not presented) KL 15: Advancing Sustainable Technologies with Nanofluids Pr. Zafar Said , Depart. of Sustainable and Renewable Energy Engineering (SREE), University of Sharjah, UAE KL 16: Micro- and nanoplastics from sea to spoon: an overview Pr. Giusy Lofrano , Department of Biology, University of Naples Federico II, Italy KL 17: Perspective of the waste water cleaning from PFAS by N-containing mesoporous silica Dr. Oksana Dudarko , Chuiko Institute of Surface Chemistry NAS of Ukraine, Kyiv, Ukraine; Swedish Univ. of Agricultural Sciences, Uppsala, Sweden (Not presented)
11h40 – 12h00	Panel discussion - Break Networking, Photography
12h00 – 13h30	Light Lunch Break, Photography
Afternoon Sessions	
Keynote Session VI : Water resources, AgroHydrology and Sustainable environment , Chair/Co-Chairs: N. Fourati, R. Djellabi, A. El Molls	
13h30 – 14h10	KL 18: Photocatalytic degradation and CO ₂ hydrogenation Pr. Seema Garg , Amity Institute of Applied Sciences, India KL 19: Valorization of research: Perspectives & cases studies Pr. Nadjib Drouiche , Research Director, centre de Recherche en Technologie des Semi-Conducteurs pour l'Energétique, CRTSE, Algiers, Algeria (Not presented) KL 20: Combating Climate Change & environmental degradation: The potential Role of Sustainable technologies solutions Dr. Ahmad El Moll , Faculty of Public Health, Faculty of Science, Doctoral School for Science and Technology, Lebanese University, Lebanon
Oral Session II: Waste valorisation and energy production : Chair/Co-Chairs: N. Fourati, A. El Moll, K. Plakas,	
14h10 - 14h50	OP 5: MoS ₂ tipped Zn _{0.1} Cd _{0.9} S nanorods a ternary dumbbell visible light driven photocatalyst for simultaneous hydrogen production with organics degradation in wastewater Dr. Muhammad Tayyab , Institute of Materials Research, Tsinghua Shenzhen International Graduate School, Tsinghua University, Shenzhen, Guangdong, China (Not presented) OP 6: Production of Aromatic Hydrocarbons from unconventional feedstock Over a metal supported Zeolite Dr. Omvir Singh , Depart. of Science and Humanities, Rajiv Gandhi institute of petroleum technology, Amethi, Uttar Pradesh, India
Oral Session III : Structural, analytical & physical chemistry , Chair/Co-Chairs: N. Fourati, A. El Moll, K. Plakas,	
14h50 – 15h30	OP 7: Effect of humidity on catechol-ozone reactivity: Insights of experimental and theoretical investigations Dr. Emil Obeid , College of Engineering and Technology, American University of the Middle East, Kuwait OP 8 : Valorization of olive mill wastewater for the production of biosurfactant by Pseudomonas luteola Dr. Radia Chemlal , FSB-University of sciences and technology Houari Boumediene, Bab- Ezzouar, Algeria
15h30 – 16h00	Panel discussion - Break Networking, Photography
16h00 – 16h20	Break
Training Courses & Workshops: Electrochemical Biosensors for Agricultural & Environmental sustainability	
16h20 – 17h00	Theme: Remote Sensing technology and its applications in environmental monitoring Session A - Remote sensing techniques for the quantitative monitoring of groundwater Session B - Remote Sensing Technologies and Hydrogeochemistry Theme: Electrochemical Biosensors for Agricultural & Environmental sustainability A - Bioelectrochemical and Ecofriendly technology for sustainable water treatment B - The monitoring and identification of inorganic and organic pollutants Part II - Theme: Agricultural Chemistry & Soil Science Theme: Agriculture technology and Environmental science Session A: Innovation Technology for Sustainable Agriculture and environment Session B: Potential role of technology innovation in sustainable agriculture and environment Theme: Phytochemical Analysis & Natural chemistry https://cimee-science.org/index.php/2024/12/01/training-courses-workshops-cimee24/
17h00– 17h30	Chair's Closing Remarks & End of Conference Day 2

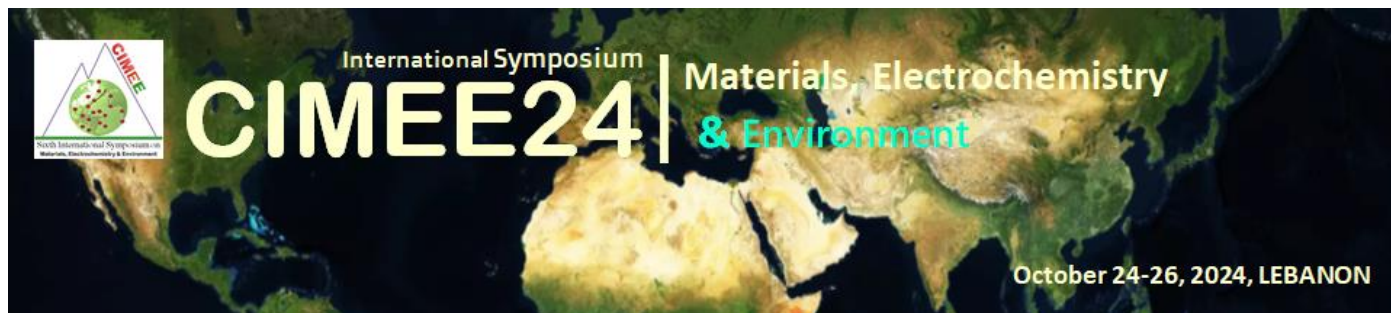

Day 3: Saturday 26 October, Lebanon time (GMT+3)

08h30 – 09h00	Registration
Morning Sessions	
Plenary Session II: Materials, Energy and sustainable Environment, Chair/Co-Chairs: A. El Moll, R. Djellabi	
09h00 – 09h30	PL 3: Talk Title: Dependency on critical raw materials for energy, medicine and biology – how long would they last Pr. M N V Prasad , University of Hyderabad, India
Keynote Session VII: Materials/Biomaterials and the Environment, Chair/Co-Chairs: A. El Moll, R. Djellabi	
09h30 - 10h30	KL 20 : Potential of Clean Energy and Raw Materials: case of Tunisia Pr. Kamel Besbes , Centre for Research on Microelectronics and Nanotechnology, CRMN, Sousse Technopole, Tunisia KL 21: Bioinspired Anode Materials Derived from Nutshells for Improved Microbial Fuel Cell Performance and Bioenergy Generation Pr. Ajit Sharma , Depart. of Chemistry, School of Chemical Engineering and Physical Sciences, Lovely Professional University, Jalandhar, India KL 22: Properties of starch extracted from potato peels Pr. Dalila Hammiche , Faculty of Technology, University Mira- Bejaia, Algeria
Oral Session IV: Biomass, biopesticides and Environment, Chair/Co-Chairs: D. Hammiche, A. El Moll	
10h30 – 11h30	OP 8: Upcycling Chicken Feathers into Organic Amino Acid Fertilizers and Yeast Biomass: A Sustainable Approach for Agricultural and Industrial Applications Soha Serhal , Depart. of Plant Protection, Faculty of Agricultural Engineering, Dekwaneh-Matn, Lebanon OP 9: Assessment of Pesticide Residue Levels in Okra under Various Preservation Methods in Lebanese Markets Nadine Bazzal , Depart. of Plant Protection, Faculty of Agricultural Engineering, Dekwaneh-Matn, Lebanon OP 10: Climate Change Impact on the Production and Physico-Chemical Characterization of Non-Alcoholic Red Grape Juice Concentrates from Cinsault, Cabernet, Syrah & Grenache Varieties Hussein Mtairek , Depart. of Plant Protection, Faculty of Agricultural Engineering, Dekwaneh-Matn, Lebanon
11h30 – 11h45	Panel Discussion
11h45 – 12h30	Lunch Break – Networking, Photography
Afternoon Sessions	
Keynote Session VIII: Waste valorization and Hydrogen production, A. El Moll, R. Djellabi	
12h30 – 13h10	KL 22: Management of plastic waste through pyrolysis: the potential environmental and economic benefits Dr. Bablu Alawa , Dr. Chakma Sankar, Indian Institute of Science Education and Research, India. KL 23: Biofueling of Castor Plant Wastes using biological & thermal methods Dr. Gawel Sołowski , Depart. of Molecular Biology & Genetics, Faculty of Science & Art, Bingol University, Turkey
Keynote Session IX: Clean energy and sustainable materials: Chair/Co-Chairs: N. Fourati, A. El Moll	
13h10 – 13h45	KL 24: Fabrication and Characterization of TiO ₂ -ABS Composite Filaments for 3D Printing: Structural Analysis and Evaluation of Antibacterial Properties Pr. Mirela Suche , Center of Materials Technology and Photonics, Hellenic Mediterranean University, 71410, Heraklion, Crete, Greece (A.B.) KL 25: Clean energy technologies: from critical raw materials, CRM, supply to contribution to a sustainable energy transition Assoc. Pr. El Moll Ahmad , Faculty of Public Health, Faculty of Science, DSST, Lebanese University, Lebanon
13h45 – 14h00	Panel Discussions
14h00 – 14h20	Refreshments - Break Networking
Oral Session V: Materials chemistry and sustainable Environment Chair/Co-Chairs: D. Hammiche, A. El Moll	
14h20 – 15h00	OP 11 : Advanced Strategies for Azo Dye Removal in Wastewater: A Comparative Review of Biological, Chemical, and Physical Degradation Methods Dr. Barkha Sharma , Research Scholar, SBAS, K R Mangalam University, Gurugram, India (Not presented) OP 12 : Bio-based materials as adsorbents for glyphosate removal in contaminated waters. Dr. Sonia Jemli , Laboratory of Microbial Biotechnology and Enzymes Engineering, Centre of Biotechnology of Sfax, University of Sfax, Tunisia
Training Courses & Workshops: Analytical chemistry, Nanotechnology & environmental Applications.	
15h40 – 16h30	Theme: Green technologies and Environmental Sustainability: the potential Role of aquatic plant Theme: Analytical chemistry, Nanotechnology & environmental Applications Session 1: Analytical chemistry & green Nanotechnology: the potential applications in the Environment Theme: Atmospheric Pollution, Air Quality and Aerosol Chemistry Session 1: Anthropogenic Air Pollution Sources: climatic factor and health risk in the Mediterranean region Session 2: Climate change and anthropogenic pressure: the impact on the regional air quality. Session 3: Emissions from Solid waste and wastewater: the impact on air pollution & climate change Theme: Trace elements in the atmospheric aerosols: the potential role of analytical techniques. https://cimee-science.org/index.php/2024/12/01/training-courses-workshops-cimee24/
Closing session, recommendations and Perspectives and brainstorming, Publications in partner journals	



CIMEE ²⁰²⁴ 6TH EDITION OF CIMEE CONFERENCE On MATERIALS ELECTROCHEMISTRY & ENVIRONMENT





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COMMITTEES

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CIMEE24 OFFICIAL OPENING CEREMONY

Official Opening Ceremony: Lebanese National Anthem and LU anthem

Opening plenary session & welcome Speech from the Conference Chair, **Assoc. Prof. Ahmad El Moll**, Lebanese university, Lebanon

Opening Ceremony

An opening ceremony was held on the first day of the conference. In this session, all participants of the sixth edition of the international symposium were welcomed and the 3-day program was officially opened.

The program started with the national anthem of Lebanon and the Lebanese University

Opening Ceremony, - Thursday 24 October 2024

OPENING SESSION



To our esteemed guests, all participants, ladies and gentlemen – A warm welcome!

I am delighted to welcome you all to this eagerly awaited conference, as it is the 6th annual meeting of the CIMEE Group and it is a great pleasure for me to stand here before you all. Before we begin the conference, I would like to thank all of you who have sincerely contributed to making this event a success. It would not have been possible without the support of each and every one of you here today.

In today's conference, we will address the serious events that have recently occurred in different regions of the world, affecting all people on all continents. Scientifically speaking, the concept of ecological solidarity means a vital interdependence of living beings within the biosphere that are related to each other.

In addition to the pressure that agriculture and urbanization exert on the environment and the pressure on land resources, there is the environmental damage caused by war in 2 areas of the planet:

First, the environmental damage caused by war in Eastern Europe and Western Asia. The great loss of agricultural land, forests, the destruction of fuel depots and the severe pollution of air, water and soil. The consequences of this damage can last for generations.

Second, the conflict in the Middle East and the scorched Earth strategy have caused environmental devastation, 17 million square meters of land have been damaged, which constitutes ecocide (environmental genocide). This severe, permanent and irreversible environmental damage has an impact not only on ecosystems but also on human health, beyond the conflict zone and long after the conflict has ended.

Therefore, the environmental impacts of this conflict affect us all and require comprehensive interdisciplinary cooperation across borders or/and without borders. Given the tremendous depletion of natural resources in the 2 regions of the planet, the proposed solutions to save and conserve resources are the implementation of green chemistry technologies using chemical expertise and knowledge. The great ambition is to work together to achieve these common goals.

Dear colleagues, on the first day of our conference, we have an opening session, 4 keynote sessions and an oral session with more than 20 participants from 12 countries. The high quality of the conference papers and the value of the topics presented at the conference go a long way in promoting collaboration and stimulating further research. In this way, further to producing conference proceedings we will publish the best papers in the partner journals.

We would like to take this opportunity to express our sincere gratitude to the members of the technical program committee and the reviewers. Without their dedication and hard work, the preparation of this excellent program would not have been possible.

We hope you will enjoy the technical program and look forward to meeting you virtually at CIMEE'24.

I would like to thank the organizers and all the participants! Thank you for your attention!

El Moll Ahmad, Lebanon

Conference chair

Day 1- Thursday 24 October 2024



Day 1- Thursday 24 October 2024

Opening keynote Session



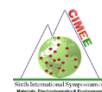
CERTH
CENTRE FOR
RESEARCH & TECHNOLOGY
HELLAS

Associate Researcher, Dr. Konstantinos Plakas,
Centre for Research and Technology - Hellas
(CERTH), Chemical Process and Energy Resources
Institute (CPERI), Thessaloniki, Greece

OPENING KEYNOTE LECTURE

Dr. Konstantinos V. Plakas, Chem. Eng., PhD, is an Associate Researcher at the Centre for Research and Technology, Hellas (CERTH) and Director of the Natural Resources and Renewable Energies Laboratory (NRRE) of the Chemical Process and Energy Resources Institute (CPERI/CERTH). Over the last 20 years, he has been involved in numerous R&D projects funded by the European Commission, the chemical industry and other national funding agencies. These have involved R&D topics related to the treatment of drinking and industrial water by membrane processes and advanced oxidation processes. His expertise includes the recovery of water and materials from wastewater by membrane processes, the removal of natural synthetic and organic pollutants, integrated and hybrid membrane processes (e.g. e-Fenton and photocatalytic membrane reactors), desalination (by membrane-based processes such as reverse osmosis, electrodialysis and capacitive deionization) and the upgrading of agro-industrial wastewater for recycling/reuse of water and recovery of valuable materials. As part of his research activities, he has published 37 peer-reviewed scientific papers, 5 book chapters, 2 patents and more than 90 papers in international and national conference/workshop proceedings.

Dr. Plakas' keynote lecture deals with the pollution of groundwater by nitrates, the state-of-the-art in nitrate removal (e.g. reverse osmosis, anion exchange resins) and the competitive properties of the emerging selective electrodialysis (SED) process which allows the selective removal of monovalent ions (nitrates, chlorides) while retaining the useful divalent ions (Ca^{2+} ; Mg^{2+} ; SO_4^{4-}) in the final product (drinking water). Special mention is made of the AQUASOLE system, which was developed as part of a national research project and consists of an integrated and energy-autonomous SED system linked to photovoltaic (PV) panels for the treatment of nitrate-rich groundwater. Preliminary results of pilot tests carried out in an operational environment will be presented as well as the theoretical design of a renewable ED system supported by PV and batteries (BAT). The latter is addressed for the first time through a systematic framework that combines multi-objective optimization (MOO) with nonlinear sensitivity analysis to evaluate system operation under variability.



Advanced denitrification of ground water by a low cost photovoltaic by electro dialysis system

Konstantinos V. Plakas¹, A. Voutetaki^{1,2}, P. Seferlis², A.I. Papadopoulos¹

¹ Centre for Research and Technology - Hellas CERTH, Thessaloniki, Greece

² Department of Mechanical Engineering, Aristotle University of Thessaloniki, Thessaloniki, Greece

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Thematic Area: Electrochemistry & the Environment

Abstract

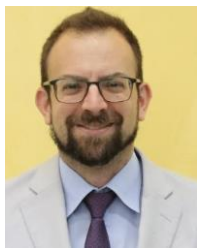
In many parts of the world, groundwater is the main source of drinking water, especially in areas with limited or polluted surface water sources. Groundwater contamination by nitrates from diffuse (e.g. extensive use of synthetic and organic nitrogen fertilizers) and point sources (e.g. concentrated livestock production, leaking septic or wastewater systems, and areas where chemicals or manure are stored) can have a direct impact on human health, as excessive nitrate (NO_3^-) levels in drinking water can have negative health effects on human well-being. To combat nitrate contamination in groundwater, there are various treatment methods to reduce the nitrate concentration before the water is used as drinking water. The most common are ion exchange (IEX), reverse osmosis (RO) and electro dialysis (ED). An alternative to RO and ED is selective electro dialysis (SED), a variant of electro dialysis (ED), which is proving to be more promising when it comes to meeting the drinking and irrigation water needs of rural communities. The main advantages of SED are: a) monovalent SED removes monovalent ions (Na^+ ; Cl^-), which are harmful to plants, while divalent ions (Ca^{2+} ; Mg^{2+}), which are useful as drinking water, remain in the desalinated water. This selective removal reduces the need for fertilizers, the addition of hardness and the associated costs. b) SED can achieve nearly 100% water recovery for brackish water solutions, as both products – diluate and concentrate – can be used for drinking and irrigation purposes respectively, increasing water savings and minimizing the volume of brine to be disposed of. c) The average lifetime of SED membranes exceeds that of RO membranes by 2–3 years as they are chemically and mechanically more stable; this could bring long-term economic benefits. d) There is less membrane fouling or scaling with SED than with RO due to process reversal (in the case of electro dialysis reversal). e) Specific energy consumption is much lower than with RO or IEX and SED can be easily combined with renewable energy due to the direct use of electricity for ion separation. The research conducted by the authors to develop and optimize an integrated SED system with photovoltaics (PV) and batteries (BAT) focusing on nitrate ion removal is described in this keynote lecture. Particular attention is given to the related laboratory-scale experimental work and modeling of the process through a systematic framework that combines multi-objective optimization (MOO) with nonlinear sensitivity analysis to evaluate system operation under variability. Ongoing research also includes the fabrication of novel monovalent selective cation exchange membranes (CEMs) with properties specifically tuned to the target ions and the operation of a pilot SED/PV/BAT plant with a treatment capacity of 16 m³/d under realistic operating conditions (treatment of a real borehole water in the municipality of Liti, near Thessaloniki)

Keywords: groundwater, nitrate pollution, electro dialysis, selective cation-exchange membranes, photovoltaic, process design, sensitivity analysis, pilot tests

Acknowledgements: This research was carried out as part of the project «AQUASOLE» (Project code: KMP6-0083181) under the framework of the Action «Investment Plans of Innovation» of the Operational Program «Central Macedonia 2014 2020», that is co-funded by the European Regional Development Fund and Greece.

KEYNOTE SESSION I:

Keynote Session I: Waste & Biomass valorization, Chair/Co-chairs A. El Moll, K. Plakas



Rafael Luque, Chemistry, Professor at King Saud University, Riyadh, Saudi Arabia

Research focus: biomass/waste valorization, nanoscale chemistry, heterogeneous catalysts

Rafael is a member of the Editorial Board of prestigious journals including Chemical Society Reviews (RSC), Catalysis Communications (Elsevier) and Sustainable Chemical Processes (Chemistry Central) as well as Editor-in-Chief of the Porous section of the journal Materials and Series Editor of Topics in Current Chemistry (Springer).

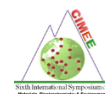
Reduces pressure on the planet's resources and combats climate change.

Waste to wealth to transform Waste into a valuable resource. From recycling to innovative technologies. This presentation explores the various ways in which we can turn waste into wealth, promoting sustainable practices and economic growth. By embracing innovative technologies, we can transform waste into valuable resources and mitigate the depletion of natural resources.



R. Vinu, Professor at the Depart, of Chemical Engineering, Indian Institute of Technology Madras, Chennai, India

Lignin valorization is underexploited, an attractive opportunity is the selective depolymerization of lignin into chemicals. To provide an overview of different approaches to address adverse structural alterations of lignin at an early stage of the biorefining process, thus enabling efficient pathways to lignin-derived chemicals. The obtained lignin-derived compounds can serve as a platform for a wide range of bio-based products. Their implementation will improve the sustainability of the chemical industry, but it will also generate opportunities for product innovation based on unique bio-based chemical structures.



The waste-to-wealth concept: advanced solutions for a more sustainable future

Rafael Luque¹

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²Universidad ECOTEC, Km 13.5 Samborondon, Samborondon, EC092302, Ecuador

* Corresponding author E-mail rluque@ecotec.edu.ec

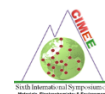
Thematic Area: Waste valorization and environmental remediation

Abstract

Society urgently needs to cope with increasing energy demands, extensive pollution concerns and most importantly resource scarcity (water, food) already predicted for the years to come. In order to become a more sustainable society, scientists have to embrace such urgent challenges in the 21st Century, coming up with suitable alternatives for the betterment of humankind. Waste valorization, going well beyond traditional waste management practices, has the potential to become an alternative for the harvesting of valuable compounds (chemicals, materials, fuels, energy carriers), generating wealth from biowaste, circumventing at the same time environmental hazards and concerns such waste feedstocks have inherently associated.

This contribution is aimed to frame the waste-to-wealth concept as illustrated in a number of (bio)waste valorization examples from sewage sludge to coffee waste grounds, plastic waste and related others as effective sources of valuable chemicals, biomaterials and biofuels.

Keywords: waste valorization, green chemistry, sustainability, flow chemistry, environmental remediation



Catalytic Lignin Valorization to Monomeric Phenols & High Value Chemicals

R. Vinu¹

¹Department of Chemical Engineering, Indian Institute of Technology Madras, Chennai 600036, India

* Corresponding author E-mail vinu@iitm.ac.in, vinu@smail.iitm.ac.in

Thematic Area: Bio-green-energy science, Waste treatment & technology

Abstract

Lignin is a three-dimensional, amorphous, polyphenolic and aromatic-rich material, and is a primary recalcitrant molecule in lignocellulosic biomass. Unlocking valuable chemicals and fuel molecules from lignin requires the cleavage of typical inter-unit linkages like β -O-4, α -O-4 and 4-O-5 in a selective manner. This presentation will focus on catalytic hydrogenolysis process to selectively convert lignin to high value C6-C9 monomeric phenols like guaiacols, alkyl guaiacols and guaiacyl alcohols. Over the years, we have developed a range of novel Pd-metal oxides (Al, Zr, Mo, and W)-supported activated bio-char (ABC) catalysts for depolymerization of lignin to propyl guaiacol. High selectivity to alkyl guaiacols was observed with Pd-Al/ABC, while the presence of W and Mo inhibited the hydrogenation of the aliphatic $C_{\alpha}=C_{\beta}$ bond. At the optimum condition, high selectivity to 4-propyl guaiacol (38%) was observed with Pd-Al/ABC. The addition of transition metals to Pd altered the chemoselective hydrogenation ($C_{\alpha}=C_{\beta}$) and dehydroxylation (C_{γ} -OH) of C9 monomeric guaiacols. Based on quantum chemical calculations, the hydrogenation of $C_{\alpha}=C_{\beta}$ is shown to be catalyzed by the Pd^0 active site, while the dehydroxylation of C_{γ} -OH is catalyzed by the transition metal. The use of these catalysts for catalytic transfer hydrogenolysis of lignin using hydrogen donor co-solvents will also be discussed. Our recent works are focused on deriving C9 phenols directly from biomass using reductive catalytic fractionation (RCF) process, which is a one-pot "lignin-first" approach. We have demonstrated selective recovery of propyl guaiacol with high retention of the carbohydrates from pine wood biomass using a range of (Ni, Ru, Pd, Pt)/activated carbon catalysts. Interesting results in this direction will also be discussed.

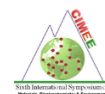
Keywords: Lignin, reductive catalytic fractionation, hydrogenolysis, activated carbon, mechanism.

References: Gurralla et al., *Fuel* **308** (2022) 121818. Gurralla et al., *Bioresource Technology* **344** (2022) 126204. Kumar et al., *Molecular Catalysis* **530** (2022) 112532. Prabhudesai et al., *Sustainable Energy and Fuels* **7** (2023) 2117.

KEYNOTE SESSION II:

Waste management and Circular Economy,

Chair/Co-Chairs: K. Plakas, A. El Moll



Green transition in wastewater treatment plants - challenges and opportunities

Marzena Smol

¹Mineral and Energy Economy Research Institute of the Polish Academy of Sciences, Cracow, Poland

* Corresponding author E-mail smol@meeri.pl

Thematic Area: Materials and the Environment

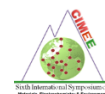
Abstract

Green Deal (GD) concept is based on sustainable development (SD) principles, that underline necessity for integration of economic, social and environmental aspects in any human activity, as a way to green economy. In Europe, GD has been indicated in general strategy for economic development in 2019, as the European Green Deal. It aims to achieve climate neutrality on continent until 2025. To achieve this ambitious goal it is necessary to take appropriate actions in various sectors, including water and waste water sector. This paper presents comprehensive analysis of initiatives taken by operators of wastewater treatment plants (WWTPs) in green transition process. WWTPs show several opportunities to be “resources hubs” or “WWTPs of the future”, as recovery of raw materials, energy or water. Scope of paper include detailed analysis of various aspects of economic activity: political and law, socioeconomic, technological and environmental. An initial result has been discussed with group of experts to verify proposed driving forces and obstacles for further greening of WWTPs. The main driving forces are supportive European policy, legal recommendations in the area of water, raw materials and energy recovery, eco-trends and society's pressure on resource protection, several financial opportunities (including Horizon Europe programme) for investments in green and circular solutions. The key barriers include unharmonized legal regulations in various European countries regarding, lack of own resources for new investments and operation, inadequate competences in the area of green management and circular technologies. Our results could be significant for further development of sustainable and circular business models in WWTPs, to support strategic management process. Further research is needed and strong collaboration with WWTP's operators to understand their needs and possible pathways to change.

Keywords: green transition, circular economy; water; wastewater; wastewater treatment plant

Acknowledgements: Paper prepared as a part of Subvention of Mineral and Energy Economy Research Institute PAS. Part of research conducted under project “Closing local water circuits by recirculation nutrients and water and using them in nature” (ReNutriWater) financed by European Regional Development Fund (ERDF), project no. #C016 (Interreg Baltic Sea Region).





Sustainable passive solar seawater desalination: concepts and system configurations

Ridha Djellabi

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Depart of Chemistry, Alfaisal University, Al Maather, Al Takhassusi Road, Riyadh, Saudi Arabia

* Corresponding author E-mail ridha.djellabi@yahoo.com

Thematic Area: Environmental Chemistry, Geochemistry & Earth Materials

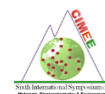
Abstract

Water is the most important element in our planet for humankind's survival [1]. The World Bank group reported that about 1.6 billion people living in remote areas will not access to clean water by 2030 which make their live in danger. Design of easy-doable processes for water treatment and desalination has been the core of wide research and technological investigation over the last decades. Solar driven photothermal process, so-called solar-to-steam generation (SSG), has received a lot of attention to be used for seawater desalination. It is based, similar but accelerated to the natural hydrologic cycle [2], on the heating of surface water using light-to-heat photothermal materials to boost the evaporation of water into steam to be condensed into fresh water [3]. SSG suffers from several technology issues which face its real-world application [4]. The most challenging issue is the salt rejection and the stability of the materials in seawater conditions. This talk aims to discuss the fundamentals of SSG technology and most of research advances to solve or/and overcome the technology issues and process intensification.

Keywords: Solar-to-steam generation; Solar sweater desalination; Energy transition; Circular economy.

References

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Sustainable Agri-food industrial Sewage sludge management and Circular Economy

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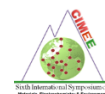
Thematic Area: Waste management, biochar, biofuels, sewage sludge, circular economy

Abstract

Agri-food processing industries consume large quantities of water for their industrial processes (cleaning, processing, treatment, packaging, etc.), and are therefore produce large quantities of industrial effluents. Wastewater treatment in agri-food sector generates industrial residual sludge, which composition is very heterogeneous and largely dependent on the upstream industrial process and the incoming effluents. Agrifood sewage sludge are pre-dried onsite (in the form of "sludge cakes") and then transferred for landfilling. Among environmentally friendly and sustainable utilization of sludge cakes, their thermochemical conversion into carbonaceous materials (chars) useful for several environmental and energetic applications (fertilizer, bio-adsorbent, combustible) is an adequate solution that can help agri-food industrials to move into sustainable waste management with circular root. First, this study focuses on the effects of pyrolysis technology on the production of biochar that can be used as a soil fertilizer. Thus, slow pyrolysis tests were carried out in a fixed-bed reactor, varying the final temperature from 300, 400, 500 and 600°C with a heating rate of 10°C/min and a residence time of 60 min. The lowest pyrolysis temperature (300°C) gave the highest biochar yield (80%). The characteristics of the produced biochars and their richness in carbon and mineral elements, make it ideal for use as a fertilizer and as a soil carbon sequestration tool. Produced biochars could be returned to the soil as part of the bio-geochemical cycle. The experimental study was completed by an economic assessment study which revealed the economic gain of converting "sludge cakes" into biochars, and the long-term interest of improving the economic balance while helping to reduce the industry's carbon footprint.

Keywords: Agrifood sludge, pyrolysis, biochar, circular economy

Acknowledgements: This work was supported and funded by the Ministry of Higher Education and Scientific Research (MESRST) in Tunisia.



Circular economy and waste management in the Mediterranean region: From innovation to upscaling

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Not presented

Thematic Area: Waste valorization & sustainable environment

Abstract

The 21 countries bordering the Mediterranean and 529 million peoples with over 70 percent of the population living in urban areas., Therefore, this growth of Mediterranean cities is closely linked to an exacerbated pressure on natural resources and energy, thus leading to an increase in the production of waste and coastal pollution. The waste generation spans all communities, from large megacities to small towns and villages in the Mediterranean. In almost all cases, communities are the primary decision-makers in local waste management. Indeed, the discharge of raw wastewater and the accumulation of plastic waste as well as the large number of landfills of municipal waste in coastal cities make the Mediterranean Sea the most polluted sea in the world. Developing new strategies to convert waste into valuable materials using sustainable technology is become needed, this affects different sectors; for example, plastics waste valorization and household waste as well as sewage sludge management which requires significant costs, both in economic and environmental terms. Given this situation, this paper aims to compile the latest research on the topics of waste valorization in the context of circular economy and sustainable development at local, national and regional levels. Concretely, this paper examines the measures involved in the development of a circular economy, CE Settings for upscaling at the Mediterranean basin level. However, many eco-innovated technologies exposed: Nature-based solutions for waste treatment and composting/co-composting of organic and human waste. Restoring value to plastics via pyrolysis as a relevant solution. Recycling organic waste into soil amendments and more sustainable circular waste management in the Mediterranean area. Moreover, encourages CE development measures and contribute to the adoption and diffusion of CE within s all communities are an essential part of the strategy. These sustainable technological innovations piloted during a local project selected according to their potential viability for scaling up will be described as well as the different parameters necessary to enable scaling up in terms of capacity and space. Finally, energetic valorization of organic matter, composting and effective selective sorting for waste solutions as case study in Algeria and Lebanon will be discussed.

Keywords: Eco-innovative technology, wastewater, plastics waste, landfill, circular economy, settings for upscaling

KEYNOTE SESSION III:

Keynote Session III A:

Natural Product Chemistry, Toxicity Assessment and potential applications, Chair/Co-Chairs: K. Plakas, A. El Moll

Evaluation of the neurobiological effect of natural phenolics from in vitro, in silico, and in vivo perspectives

Pr. Ilkay Erdogan Orhan, Dean at Lokman Hekim University, Faculty of Pharmacy, Ankara, Turkey

Keynote Session III B:

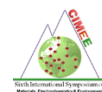
Structural, analytical & physical chemistry Chair/Co-Chairs: K. Plakas, A. ElMoll

Exploration of metallic iron in dust from ventilation system using Mössbauer spectrometry, synchrotron radiation and magnetic methods

Pr. Tadeusz Szumiata, Casimir Pulaski Radom University, Poland

Sustainable technologies: the promising role in combating the effects of climate change and environmental degradation

Pr. El Moll Ahmad, Faculty of Public Health, Faculty of Science, DSST, Lebanese University, Lebanon



Evaluation of the Neurobiological Effects of Natural Phenolics from In Vitro, In Silico, and In Vivo Perspectives

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Thematic Area: Natural Product Chemistry, Toxicity Assessment and potential applications

Abstract

Plant phenolics have always been of great interest in pharmacognostic research due to their significant pharmacological effects. They have demonstrated neuroprotective properties through various molecular and pathological mechanisms. Since the 2000s, our ongoing research has reported numerous coumarins, flavonoids, terpenoids, and other compounds with promising neurobiological effects, particularly against Alzheimer's disease (AD). We tested the potential neuroprotective effects of thirty-seven selected phenolic compounds using a combination of in vitro, in vivo, in silico, and molecular methods. Their inhibitory effects on cholinesterase (ChE) and β -secretase 1 (BACE1), as well as their antioxidant activity, were evaluated using microtiter assays. Our findings led us to further examine rosmarinic acid, gallic acid, and 3-hydroxytyrosol for their anti-amnesic activity through passive avoidance tests in scopolamine-induced mice, novel object recognition tests (NOR), novel tank diving tests (NTT), and Y-maze test models in zebrafish (*Danio rerio*). The active ChE inhibitors underwent molecular docking simulations, and the *in silico* toxicity of the selected active compounds was assessed. Some inhibitory compounds were tested on genes associated with AD using a human neuroblastoma (SH-SY5Y) cell line. The anti-aging effects of the selected phenolics were also evaluated using *Drosophila melanogaster* (fruit fly) strains. In this talk, the latest findings from our team on the neurobiological potential of selected plant phenolics will be discussed.

Keywords: Plant phenolics, neuroprotection, enzyme inhibition, passive avoidance test, zebrafish

Acknowledgements: The author would like to thank for the financial support delivered by the Scientific Research Project Unit of Gazi University (Ankara, Türkiye) for this research under grant number 02/2019-31. The huge contribution of the project team and collaborators consisting of Tugba Ucar Akyürek, F. Sezer Senol Deniz, Ipek Süntar, Gokcen Eren, Mürşide Ayşe Demirel, Esra Emerce, Alaattin Şen, Güzin Emecen, and Lucian Hritcu is also acknowledged. IEO extends her appreciation to the Turkish Academy of Sciences (TÜBA) for providing partial financial support for this work.



Exploration of metallic iron in dust from ventilation system using Mössbauer spectrometry, synchrotron radiation and magnetic methods

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Thematic Area: T3. Atmospheric Chemistry & Environmental Pollution

Abstract

In this work, the evidence of metallic iron in ventilation system dust has been performed. The presence of metallic iron can be regarded as an indicator of anthropogenic and technogenic "fresh activity" - contrary to the case of environmental samples from postindustrial regions [1,2]. Numerous experimental techniques have been applied for the characterization of the samples (raw ones and magnetic separates): transmission Mössbauer spectrometry, SEM-EDS, XRF-WDS, TEM, XRD, magnetometry and synchrotron XAS – NEXAFS. In the Mössbauer spectra, several phases – typical for environmental dust – were identified, like hematite, magnetite and aluminosilicates with Fe³⁺ and Fe²⁺ sites [1,2]. However, two other sub spectra could be assigned to the metallic iron as well as to the metallic α -Fe and iron carbides from steel. This could be a natural consequence of the fact that the ventilation system operated in the vehicle diagnostic laboratory hall (in the Faculty of Transport, Electrical Engineering and Computer Science at Radom University, Poland). Unfortunately, clear and direct interpretation was not possible, because the corresponding subspectra were very smeared – possibly due to the small size of the strongly defected grains. Such explanation was confirmed by the results of thermomagnetic measurements – especially owing to hysteresis loops decomposition procedure. The synchrotron radiation absorption experiment (XAS–NEXAFS) confirmed undoubtedly the presence of metallic iron.

Keywords: dust, ventilation system, Mössbauer spectrometry, synchrotron radiation, magnetic methods

Acknowledgements: Thanks to: S. Olszowski, A. Bocho-Janiszewska, E. Rogoś, R. Idczak, M. Witkowski, J. Szczytko and M. Zajęc for the common work.

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Sustainable technologies: the promising role in combating the effects of climate change and environmental degradation

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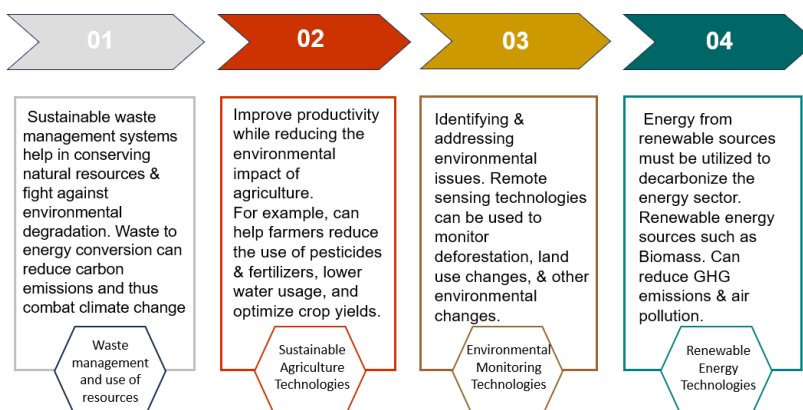
Thematic Area: Environmental monitoring, Environmental chemistry & renewable energy

Abstract

The triple global crisis that humanity is currently facing: climate change, nature loss and pollution and waste, require addressing these environmental challenges and finding solutions on a global scale. As humanity suffers from the practical consequences of climate change on a global scale, the role of technology is paramount in providing innovative solutions, mitigating environmental degradation, and preserving natural resources. In this context, technology plays a multifaceted role, serving to achieve a radical change in the energy, agriculture, and industry sectors. From reduce global emissions and even manage waste and reducing pollution, supporting environmental monitoring, renewable energy technology that helps to reduce environmental and carbon footprint, to industrial carbon capture and storage. Moreover, advanced technology provides innovative solutions to reverse environmental degradation. It enables ecosystem monitoring and assessment and informed conservation strategies. Advanced sensors and satellite imaging technologies, for example, facilitate the collection of real-time data on environmental pollution. In addition, technology promotes sustainable resource management practices by optimizing resource use, reducing waste, and promoting circular economy principles.

In this perspective, research efforts are needed to shed light on the all problems of climate change and present new environmental technologies solutions via this call for papers CIMEE24 regular and special sessions, from reduce global emissions and even manage waste and reducing pollution, supporting environmental monitoring, renewable energy technology that helps to reduce environmental and carbon footprint, to industrial carbon capture and storage.

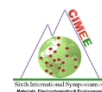
Keywords: pollution and waste management, sustainable agriculture technologies, environmental monitoring, natural resource, circular economy, biomass, Carbon Capture and Storage, renewable energy.



Graphical abstract: Innovative technology approach to tackle triple planetary crisis

ORAL SESSION I:

Biotechnology, Biopesticide and environmental sustainability,
Ilkay Erdogan Orhan, Ridha Djellabi



Harnessing Halophilic Microbiomes for Sustainable Polyhydroxyalkanoate (PHA) Production: A Path Towards Eco-Friendly Plastics

Fatma Karray¹, Jihen El Ghazel^{1&2}, Finya Meyer², Aichatou Baty¹, Najla Mhiril¹, Steffani Diaz Valerio², Dominik Schneider², Heiko Liseganag², and Slim Tounsi³

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(Not presented)

Thematic Area: Structural, Analytical & Physical Chemistry

Abstract

The massive use of non-degradable plastics in our daily lives represents a serious threat to human health, wildlife, and terrestrial and marine habitats. Polyhydroxyalkanoates (PHAs) are biodegradable and biocompatible polymers that have been promoted as an alternative to conventional petroleum-based plastics. Compared to other extremophiles, halophilic microorganisms are considered cellular factories to produce PHAs which will be applied in different fields such as health, agriculture, and packaging. Our study aimed to study the microbiome of the Tunisian hypersaline ecosystem to prospect PHAs producing halophilic using metagenomics and genomics approaches. Sediment and brine samples were collected from Tunisian hypersaline ecosystems (solar salt, Chotts). Extraction of environmental DNA from samples was carried out. The advent of metagenomics and the recent advancement of next-generation sequencing tools have made it feasible to investigate the microflora of an ecosystem, its interactions, and its functions. Target gene and shotgun metagenomic sequencing approaches are employed for hypersaline microbial community analyses. *In silico* screening of hypersaline metagenomes allows the mapping of the total microbial biodiversity and the selection of many promising gene candidates producing PHA.

Keywords: Bioplastic, Halophilic, Hypersaline Lake, Metagenome, Polyhydroxyalkanoate

Acknowledgements: This work was supported by grants from the European Union's Horizon Europe Research and Innovation program under Grant Agreement N° 101079425



Genomic Insights into a Sustainable Tunisian Biopesticide based on *Bacillus thuringiensis*

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Thematic Area: T4. Physical Chemistry – Biotechnology & phytochemical analysis

Abstract

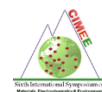
Disease vectors are responsible for more than 17% of infectious human diseases. More than 40% of losses in global agriculture each year are caused by plant pests, putting food production at risk (FAO, 2020). At the heart of this confrontation between human health and food security, an ecological protagonist emerges, *Bacillus thuringiensis* (Bt). However, the application of *Bacillus thuringiensis israelensis* (Bti) is limited by several factors, notably its high cost. To address this issue, we are working on the development of a Tunisian biopesticide derived from a locally sourced strain that is both effective and economical (Zghal et al., 2018). To ensure the safety and efficacy of this strain, we utilized advanced genomic techniques, including whole-genome sequencing. This approach allows us to compare our local strain with a reference strain, providing valuable insights into its genetic makeup and potential environmental impact. Through this research, we aim to create a sustainable and cost-effective biopesticide solution tailored to local agricultural needs.

Keywords: *Bacillus thuringiensis*, Bacteria genome visualization, Biopesticide production, Whole genome sequencing.

Acknowledgements: This work was supported by grants from the European Union's Horizon Europe Research and Innovation program under Grant Agreement N° 101079425;

References:

Raida Zribi Zghal, Marwa Kharrat, Ahmed Rebai, Saoussen Ben Khedher, Wafa Jallouli, Jihen Elleuch, Carole Ginibre, Fabrice Chandre, Slim Tounsi, (2018), Optimization of bio-insecticide production by Tunisian *Bacillus thuringiensis israelensis* and its application in the field. *Biological Control*, 124, 46-52, ISSN 1049-9644, <https://doi.org/10.1016/j.biocontrol.2018.06.002>.



Whole-genome shotgun sequencing of *Streptomyces cyaneofuscatus* CTM50504 expands understandings of extremozymes: New attractive biochemical properties for the phospholipase D

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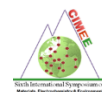
Thematic Area: T5: Agro Geoenvionnment, Agrochemistry & Biogeochemistry

Abstract

Even though extremophiles and their associated enzymes are useful in industrial applications, comprehensive studies on their genomic adaptations are lacking. Next-generation sequencing (NGS) methods quantify the functionality and dynamics of microorganisms in their biotopes. The enormous volume of data NGS produces necessitates understanding structural and functional genomics through omics techniques. *Streptomyces cyaneofuscatus* strain CTM50504 is a potential extracellular hydrolase producer, isolated from a terrestrial hot spring in Korbous (Nabeul, Tunisia). This strain can grow at 50 °C and a pH range of 6-9. It requires the presence of sodium chloride for growth and secretes lipases, phospholipases (PL), proteases, amylases, and chitinases. The whole-genome shotgun sequence (WGS) analysis was performed on strain CTM50504 to identify protein-encoding genes, including hydrolases. The genome sequence was assembled into 1,252 contigs with an average G+C content of 71% and a total length of 8,591,922 bp. Genome annotation revealed 770 protein-coding enzymes with 323 open reading frames (ORFs) encoding for hydrolases, including 10 phospholipases (A2, C, lyso, and D), 20 TG-lipases, 179 proteases, 5 amylases, and 5 chitinases. The assembly of WGS was deposited in the DDBJ/ENA/GenBank databases under the sequence read archive accession number PRJNA1065629. This study is the first to target the hydrolase repertoire of a *Streptomyces cyaneofuscatus* strain, providing insight into the tremendous biotechnological potential of the enzymes identified. A novel phospholipase D (*ScpID*) gene from the strain CTM50504, encoding a polypeptide of 416 residues, was synthesized, cloned, and successfully expressed in *E. coli* BL21 (DE3)pLysS. The purified recombinant enzyme (rScPLD) has a monomeric structure of 50 kDa. The rScPLD activity and thermostability were shown to be significantly dependent on the Ca²⁺. These data constitute a pivotal first step toward the creation of new efficient extremozymes with enhanced catalytic properties and high potential for biotechnological and industrial uses.

Keywords: Annotation, Assembly, Extremophiles, Hydrolases, Illumina, Whole-Genome Sequence.

Acknowledgements: This work was conducted within the HORIZON EUROPE, HORIZON-Coordination and Support Action (CSA), HORIZON-WIDERA-2021-ACCESS-03-01, Twinning Project NGS-4-ECOPROD



High-precision genome sequencing of the chitinolytic *Nocardiopsis halophila* strain TN-X8 by combining long Nanopore and short accurate Illumina reads

Sondes Mechri^{1-3*}, Imen Rekik¹, Severine Croze², Alexandre Noiriel³, Abdelkarim Abousalham³, Slim Tounsi¹, Joel Lachuer^{2*}, Saloua Sadok^{4*}, Bassem Jaouadi^{1*}

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³Univ Lyon, UCBL, Institut de Chimie et de Biochimie Moléculaires et Supramoléculaires (ICBMS), UMR 5246 CNRS, Génie Enzymatique, Membranes Biomimétiques et Assemblages Supramoléculaires (GEMBAS), Villeurbanne, France

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(Not presented)

Thematic Area: T6: Bio-Green-Energy Science, Waste treatment & Technology

Abstract

The biotransformation of blue swimming crab *Portunus segnis* (Forskål, 1775) residues obtained from the Fishing Port of Sfax by an extracellular chitinase produced by *Nocardiopsis halophila* strain TN-X8 isolated from Chott El Jerid (Tozeur, Tunisia). From the analysis of multiple extremophilic *Actinomycetota*, it was determined that strain TN-X8 exclusively utilized 60 g/L of raw blue swimming crab as its carbon and energy source, achieving a chitinase activity of approximately 950 U/mL following a 6-days incubation period at 40 °C. Pure chitinase, designated as ChiA-Nh30, was obtained after heat treatment (30 min at 70 °C), followed by ammonium sulfate fractionation (40-85%) and Sephacryl® S-200 column chromatography. The maximum ChiA-Nh30 activity was observed at pH 3 and 75 °C. Interestingly, compared with cyclohexamidine, ChiA-Nh30 showed a good antifungal effect against four pathogenic fungi. Furthermore, when using colloidal chitin as substrate, ChiA-Nh30 demonstrated a higher degree of catalytic efficiency than the commercially available Chitodextrinase®. Additionally, ChiA-Nh30 could be immobilized by applying encapsulation and encapsulation-adsorption techniques. The kaolin and charcoal used acted as excellent binders, resulting in improved ChiA-Nh30 stability. For the immobilized ChiA-Nh30, the yield of *N*-acetyl-D-glucosamine monomers released from 20% (w/v) blue swimming crab residues increased by 3.1 (kaolin) and 2.65 (charcoal) times, respectively. With the advent of rapid automated *in silico* identification of extremozymes, genomics presents vast opportunities to accelerate enzyme discovery. These pose challenges in sequencing and high-quality genome assembly which are currently circumvented *via* intensive hybrid-sequencing. Here, we outline a more cost-effective workflow on the gDNA of the strain TN-X8 using multiplex Illumina (NextSeq™ 500) and Oxford Nanopore (PromethION 2 Solo) sequencing with hybrid long-short read assembly algorithms to generate high quality genomes. The gene coding the ChiA-Nh30 activity will be synthesized and heterologously expressed in Prokaryotic and Eukaryotic systems.

Keywords: Annotation, Assembly, Chitinases, Hybrid-sequencing strategy, Illumina, *Streptomyces*, Whole-Genome Sequence.

Acknowledgements: This work was conducted within the HORIZON EUROPE, HORIZON-Coordination and Support Action (CSA), HORIZON-WIDERA-2021-ACCESS-03-01, Twinning Project NGS-4-ECOPROD

KEYNOTE SESSION IV:

Structural, analytical & physical chemistry

Chair/Co-Chairs, K. Plakas, A. El Moll



Enzyme immobilisation for the removal of xenobiotic compounds from wastewater: a laccase-focused study

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Thematic Area: Environmental Biotechnology, Enzyme Technology

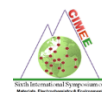
Abstract

Industrialisation, urbanisation and increasing population have resulted in the generation of a huge quantity of xenobiotic pollutants worldwide with detrimental consequences for the environment. Such compounds are recalcitrant to biodegradation, provoking their persistence and accumulation in the environment. In addition, most of them are highly toxic posing wildlife and human health at risk. Therefore, their removal from wastewater before being discharged into the environment is imperative. However, conventional wastewater treatments are ineffective in the removal of such type of compounds and emerging approaches are either expensive or non-environmentally friendly [1]. This has arisen the search for new cost-efficient and green technologies to replace or complement the conventional ones such as those based on the use of biocatalysts. In this sense, the enzyme laccase (benzenediol: oxygen oxidoreductases; EC 1.10.3.2) appears as a promising natural biocatalyst for the development of sustainable and green approaches to degrade xenobiotic compounds. Laccases belong to a group of polyphenol oxidases containing copper atoms in their catalytic centre, generally called multicopper oxidases. They reduce molecular oxygen to water in a four-electron step with the concomitant one-electron oxidation of several aromatic substrates [2]. However, the use of free laccases has several drawbacks such as poor reusability, high cost, low stability and sensibility to different denaturing agents that may be present in wastewater. Such limitations can be overcome by immobilising laccase enzymes in/on solid carriers [3]. Hence, during the last decades different approaches considering different techniques and solid carriers to immobilise laccase enzymes have been developed and tested for the removal of pollutants from wastewater.

Keywords: enzyme, immobilisation, laccase, white-rot fungus, xenobiotic

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Harnessing microalgal capacities for bioremediation of contaminated waters: Insights from ex-situ phycoremediation

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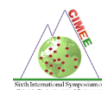
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Thematic Area: Environmental Chemistry & bioMaterials/biopolymers

Abstract

Microalgae present a promising solution for addressing water contamination through ex-situ phycoremediation, utilizing their diverse metabolic and biochemical properties. This keynote presentation explores several critical aspects that enhance the effectiveness of microalgae in bioremediation. Firstly, microalgae cultivated under controlled conditions exhibit a remarkable metabolic capacity to break down various pollutants, encompassing organic compounds, nutrients, and contaminants like heavy metals. By optimizing growth parameters such as nutrient availability, light intensity, and pH levels, researchers can significantly enhance the efficiency of pollutant removal by microalgal cultures. Secondly, the live biomass of microalgae possesses unique membrane characteristics essential for bioremediation processes. These membranes play a crucial role in physically adsorbing and bioaccumulating contaminants from water sources. Through selective binding, microalgal membranes concentrate pollutants within the biomass, facilitating their subsequent removal during harvesting and separation processes. Furthermore, biopolymers derived from microalgae, such as polysaccharides and proteins, offer promising applications in enhancing bioremediation efficacy. These biopolymers can act as effective biosorbents or bioflocculants, aiding in the aggregation and precipitation of contaminants for easier extraction from water matrices. By integrating these approaches, ex-situ phycoremediation emerges as a sustainable and effective strategy for mitigating water pollution. Harnessing the inherent capabilities of microalgae not only supports environmental remediation efforts but also promotes sustainable water management practices globally. This presentation aims to underscore the transformative potential of microalgae-driven bioremediation in addressing current and future challenges in environmental conservation and water quality improvement.

Keywords: Microalgae, Ex-situ phycoremediation, Metabolic capacity, Biomass properties, Biopolymers, Sustainable water management.



Analysis of Polychlorinated biphenyl and identification of biphenyl metabolizing microbes in e-waste contaminated soils from Pakistan

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(Not presented)

Thematic Area: Atmospheric chemistry and Environmental pollution

Abstract

In current study e-waste contaminated soils from Rawalpindi, Quetta and Peshawar cities of Pakistan were collected and analyzed to check the concentration of PCBs and their microbial degradation rate under aerobic and anaerobic conditions. Total 24 PCB congeners (PCB28/31, PCB17/18, PCB33, PCB52, PCB49, PCB44, PCB74, PCB70, PCB95, PCB101, PCB99, PCB87, PCB110, PCB82, PCB105, PCB118, PCB151, PCB149, PCB156, PCB153/132, PCB128, PCB138, PCB158 and PCB169) were analyzed. Soil physicochemical properties were determined in which Quetta soil was found loam, however in other sites soil was sandy loam. OM was also higher for all sites. Nitrate and phosphate contents were lower for all sites. Potassium contents were marginal for all the sites. The trends of PCBs concentration among different sites were: Quetta> Peshawar>Rawalpindi. Peshawar showed highest PCBs removal efficiency after 80 days as compared to the other sites during anaerobic soil condition. The removal efficiency of total PCBs was 46.69% at Peshawar after 80 days. During aerobic condition lower chlorinated PCBs showed more degradation results in complete mineralization of PCBs. The bacterial species found in soil were *Pseudomonas aeruginosa* gene for 16S ribosomal RNA, *Bordetella avium 197N*, *Enterobacter sp. GB27* 16S ribosomal RNA gene, *Bacillus safensis strain S8* 6S ribosomal RNA gene. The qPCR results showed that under sequential flooded conditions, the abundance of bphC and bphA gene carriers experienced a gradual decline during the flooded periods. The bphC and bphA gene expressed during the aerobic soil condition and were the main reason of low chlorinated PCBs degradation. *Chloroflexi* and *Pseudomonas spp.* expression was more during the anaerobic soil condition. These microbes were dechlorinated and attach on the higher chlorinated PCBs. In this project it was further concluded that Pakistani soils from different geographic location and climatic condition have the capability to degrade the e-waste pollutants.

Keywords: Microbial degradation, Polychlorinated biphenyl, Anaerobic, Aerobic, Physicochemical, Dichlorination

Training Courses and Workshops



Day 1 Materials Chemistry and environmental sustainability

Theme: Carbon Nanotube-Based Electrochemical Biosensors & environmental Applications

Session A-: Nanotechnology in Agriculture: Effects of Engineered Nanomaterials (ENPs) on Plants

Session B-: Carbon Nanotubes-Based Electrochemical Sensing for monitoring of environmental pollutants

Theme: Advanced Nanomaterials for Environmental Applications

Session: The potential Role of Nanotechnology in Environmental Applications

Theme: Green Chemistry & materials science: towards a sustainable Environment

Session: chemical processes, fostering a more sustainable and circular economy.

Session: Recent advances in Functional Nanotechnologies for Energy Conversion

Session: Nanotechnology and their applications in renewable energy

<https://cimee-science.org/index.php/2024/12/01/training-courses-workshops-cimee24/>

Day 2



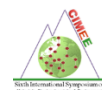
Dr. Najla Fourati is a member of SATIE Laboratory, UMR CNRS 8029, at Conservatoire National des Arts et Métiers, Cnam, Paris. Her research is focused on the design and realization of electrochemical and surface acoustic wave sensors for selective detection of chemical analytes (pesticides, heavy ions, endocrine disruptors...) and biomolecules (proteins, cancers biomarkers, neurotransmitters ...)

Research Interest: Physical Chemistry, Nanotechnology, Materials Chemistry, Materials Science, Experimental Physics

PLENARY SESSION II:

Electrochemistry and the Environment, Chair/Co-Chairs: Ridha Djelabi, A. ElMoll, K. Plakasbi

Electrochemistry and the Environment,
Chair/Co-Chairs: Ridha Djelabi, A. ElMoll, K. Plakas



Cutting-Edge Electrochemical Sensors for Endocrine-Disrupting Chemicals Detection

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Thematic Area: Materials, Electrochemistry & Environment

Abstract

Endocrine-disrupting chemicals (EDCs) such as bisphenol A (BPA), phthalates (DEHP, DBP), polychlorinated biphenyls (PCBs), and per- and polyfluoroalkyl substances (PFAS) present significant health risks, including hormone imbalances, reproductive issues, and cancer. Their detection at very low concentrations in various environments is essential for assessing exposure and mitigating risks. Electrochemical sensors have emerged as a promising solution for rapidly and sensitively detecting these compounds. This presentation will explore the latest advancements in electrochemical sensors designed specifically for detecting EDCs, from recent studies published after 2022.

One of the key advancements is using nanomaterials, such as graphene or carbon nano-tubes, to enhance the sensitivity and selectivity of the electrochemical sensors. These materials provide a high surface area and excellent electrical conductivity, significantly improving detection limits compared to traditional ones [1].

Using molecularly imprinted polymers (MIPs) has also shown great potential for EDCs detection. MIPs are synthetic polymers with specific binding sites that mimic the molecular recognition of natural receptors. MIPs-based electrochemical sensors were, for example, designed for the selective detection of phthalates [2], PFAS [3], and BPA [4]. These sensors achieved high specificity and stability, making them suitable for real-world applications. In addition to material innovations, the design of sensor platforms has also evolved. Microfluidic electrochemical sensors have been developed to enable on-site and real-time monitoring of EDCs in water samples [5]. These platforms permit the rapid analysis of small sample volumes and reduce the overall cost and complexity of the detection process.

Another significant advancement is the application of artificial intelligence (AI) and machine learning (ML) algorithms in interpreting electrochemical sensor data. Incorporating AI techniques can enable the differentiation of target analytes from potential interferences, thus enhancing the overall performance of the sensors [6].

The future of electrochemical sensors for EDCs detection lies in further enhancing their sensitivity, specificity, and practicality. Continued interdisciplinary research is essential, particularly in developing new nanomaterials, combining electrochemical sensors with Internet of Things (IoT) technologies to enable real-time data collection and remote monitoring, designing sensors that are easy to use for non-specialists to facilitate widespread adoption in various settings, mainly natural environments, and ensuring that new sensors meet regulatory standards for environmental monitoring and public health.

Keywords: Electrochemical Sensors, new nanomaterials, Endocrine-Disrupting Chemicals.

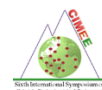
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KEYNOTE SESSION V:

Nanomaterials and the environmental applications

N. Fourati, A. El Moll, K. Plakas



Advancing Sustainable Graphene-Based Nanomaterials for Environmental Solutions

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Thematic Area: Advanced Nanomaterials for Environmental Applications

Abstract

Green synthesis, synthesis of nanomaterials via different biological sources involving plants and microorganisms, is sustainable, environmentally eco-friendly method which helps to eliminate toxic waste. We have prepared more than 70 nanocomposites with different derivatives of graphene (GO, rGO) and *p*, *d* and *f* block metal/metal oxides and their nanocomposites using plant extracts and microbes via two different green methods, green one pot method and green deposition method. These nanocomposites were prepared for their applications in degradations of pollutants coming out from textile, pharmaceutical, pesticides, fertilizers and chemical industries [1-4].

Graphene has got much attraction in recent years and is considered one of the most promising nanomaterials because of its exceptional properties and applications. Graphene oxide (GO) and reduced graphene oxide (rGO), derivative of graphene, are prepared from graphite by using variety of methods. GO and rGO are different from each other due to their C/O ratio, surface area, dispersibility, hydrophobicity, and electrical conductivity. Surface of GO and rGO is further modified with the doping of metal and metal oxides nanoparticles to enhance their chemical and biological activities to remove environmental pollutants from chemical and pharmaceutical waste water.

Keywords: Graphene, nanocomposites, antibiotics, degradations, pollutants, pesticides, wastewater

Acknowledgements: The author would like to thank Pakistan Science Foundation for project PSF-NSFC/JSEP/ENG/P-FCC/18, Higher Education Commission (HEC) Pakistan for providing funds through Project No. 20-3142/NRPU/R&D/HEC/ & Project No. 20-2660/NRPU/R&D/HEC/ and The World Academy of Sciences (TWAS), Italy. TWAS Research Grant No. 11-028 RG/MSN/AS_C.

References:

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Efficient Hydrogen production with methanolysis on catalysts derived from waste materials

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(not presented)

Thematic Area: Environmental Chemistry

Abstract

Energy is one of the most important needs for humanity. The world's energy need is provided from fossil fuels such as oil, coal and natural gas. However, with the increasing world population and rapidly developing industrialisation, the current energy demand is increasing day by day. The development of alternative energy sources is of great importance due to the increasing depletion of fossil fuels and environmental damage. Renewable high purity hydrogen has attracted attention as a clean and efficient energy source alternative to fossil fuels. Among various alternative technologies, hydrogen has attracted great interest in recent years due to its high gravimetric energy density and energy conversion without CO₂ emission. In recent years, hydrogen is obtained from methanolysis of borohydride species. Sodium borohydride (NaBH₄) is a highly advantageous material for providing pure hydrogen at room temperature due to its various advantages such as being very stable, non-flammable, non-toxic in nature and able to store hydrogen. Catalysts are of great importance in hydrogen production with NaBH₄. Metal-containing or metal-doped support materials have been developed as catalysts. Despite their high catalytic activity, these metal-containing catalysts are costly and have disadvantages due to their environmental impact. Therefore, metal-free catalysts have attracted the attention of the scientific world in recent years due to their advantages such as low cost, environmental friendliness and high activity. Metal-free catalysts such as activated carbon, zeolite, and glass frits, have high hydrogen production activities. These materials exhibited high catalytic activity in hydrogen production. In this study, the catalytic activities of activated carbon, zeolite, and glass frits catalytic activities of the composites was investigated. These materials were characterised by N₂ adsorption-desorption, Scanning Electron Microscopy (SEM-EDX), Transmission electron microscopy (C-TEM) and High-Resolution transmission electron microscopy (HR-TEM), X-ray diffraction (XRD), X-ray photoelectron Spectroscopy (XPS). Their catalytic performance as catalysts for H₂ production from methanolysis of NaBH₄ was investigated. Different methanol concentration, different amount of catalyst and different amount of NaBH₄ will be analysed to determine the optimum conditions. In addition, analyses were carried out at different temperatures and Arrhenius equation were used to determine the activation energy. We achieved an HGR value of 30.000-100 000 mL/min.gcat and these results revealed that these materials are promising materials for hydrogen production.

Keywords: activated carbon, energy, hydrogen, methanolysis

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Advancing Sustainable Technological with Nanofluids

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Thematic Area: Nanomaterials for Energy Systems

Abstract

Nanofluids are engineered to sustain technological evolution with due consideration toward energy efficiency and environmental sustainability in various fields. These nanofluids are specially engineered colloidal suspensions of nanoparticles within base fluids, having unique thermal, optical, and mechanical properties that are far superior to those shown by conventional fluids. In other words, this represents nanofluids in relation to sustainable development based on advances in heat transfer, refrigeration systems, and renewable energy-based systems with environmentally friendly clean technologies. It increases the energy efficiency and thermal performance in several applications such as solar panels, refrigeration units, and industrial cooling. Energy consumption and the carbon footprint are estimated to be reduced by using nanofluids, which could contribute to further eco-friendly engineering solutions. The basis for discussion will be the fundamental properties of nanofluids and their applied usage related to the sustainable development of technology. Complementary to this, the discussion will outline issues related to the problems of stability, the economic aspects, and the scalability of the processes involved in generating nanofluids and possible research and development opportunities. Nanofluids are bound to be crucial in the path toward sustainable development and energy efficiency.

Keywords: Heat Transfer, Nanofluids, Thermal conductivity, Energy Systems, Stability



Micro- and nanoplastics from sea to spoon: an overview

Giusy Lofrano

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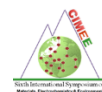
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Thematic Area: Structural, analytical & physical chemistry

Abstract

Plastic is ubiquitous in our life, and its durability and end of life represents a great problem for public health and the environment. Several studies reported the occurrence of plastic litter in different environmental compartments and, consequently, numerous efforts are currently focused on how improving its recycling process and produce environmentally friendly solutions. The BIOPLAST4SAFE project, funded by the Italian Ministry of Health – PNC, focuses on potential adverse effects of micro and nanoplastics (MNPs) in a one health perspective. Plastic particles can enter in living organisms, including humans, primarily through ingestion and inhalation. Their biological effects depend on their size, chemical composition, and the characteristics of substances that later absorb these particles. An estimate of the ingestion rate is not yet available as well as the identification of the exact route of entrance. Seas and oceans are not only the final sink of MNPs, but also a source of food that can vehiculate MNPs to humans thus increasing public health concerns. An overview of the main potential hot spot of MNPs exposure will be investigated.

Keywords: micro-nanoplastics, recycling process, Seas, oceans, food, environmentally friendly solutions



Perspective of the waste water cleaning from PFAS by N-containing mesoporous silica

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(Not presented)

Thematic Area: Environmental Chemistry

Abstract

Based on the assessment of the extent of exposure of per- and polyfluoroalkyl substances (PFAS) to public health, World Health Organization initiated the development of a basic document for Guidelines for Drinking Water Quality with an emphasis on perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA).

The purpose of this research is to explore the possibilities of using our sorbents to remove PFAS from simulated solutions and real water samples. A multicomponent PFAS solution model should be studied to understand the partitioning trend (e.g., pH, selectivity) and to assess the affinity of adsorbents for specific PFAS molecules. The mechanism of PFAS extraction by a series of adsorbents will be discussed.

In order to solve this problem, as well as to offer qualitatively new materials as sorbents, we studied the sorption behavior of 20 anionic, neutral and zwitterionic PFASs, varying in the length of the perfluorocarbon chain (C₃-C₁₆, Fig. 1) and functional groups and probes of natural waste water, with 4 different sorbents based on SBA-15.

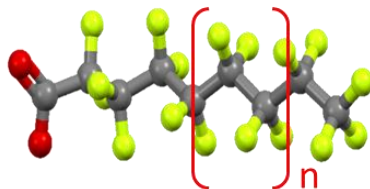


Fig. 1. The basic molecular structure of per- and polyfluoroalkyl substances

It was established that sorbents with a higher concentration of nitrogen-containing functional groups had the highest adsorption efficiency on PFAS, mainly due to electrostatic interactions.

Keywords: PFAS, SBA-15, sorption, water treatment.

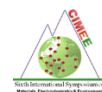
Acknowledgements: MSCA4Ukraine, funded under the European Union's Marie Skłodowska-Curie Actions.

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KEYNOTE SESSION VI:

**Water resources, AgroHydrology and Sustainable environment,
Chair/Co-Chairs: N. Fourati, A. El Moll, K. Plakas**



Bismuth based photocatalyst for efficient photodegradation and CO₂ reductions

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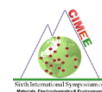
Thematic Area: Materials for the Environment

Abstract

Nano photocatalysts (BiOXs, Bismuth Molybdate, Bismuth Titanate and their composites) have been successfully synthesized using hydrolysis method. To obtain a better understanding of the results, the Bismuth based material and their composites were also immobilized on Alumina (Al₂O₃)-based ceramic fiber sheet and activated carbon block as supporting material. The results revealed that the higher pH value was more favorable for bisphenol A (BPA), Amoxicillin (AMX) and Ampicillin (AMP) degradation, while the MO was completely degraded at all pH range. Moreover, the stability test was performed, and high stability of the immobilized samples was observed for five cycles without leaching out in the aqueous medium.

Carbon dioxide hydrogenation was also carried out using prepared Bismuth based material by hydrolysis method. Tests indicated that bismuth-based nanocrystals fabricated at acidic pH and calcined at 700 degrees showcased a notable increase in CO₂ photoreduction capability, yielding CO at a rate of 673.3 μmol/g/cat and CH₄ at a rate of 70.2 μmol/g/cat.

Keywords: Bismuth based material, photocatalyst, ceramic fiber, Carbon block, clean environment, CO₂, CO, CH₄



Valorization of research: Perspectives & cases studies

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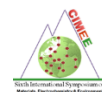
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Thematic Area: environmental challenges and green technology

Abstract

Algeria is making significant strides in scientific valorization, focusing on fostering innovation through research and development. A key priority is the promotion of technology transfer, aiming to bridge the gap between scientific research and practical applications across various industries. The environmental research team at the Centre de Recherche en Technologies des Semi-conducteurs pour l'Énergétique (CRTSE) plays a vital role in this effort. Their participation in international research programs such as PRIMA which focus on sustainable water management, highlights the practical applications of scientific research in addressing environmental challenges. The team also contributes to strengthening both national and international research collaborations, working with partners to advance green technologies and improve resource management. These initiatives are designed to enhance the impact of scientific advancements, promote sustainable development, and bolster the country's technological and industrial capabilities.

Keywords: resource management, green technology, water, sustainable technology



Combating Climate Change & environmental degradation: The potential Role of Sustainable technologies solutions

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Thematic Area: Environmental monitoring, materials chemistry & renewable energy

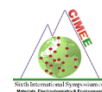
Abstract

The triple planetary crisis that humanity currently faces: climate change, pollution and waste and nature loss, so the need to address environmental these challenges has become increasingly urgent and require solutions on a global scale. As humanity suffers from the practical consequences of climate change at the global level, the role of technology is paramount in providing innovative solutions, mitigate environmental degradation and preserve natural resources. In this context, technology plays a multifaceted role, serving to achieve a radical change in both the transportation, agricultural and industrial sectors. From renewable energy and agricultural technologies to advanced waste management systems, the application of technology has immense potential to revolutionize and advance sustainable development at the global level. Advanced technology can provide innovative solutions to reverse environmental degradation. It enables the monitoring and assessment of ecosystems and informed conservation strategies. For examples, advanced sensors, and satellite imaging technologies facilitate the collection of real-time data on environmental pollution. Additionally, technology fosters sustainable resource management practices by optimizing resource utilization, reducing waste, and promoting circular economy principles.

Keywords: sustainable agriculture technologies, environmental monitoring, natural resource management, circular economy, biomass, renewable energy.

ORAL SESSION II:

Waste valorization and energy production:
Chair/Co-Chairs: N. Fourati, A. El Moll, K. Plakas



MoS₂ tipped Zn_{0.1}Cd_{0.9}S nanorods a ternary dumbbell visible light driven photocatalyst for simultaneous hydrogen production with organics degradation in wastewater

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(Not presented)

Thematic Area: Photocatalysis, Environmental Chemistry, Renewable energy & catalysis

Abstract

After photo reforming of plastic waste and organic moieties, photocatalytic hydrogen (H₂) production with organic degradation in wastewater is considered an attractive, synergistic redox reaction and potential research gaps. However, to achieve the above desired goal we need efficient coupled redox photocatalytic systems which are still insufficient. In this project, we rationally designed the MoS₂ nano flower tipped Zn_{0.1}Cd_{0.9}S nanorods (NRs) photocatalytic system through the two steps hydrothermal process with strategic use of soft templates for photocatalytic H₂ production with organic degradation in wastewater. Ultimately, the optimized photocatalytic system of 20% MoS₂ nano flower tipped Zn_{0.1}Cd_{0.9}S NRs (MTCS-2) reveals an exceptional photocatalytic H₂ production rate of 11.01 mmol g⁻¹ h⁻¹ in the presence of Na₂S·9H₂O/Na₂SO₃ as a sacrificial reagent and 525 μmol g⁻¹ h⁻¹ with 99 % Ofloxacin (OFX) degradation in wastewater, which was significantly greater photoactivity than that of pure MoS₂ nano flower, Zn_{0.1}Cd_{0.9}S NRs, and MoS₂/Zn_{0.1}Cd_{0.9}S NRs composite. The spatial separation of reaction sites via the loading of MoS₂ nano flower at the tips of Zn_{0.1}Cd_{0.9}S NRs (versus homogenous loading of MoS₂ nano flower at Zn_{0.1}Cd_{0.9}S NRs) plays a crucial role in efficient photocatalytic H₂ production rate with OFX degradation in wastewater and has an inhibitory effect on the annihilation of photoexcited electron-hole pairs, leakage of Cd²⁺ and photo corrosion of Zn_{0.1}Cd_{0.9}S NRs. This surprising photocatalytic performance of synergistic redox reaction and stability is due to the development of the Schottky junction between spatially separated reaction sites of MoS₂ nano flower and Zn_{0.1}Cd_{0.9}S NRs in MTCS-2. Furthermore, the unique structure and spatial separation of reaction sites in MTCS-2 are strategically useful for adsorption and surface reactions such as organic degradation at the stem of Zn_{0.1}Cd_{0.9}S NRs and H₂ production at the MoS₂ nano flower. This spatial separation of reaction sites on a dual-functional photocatalytic system could be an encouraging effort for the development of novel competent dual-functional photocatalysts for sufficient H₂ production with organic degradation in wastewater (a tactic of catching two fishes with one hook).

Keywords: Noble-metal-free, Photocatalyst, Visible light, Photocatalytic H₂ production, Organic degradation, Wastewater

Acknowledgements: This work is dedicated to my PhD supervisor and mentor Professor Jinlong Zhang, East China University of Science and Technology, on his 60th birthday.



Production of Aromatic Hydrocarbons from unconventional feedstock Over a metal supported Zeolite

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Thematic Area: Environmental Chemistry and Materials

Abstract

The efficient and sustainable use of large spare of food waste in developing countries. The use of Used cooking oil (UCO) for different process (esterification, catalytic upgradation) is better and alternative feedstock for petrochemicals industry. The transformation of Methanol assisted upgrading of UCO into xylene rich aromatics over ZSM-5 catalyst with different loading of Ga and Co has been investigated in a continuous down flow reactor. To study the aromatization as well as alkylation effect of methanol on UCO for production of xylene aromatic. The Nano zeolite mainly Co-Ga supported ZSM-5 zeolite has increased its acidic site, and porosity which can interacted with UCO and methanol to give Xylene rich aromatics product. Different analytical techniques such as BET-surface area measurements, XRD, SEM, TEM, XPS, TPR, FT-IR, RAMAN, and TGA analysis were employed to characterize the catalyst. The BET shows a pore size of Co-Ga- ZSM-5 supported zeolite catalyst was found to be ~6.3 nm, which significantly contributed and enhanced the conversion and selectivity towards aromatic (C 6-C 8). The alkylation effect of methanol with used cooking oil (UCO) for achieving the p-xylene selectivity, the excess amount of methanol can cause side change alkylation reaction, resulting in the formation of Trimethyl benzene (TMB) and other alkylated product. Therefore, on the optimized condition 20% methanol bleeding with used cooking oil give the maximum selectivity of p-xylene 8.5% and total xylene selectivity is 20.1%. The deactivation of Cobalt supported zeolite acidic catalysts for the production of aromatic hydrocarbon via formation of intermediate depends on the catalyst acidity and pore size. This indicates the main reaction between Paraffinic rich UCO on bimetallic Co-Ga supported ZSM-5 with significant participation of the support. Gradually, the coke on the support Co-Ga supported ZSM-5 zeolite increases to an extent that it blocks the reaction also at that location.

Keywords: Used cooking oil, methanol, catalytic upgradation, aromatics hydrocarbon, xylene

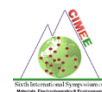
Acknowledgements: OS acknowledges the Rajiv Gandhi Institute of Technology for the financial support.

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ORAL SESSION III:

Structural, analytical & physical chemistry,
Chair/Co-Chairs: N. Fourati, A. ElMoll, K. Plakas



Effect of humidity on catechol-ozone reactivity: Insights of experimental and theoretical investigations

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Thematic Area: atmospheric chemistry & Environmental pollution

Abstract

Volatile organic compounds (VOCs) are widespread environmental pollutants, emitted from both natural and anthropogenic sources. These compounds significantly contribute to the formation of secondary organic aerosols (SOA). This study investigates the gas-phase reaction of 1,2-benzenediol (catechol) with ozone in a simulation chamber at atmospheric pressure and 294 ± 2 K, under varying relative humidity conditions. Catechol concentrations were continuously monitored using a PTR-ToF-MS device across relative humidity levels ranging from 7.5% to 78.8%. The results suggest that catechol-H₂O clusters form in the gas phase, decreasing catechol's reactivity with ozone and other gases, and thus reducing the reaction rate constant [1], [2]. To understand the impact of water on catechol-ozone reactivity, force field parameters for catechol were developed. These parameters were used to optimize the structures of catechol dimers and catechol-(H₂O)_n clusters, which were then benchmarked against quantum chemistry calculations at the B3LYP and w97XD levels, considering basis set superposition error. Molecular dynamics (MD) simulations were performed using the developed force field parameters for a catechol-(H₂O)₁₅ cluster. The simulations revealed that an increased coordination number affects the hydrogen bond network around catechol, potentially impacting its reactivity with ozone under wet conditions [3]. The MD results indicated that water molecules form a cage-like hydrogen bond network around catechol's hydroxyl groups, thereby blocking the active sites on catechol.

Keywords: Catechol, Catechol (H₂O)_n cluster, PTR-ToF-MS, hydrogen bond, classical force field, quantum theory simulations.

Acknowledgements: Calculations have been performed using Gaussian 16 implemented at the American University of the Middle East High-Performance Computing Center. In addition, we would like to express our sincere gratitude to Universite du Littoral Cote d'Opale and American University of the Middle East for their valuable material and scientific support.

References:

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Valorization of olive mill wastewater for the production of biosurfactant by *Pseudomonas luteola*

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Thematic Area: Agro-Geo-Environment, Agrochemistry & BioGeoChemistry

Abstract

The olive mill wastewater (OMW) has a very high polluting power and a toxic effect on the environment because of their very complex composition. In the context of sustainable development, it is interesting to valorize olive mill wastewater to transform it into a value-added product. This study is part of the framework of sustainable development and environmental protection. In this work, the bacterial strains *Pseudomonas luteola* was used for a biosurfactant production assay under different conditions. The influence of the culture medium and the substrate used on the quantity and stability of the production of biosurfactant was demonstrated. Growth kinetics, emulsion index and surface tension were examined at 2% diesel concentration and then at different OMW concentrations (0.5%, 1%, 2%, 3%, 4% and 8%). Faster adaptation, higher growth and production rates were obtained in the fermentation medium, in the presence of gas-oil with bacterial strains. *P. luteola* showed better biosurfactant production with 0.5% OMW (84.48%) and an increase in the concentration of these OMW inhibits the production. This result indicates that *P. luteola* can potentially be used in environmental remediation and purification processes.

Keywords: Biosurfactant, Gas-oil, OMW, *Pseudomonas luteola*, Surface tension.

Training Courses and Workshops



Day2: Electrochemical Biosensors for Agricultural & Environmental sustainability

Theme: Remote Sensing technology and its applications in environmental monitoring

Session A- Remote sensing techniques for the quantitative monitoring of groundwater

Session B - Remote Sensing Technologies and Hydrogeochemistry

Theme: Electrochemical Biosensors for Agricultural & Environmental sustainability

A - Bioelectrochemical and Ecofriendly technology for sustainable water treatment

B - The monitoring and identification of inorganic and organic pollutants

Part II - Theme: Agricultural Chemistry & Soil Science

Theme: Agriculture technology and Environmental science

Session A: Innovation Technology for Sustainable Agriculture and environment

Session B: Potential role of technology innovation in sustainable agriculture and environment

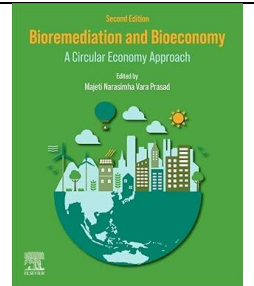
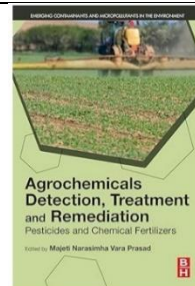
Theme: Phytochemical Analysis & Natural chemistry

<https://cimee-science.org/index.php/2024/12/01/training-courses-workshops-cimee24/>

Day 3



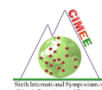
Majeti Narasimha Vara Prasad is an emeritus professor in the School of Sciences at the University of Hyderabad, Hyderabad, India. He also taught at the North Eastern Hill University, Shillong, India. He has made significant contributions to the field of plant-metal interactions, bioremediation, and bioeconomy. He has also published over 210 research articles in peer-reviewed journals with Google Scholar h-index of 61. He is the author, co-author, editor and co-editor of several books by leading international publishers.



PLENARY SESSION III:

Materials, Energy and sustainable Environment, Chair/Co-Chairs: A. ElMoll, R. Djellabi

Materials, Energy and sustainable Environment,
Chair/Co-Chairs: A. ElMoll, R. Djellabi



Dependency on critical raw materials for energy, medicine and biology

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Thematic Area: Materials and Environment

Abstract

Several terms for naturally occurring minerals resources have been used viz. heavy metals, trace elements, noble metals, rare earth elements etc. in literature. These are non-renewable resources. Certain metals are abundant on earth crust, while several others are less than 1% of the total matter which are called trace elements. How long these naturally occurring resources last at the current pace of consumption is a big question. One of the classic e. g. is phosphorus and naturally available rock phosphate is confined to a few countries and demand for phosphate fertilizers is growing and finding solution for its sustainability is yet to be answered for India [1,2]

Seventeen of the metals having unique physicochemical properties are referred to as rare earth elements (REEs) encompassing the Lanthanoids, Scandium and Yttrium. Most of them are not rare at all; for instance, Cerium is the 25th most abundant element (more abundant than Sn and Pb, just after Zn). “Rare” relates to the considerable difficulties in separating one REE from another because of their close similarity in chemical and physical properties. Chemists are generally interested in REEs due to their unique chemical properties. However, currently, environmental biologists, plant and molecular biologists have also discovered that REEs are a hotspot. Even though these elements—also known as metals—have been the subject of numerous studies on their biology, biologists still know very little about the mechanisms by which these elements act in different organisms (particularly with regard to lowering their toxic effects at high doses) and about the domains in which these metals can be employed as biotechnology. One unique property of REEs is their ability to attach to other molecules and increase a number of physiological processes, including growth and development. Other eight essential metals (Y, La, Ce, Pr, Nd, Gd, Tb, and Dy) belonging to the so-called group of rare-earth elements (REEs) commonly referred to as lanthanides, which are characterized by unusual physical and chemical properties, in particular magnetic and optical properties, are utilized in a smart-phone. Some REEs are essential to the manufacture of smartphones, tablets, and computer flat-panel screens, and also in computers hard disk drives, special alloys, fluorescent and LED lightings, catalytic converters, medical imaging devices, etc. There are 15 REEs which are classified into two groups: light REEs (La, Ce, Pr, Nd, Sm, Eu, and Gd) and heavy REEs (Tb, Dy, Ho, Er, Tm, Yb, Lu, and Y). The REEs commonly occur together in the Earth’s crust in carbonatites, alkaline igneous rocks, ion adsorption clay deposits, and monazite-xenotime-bearing placer deposits.

Keywords: raw materials, energy, metals, rare earth elements, biotechnology

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KEYNOTE SESSION VII:

Materials/Biomaterials and the Environment,

Chair/Co-Chairs: A. El Moll, R. Djellabi



Potential of Clean Energy and Raw Materials: case of Tunisia

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Thematic Area: Materials Energy and the Environment

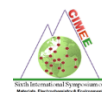
Abstract

Tunisia has embarked on an ambitious clean energy plan aimed at reducing its reliance on fossil fuels and enhancing energy security. The country targets increasing the share of renewables in its energy mix to 30% by 2030, and may be 100% by 2050 with significant investments in solar, wind, and hydrogen projects. This strategy is aligned with global sustainability goals and Tunisia's commitment to the Paris Agreement. The plan emphasizes not only energy generation but also the development of infrastructure and regulatory frameworks to support the transition to a low-carbon economy. To achieve its clean energy targets, Tunisia requires substantial quantities of raw materials and particularly silicium, which are essential for solar panel production. The demand for high-purity silicium is expected to rise as solar capacity expands, necessitating investments in both local development units and importation. Additionally, the country must secure other critical materials such as rare earth elements for energy storage systems. Ensuring a stable supply chain and developing local industries for solar panel production are crucial to meet the quantitative and qualitative demands of the clean energy sector.

Tunisia is also exploring the potential of green hydrogen as a key component of its clean energy strategy.

The hydrogen plan focuses on leveraging the countries to produce hydrogen through electrolysis, with the aim of becoming a regional hub for green hydrogen export. This initiative could significantly contribute to decarbonizing industries, enhancing energy independence, and creating new economic opportunities. The plan includes developing pilot projects, establishing partnerships with international stakeholders, and investing in research and development to scale up hydrogen production. One of the most promising applications of clean energy in Tunisia is in the extraction and processing of phosphates, a critical industry for the country's economy. By integrating clean energy into phosphate mining operations, Tunisia can reduce its carbon footprint and lower operational costs. Not only renewable energy can power the extraction processes and facilitate the electrification of transportation within mines but additionally, the use of green hydrogen produced from renewable sources can be employed in the transformation of phosphate rock into fertilizers, further enhancing the sustainability of the industry.

Keywords: Clean energy, green hydrogen, phosphate, raw materials, sustainability, industry, renewable sources.



Bioinspired Anode Materials Derived from Nutshells for Improved Microbial Fuel Cell Performance and Bioenergy Generation

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Thematic Area: Electrochemistry, BioElectrochemistry & Environment

Abstract

Biochar, a highly carbonaceous material, results from the thermal decomposition of biomass in the absence of oxygen, yielding a stable solid product. This study investigates the electrochemical performance of biochar derived from peanut shell, coconut shell, and walnut shell in a dual-chamber microbial fuel cell (MFC). The biochar exhibits a unique combination of physicochemical properties, including macro-porosity, amorphousness, biocompatibility, and electrochemical conductivity, making it an ideal material for bio-electrochemical applications. Polarization curve analysis reveals that Peanut shell biochar (PSB) achieves the highest power density of 165 mW/m², outperforming Coconut shell biochar (CSB), Activated Charcoal (AC), and Walnut shell biochar (WSB). The enhanced electrochemical performance of PSB was attributed to its unique combination of high surface area and suitable pore size distribution, enabling robust biofilm formation and efficient electron transfer. The high electrical capacitance of PSB facilitated enhanced electron transfer kinetics between microbial cells and the anode, boosting bio-electrochemical performance.

Keywords: Microbial fuel cell; Bio electrochemical; Biochar's; Conductivity; Bioenergy

References:

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Properties of starch extracted from potato peels

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Thematic Area: Area: Bio-Green-Energy Science, Waste Treatment & Technology

Abstract

Starch is the subject of many investigations due to their beneficial properties and the availability of some functional properties. In this instance, the main objective of this work is to achieve two primary goals. The first one is to use plant-derived waste by extracting starch from potato skins. To compare it with the starch extracted from potato, study the chemical composition of the two starches and determine the content of amylose and amylopectin because each of these compounds is relative to the final function and thus plays a decisive role. The structure and properties of the two-powder resulting were fully characterized by Fourier transform infrared spectroscopy (ATR-FTIR), X-ray diffraction analysis (XRD), and Thermogravimetric Analysis.

The second purpose is therefore the development of the food packaging from these two starches using glycerol as a plasticizer at the ratio of 30% (w/w, starch basis) using a solution casting technique. The developed films were analyzed in terms of environmental and barrier properties. Their antibacterial properties were compared as well. The findings of this research provide insights that are very interesting in extracting starch from potatoes and also into the development of bio-degradable food packaging.

Keywords: Food packaging, biopolymer, potato peel, chemical composition, antibacterial properties

ORAL SESSION IV:

Biomass, biopesticides and Environment,
Chair/Co-Chairs: D. Hammiche, A. El Moll



Upcycling Chicken Feathers into Organic Amino Acid Fertilizers and Yeast Biomass: A Sustainable Approach for Agricultural and Industrial Applications

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Thematic Area: Environmental Chemistry

Abstract

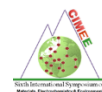
Chicken feathers, typically considered waste and destined for landfills, are rich in keratin. Through hydrothermal treatment and enzymatic hydrolysis, these feathers can be converted into organic amino acid fertilizers [1-2]. This process not only reduces landfill waste but also produces a sustainable and eco-friendly alternative to conventional chemical fertilizers. The obtained organic amino acid fertilizers provide essential nutrients, including nitrogen, to the soil, improving soil fertility and promoting healthier crop growth. The application of these bio-fertilizers supports sustainable agriculture by enhancing nutrient availability and minimizing environmental harm, contributing to ecosystem balance. Additionally, chicken feathers can be upgraded to yeast biomass after pre-treatment and hydrolysis. Our study aims to optimize the use of liquid chicken feather peptone (LCFP) as the sole nitrogen source and apple syrup or glucose as the carbon source in *Saccharomyces cerevisiae* culture to maximize yeast biomass yield with acceptable viability and fermentation power at low cost [3-4].

Therefore, our project aligns with global sustainability goals and presents a scalable model for recycling and upcycling agricultural waste. By leveraging local resources and fostering innovation, we aim to contribute positively to establish a circular economy where waste is transformed into valuable resources.

Keywords: Upcycling, Chicken Feathers, Bio-fertilizers, Amino Acids, Hydrolysis, Yeast Biomass, Sustainable Agriculture.

References:

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Assessment of Pesticide Residue Levels in Okra under Various Preservation Methods in Lebanese Markets

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Thematic Area: Environmental Chemistry

Abstract

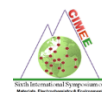
The European Commission and the Codex Alimentarius have not established Maximum Residue Limits (MRLs) for many minor crops due to a lack of research studies. Consequently, they set the maximum pesticide residue levels to the limit of detection, 0.01 mg/kg, by default, which impedes their export. Therefore, our research team excels in conducting comprehensive studies to implement Good Agricultural Practices (GAPs), determine pesticide residues in specific matrices (molokhiya, cactus, and grapevine leaves), mathematically estimate the pre-harvest intervals (PHIs) and the shelf life of pesticide active ingredients across various formulations, and assess consumer risk [1-4]. Residue analyses were performed using the QuEChERS method, followed by LC/MSMS and GC/MSMS.

Building on our previous success and expertise in developing cultivation guidelines for these minor crops in Lebanon, this study aims to assess the status of okra in the Lebanese markets, establish PHIs for pesticides, develop GAPs for okra cultivation, and study pesticide behavior to determine adequate processing methods (drying, blanching, freezing) to ensure consumer safety. The impact of this project includes improving ecosystem health, developing a pesticide spraying program for okra, and facilitating the export of okra from Lebanon to international markets, given its added value as a significant Lebanese culinary ingredient.

Keywords: Pesticide Residues, Food Safety, Pre-Harvest Intervals (PHIs), Okra, Minor Crops, Consumer Risk Assessment.

References:

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Climate Change Impact on the Production and Physico-Chemical Characterization of Non-Alcoholic Red Grape Juice Concentrates from Cinsault, Cabernet, Syrah & Grenache Varieties

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Thematic Area: Environmental Chemistry

Abstract

This study evaluates the suitability of four red grape varieties (Cinsault, Cabernet Sauvignon, Syrah, and Grenache) for concentrated, natural, non-alcoholic red grape juice production in the context of a changing climate and its impact on viticulture. Field observations monitored maturity indices over five weeks, and yield was estimated, taking into account the influence of environmental factors and climate variability. Laboratory analyses focused on physicochemical characterization (Brix, acidity, pH) and determination of total phenolic content (TPC) including anthocyanins, tannins, and resveratrol in the non-alcoholic juice concentrates via spectral analysis. Microbiological testing confirmed yeast elimination through pasteurization using plate count assays (PDA) and Thomas' cell enumeration. Cinsault displayed the highest yield (2.5 tons/acre) and earliest ripening, while Cabernet Sauvignon exhibited the highest TPC (620 mg/g). The findings suggest a correlation between grape variety and both yield and total phenolic content in the resulting non-alcoholic juice concentrate, highlighting the need for sustainable agricultural practices to mitigate the effects of climate change. Additionally, the study demonstrates the effectiveness of pasteurization in ensuring microbiological stability of the final product, underscoring the importance of environmentally friendly processing methods in the beverage industry (Kondi et al. 2018; Mercenaro et al. 2019).

Keywords: Climate Change, Non-alcoholic wine, Anthocyanin, Resveratrol, TPC, Tannins

Acknowledgements: The authors would like to extend their gratitude to the Lebanese University, Doctoral School of Science and Technology, and Chateau Kefraya laboratory.

his work was supported by the Lebanese University [Grant number 4/6081] and by the Lebanese Industrial Research Achievements program (LIRA Industrial Funds) 2022, [Grant number 6809].

References:

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KEYNOTE SESSION VIII:

R, Djelabi, A. El Moll
Waste valorization and Hydrogen production



Management of Plastic Waste Through Pyrolysis: The Potential Environmental and Economic Benefits

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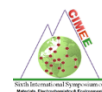
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Thematic Area: Bioenergy, Wastes and biomass valorization

Abstract

We have highlighted the significance of the biomass-to-plastic ratio in the co-pyrolysis of waste plastics, which helps regulate the levels of aromatic compounds and oxygenated substances in hydrocarbon-rich fuels, ultimately enhancing engine performance. The study demonstrated that varying the biomass-to-plastic ratio can effectively influence the composition of aromatics. The resulting products were analyzed using various instrumental techniques, including NMR, FTIR, and GCMS, to identify the types of hydrocarbons present in the liquid product. The findings indicated a presence of carbon compounds ranging from C₈ to C₂₄, with a predominance of aromatic compounds, as confirmed by ¹H NMR and FTIR analyses. The pyro-oils contained various hydrocarbons such as olefins, paraffins, aromatics, esters, and alcohols. Notably, the inclusion of biomass in the co-pyrolysis process resulted in oxygenated compounds comprising approximately 12.08% and enhanced the calorific value from 48.3 MJ/kg to 55.4 MJ/kg, attributed to the longer hydrocarbon chains of esters in the pyro-oil. Additionally, biomass co-pyrolysis improved fuel properties, achieving a pour point below -25°C and a 4°C increase in the flash point. Engine performance tests showed that blending biomass pyro-oil, specifically B25PS75, reduced fuel consumption and improved brake thermal efficiency (BTE).

Keywords: Waste Valorization; Waste Management; Pyrolysis; Economic Analysis



Biofueling of Castor Plant Wastes using biological & thermal methods

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Thematic Area: Bioenergy, Wastes and biomass valorization

Abstract

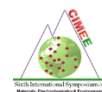
There is embarking on a new pilot project in Africa (Nigeria), this project focuses on Food and Energy Production, together with Civil Works and Social Restructuring and Empowerment. African/Nigerian Business Plan pertains to a pilot project of 2,000 Hectares being destroyed by oil mining, it explains in more detail the synergy between the cultivation of Castor. We focus mostly on castor plant sate for providing hydrogen and methane by biological decomposition (dark fermentation and anaerobic digestion) while the bottom product will provide materials for bioplastics that would be a source of membranes enabling modern membrane systems. Such membranes can be suitable for the separation of glycerol from other extracts that can be used for polymer and aviation fuel. Additionally, research on the plastic potential of waste along with the mixing of other wastes would provide a source for conjugated polymers and silicones enabling the use as a source of photovoltaics and ammonia splitting. This region is going to be the first region to agree on a zero-waste policy being an example for other parts of the world on how to provide modern cutting-edge approaches.

Keywords: hydrogen, castor oil; Africa, Nigeria; bioplastics membranes.

Acknowledgements: Thanks to Afolabi Oludoy and Titbam for their generosity

KEYNOTE SESSION IX:

Clean energy and sustainable materials:
Chair/Co-Chairs: N. Fourati, A. El Moll, R. Djelabi



Hydrogen production by valorizing waste plastics and biomass through thermochemical techniques: the potential environmental and economic benefits

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Thematic Area: Bioenergy, Wastes and biomass valorization

Abstract

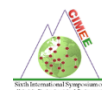
Plastic waste is accumulating in landfills and oceans, and its management have consequences on GHG emissions and, consequently, on climate change. Despite this increased pollution, global production continues its explosive growth. However, at the end of the chain, recycling has never managed to keep up with the trend and a large majority of these waste materials are therefore incinerated or landfilled. In order to effectively respond to the global plastic crisis, thermochemical conversion processes make it possible to transform this waste into useful energy vectors as an alternative in the context of circular economy. Municipal solid waste (MSW) being polymeric waste, its heterogeneous composition requires an efficient thermochemical conversion process such as pyrolysis.

Indeed, the valorization of mixed plastic and biomass waste represents a real way to provide an energy source such as high-value chemicals resources and hydrogen fuel. Catalytic copolymerization (CCP) is a process that involves the simultaneous pyrolysis of biomass and plastics to produce a combination of liquid and gaseous products, such as syngas. This conversion technology a thermal decomposition process that takes place at elevated temperatures (>400°C), resulting gaseous, liquid (e.g. pyrolysis-oil) and solid products (e.g. residue, char). The potential of waste feedstocks for hydrogen production, solving environmental problems, waste management issues and energy demand. Hence, this paper aims to study the principle of the co-pyrolysis process of plastics and biomass as a most promising way for the green production of H₂ by presenting the highlights, and the optimization of the operating parameters such as the reactor temperature, the equivalence ratio (air or oxygen), the steam/fuel ratio and the catalyst for better efficiency. Finally, the role of hydrogen as a key contributor to energy sector and transport decarbonization will be explored.

Keywords: Hydrogen; Biomass; Plastic Waste; circular economy, Pyrolysis; energy transition

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Fabrication and Characterization of TiO₂-ABS Composite Filaments for 3D Printing: Structural Analysis and Evaluation of Antibacterial Properties

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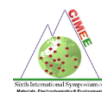
Thematic Area: T1 Materials Science, Nanotechnology & Environment

Abstract

This study investigates the preparation and characterization of acrylonitrile-butadiene-styrene (ABS) polymer composites reinforced with titanium dioxide (TiO₂) nanoparticles, aiming to enhance their antibacterial and antifouling properties for 3D printing applications. The composites were fabricated by integrating TiO₂ nanoparticles (0.5–20 wt.%) into the ABS matrix through melt compounding, followed by filament extrusion. The morphological and structural properties of the filaments and printed materials were analyzed using Scanning Electron Microscopy (SEM), X-ray Diffraction (XRD), and Raman spectroscopy. Antibacterial performance was assessed against *Escherichia coli*, *Staphylococcus aureus*, and *Candida albicans*, showing a modest reduction in bacterial adhesion on the composite surfaces. Additionally, the incorporation of TiO₂ nanoparticles enhanced UV resistance and introduced self-cleaning capabilities, highlighting the potential of these composites for use in medical devices, water purification systems, and other high-performance 3D-printed applications.

Keywords: antibacterial activity, TiO₂-ABS composites, structural characterization, filament fabrication, 3D printing,

Acknowledgements: HMU contribution to this work was partially supported by NATO Science for Peace and Security Programme, grant G5868. IMT contribution was partially supported by PNRR/2022/C9/MCID/I8 CF23/14 11 2022 contract 760101/23.05.2023 financed by the Ministry of Research, Innovation and Digitalization in “Development of a program to attract highly specialized human resources from abroad in research, development, and innovation activities” within the – PNRR-IIIC9-2022 - I8 PNRR/2022/Component 9/investment 8 and by the Romanian Ministry of Research, Innovation and Digitalization through the μNanoEl, Cod: 23 07 core Programme.



Clean energy technologies: from critical raw materials, CRM, supply to contribution to a sustainable energy transition

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Thematic Area: clean energy technologies and raw materials

Abstract

To meet the goals set by the Paris Agreement, we must achieve global carbon neutrality by 2050. To reach this, clean energy technologies play a key role in this strategy. However, the replacement of fossil fuels with clean energy sources increases the dependence on so-called critical raw materials (CRMs), as clean energy technologies require more materials such as copper, cobalt, nickel, lithium. Given the use of most minerals and metals in current industrial applications, global competition for resources can be expected to become fierce over the next decade. Indeed, the transition to clean energy technologies is driving extraordinary demand for critical raw materials needed to manufacture batteries, electric vehicles (EVs), solar panels and other clean energy solutions. Despite the presence of vast geological reserves, ensuring sustainable access to these materials is essential to successfully transition to clean energy, taking into account environmental and social impacts. The second part of this presentation is the shift towards clean energy technologies and Improving materials efficiency. As the energy transition gains momentum, attention is shifting from renewable energy sources to the materials that compose them in order to support decarbonization efforts. The integration of sustainable materials into clean energy solutions will certainly help reduce their environmental impact and may potentially improve their efficiency. Taking into account all these elements, innovation in next-generation energy technologies is urgent and necessary

As the energy transition gains momentum, attention is shifting from renewable energy sources to the materials that compose them in order to support decarbonization efforts. The integration of sustainable materials into clean energy solutions will certainly help reduce their environmental impact and may potentially improve their efficiency. Taking into account all these elements, innovation in next-generation energy technologies is urgent and necessary

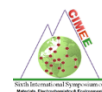
Keywords: critical raw materials, clean energy technologies; renewable energy sources; energy transition

References: The material basis of energy transitions, 2020, by Alena Bleicher and Alexandra Pehlken, Elsevier, ISBN: 0128235543

ORAL SESSION V:

Materials chemistry and sustainable Environment

Chair/Co-Chairs: D. Hammiche, A. El Moll



Advanced Strategies for Azo Dye Removal in Wastewater: A Comparative Review of Biological, Chemical, and Physical Degradation Methods

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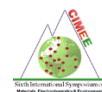
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Thematic Area: Materials chemistry and sustainable Environmen

Abstract

Azo dyes, which are widely used in the textile industry due to their vibrant colors and stability, pose significant environmental and health issues due to their persistence and potential toxicity in wastewater. This comprehensive review examines various methods for the removal of azo dyes from wastewater, including biological, chemical, and physical approaches. Biological degradation involves microbial processes that convert azo dyes into less harmful substances, providing eco-friendly and cost-effective solutions, though their efficiency and operational requirements may vary. Chemical methods, such as electrocoagulation and catalytic degradation, offer rapid and effective dye removal but may involve higher operational costs and energy consumption. Physical methods, particularly photocatalysis, use light-activated catalysts like titanium dioxide and copper sulphide to break down dye molecules, showing high efficiency but limited by light dependence and catalyst costs. This review emphasizes the comparative effectiveness of these methods, highlighting their sustainability, efficiency, and applicability to diverse wastewater scenarios. Future research directions are proposed to address existing challenges, including enhancing method efficiency, reducing costs, and integrating hybrid systems for optimized dye removal performance.

Keywords: Azo Dyes, Textile Industry, Environmental Challenges, Wastewater Treatment



Bio-based materials as adsorbents for glyphosate removal in contaminated waters

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Thematic Area: Material Science, Nanotechnology & Environment

Abstract

Herbicides are a class of pesticides used to control weed growth. Due to overuse, herbicide contamination has been found in soil, groundwater, streams, stormwater, and air, which is a serious concern. In addition to the negative environmental impacts, herbicide exposure has been linked to the risk of neurological disease and severe disabilities in humans and animals [1]. Glyphosate, also known as N-(phosphomethyl) glycine, is the most widely used herbicide in the world and is currently associated with human carcinogenic risks [2].

Various approaches such as adsorption, biological treatment, advanced oxidation, and UV irradiation have been established to remove glyphosate from wastewater and environmental samples. Adsorption is often characterized by its simplicity, low cost, high performance, efficient regeneration, and environmentally friendly process [3]. Finding new, simple, environmentally friendly, and cheap adsorbents is always of interest, especially when abundant and inexpensive agro-industrial wastes are valorized into bioadsorbents. In particular, a novel bioadsorbent generated in this study from a circular economy and sustainable development perspective using a combination of cyclodextrins and residual potato peel waste was found to be efficient for glyphosate removal, green, sustainable, and inexpensive.

Keywords: bioadsorbent, cyclodextrins, glyphosate, sustainable development, circular economy.

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Training Courses and Workshops



Day 3: Analytical chemistry, Nanotechnology & environmental Applications

Theme: Green technologies and Environmental Sustainability: the potential Role of aquatic plant

Theme: Analytical chemistry, Nanotechnology & environmental Applications

Session 1: Analytical chemistry & green Nanotechnology: the potential applications in the Environment

Theme: Atmospheric Pollution, Air Quality and Aerosol Chemistry

Session: Anthropogenic Air Pollution Sources: climatic factor and health risk in the Mediterranean region

Session: Climate change and anthropogenic pressure: the impact on the regional air quality.

Session: Emissions from Solid waste and wastewater: the impact on air pollution & climate change

Theme: Trace elements in the atmospheric aerosols: the potential role of analytical techniques.

<https://cimee-science.org/index.php/2024/12/01/training-courses-workshops-cimee24/>

CLOSING SESSION



Speech at the Closing Ceremony of the International Symposium, CIMEE24:

Transition to sustainable agriculture: the significant role in climate change mitigation

اختتام فعاليات المؤتمر العلمي الدولي السادس CIMEE24 في لبنان

كلمة في الحفل الختامي للندوة الدولية CIMEE24

الانتقال إلى الزراعة المستدامة: دور مهم في التخفيف من تغير المناخ

أشاد رئيس اللجنة العلمية خلال الحفل الختامي بنجاح المؤتمر وما تم خلاله من مناقشات، كما أعلن عن إطلاق الشراكة الاستراتيجية مع موافقة كامل أعضاء مجموعة CIMEE لمتابعة وتقديم خارطة طريق واضحة لتطوير علاقتنا في المستقبل: حدد موضوع البحث الأكثر إلحاحًا لمنطقة البحر الأبيض المتوسط التي تضم القارات الثلاث: آسيا وأوروبا وشمال إفريقيا. تشجيع نشر جلسات خاصة وأوراق مؤتمرات وكتب علمية وندوات عبر الإنترنت وورش عمل / دورات تدريبية وما إلى ذلك. تعزيز التعاون من خلال دعم برنامج الماجستير وطلاب الدكتوراه في الجامعات الواقعة على حوض البحر الأبيض المتوسط. تجدون التفاصيل والمقترحات المتعلقة بالتقنيات الجديدة والاستراتيجيات المستدامة لتحقيق الحياد الكربوني كحل لتغير المناخ ورفاهية كوكبنا في توصيات المؤتمر

كلمة رئيس اللجنة العلمية في حفل اختتام وتوصيات المؤتمر الدولي السادس CIMEE24

الانتقال إلى الزراعة المستدامة: الدور المهم في التخفيف من آثار تغير المناخ

أيها المشاركون الأعزاء، اسمحوا لي أن أناقش معكم دور القطاع الزراعي وتأثيراته المباشرة وغير المباشرة لتغير المناخ.

إن أكبر تهديد للأمن العالمي هو تغير المناخ، لكن عدم الاستقرار المناخي هذا، الذي يؤثر على العديد من جوانب الحياة على الأرض، لم يعد يُنظر إليه في المقام الأول على أنه مشكلة بيئية بل يولد مشكلة اقتصادية. إن لتغير المناخ عواقب تمس الأمن العالمي.

تشمل التحديات الأمنية المرتبطة بتغير المناخ التأثيرات على إمدادات الغذاء والمياه والطاقة، وزيادة المنافسة على الموارد الطبيعية، وفقدان سبل العيش، والكوارث المرتبطة بالمناخ والاضطراب الاقتصادي (التكاليف الاقتصادية لتغير المناخ). وفي الواقع، شهد العالم خلال السنوات القليلة الماضية زيادة في التهديدات والآثار الناجمة عن المخاطر المرتبطة بالمناخ أو البيئة. ونتيجة لذلك، تضاعفت الصراعات المسلحة في أكثر من منطقة من الكوكب.

إنها ليست مسألة أمن وطني، بل هي مسألة أمن جماعي في عالم متزايد الهشاشة والترابط. الأمر الأكثر مأساوية هو أن الأشخاص الأكثر ضعفاً والأقل تجهيزاً للتعامل مع هذا الوضع، هم مرة أخرى أول الضحايا.

وبالنظر إلى أن ربع انبعاثات الغازات الدفينة العالمية ناجمة عن الممارسات الزراعية والحيوانية التي تستخدم أيضاً 75% من موارد المياه، فإن الاستدامة تحتل المرتبة الأولى بين الحلول لأزمة المناخ هذه. مع الأخذ في الاعتبار هذه العلاقة بين الاستدامة البيئية وتغير المناخ. السؤال: كيف يمكن للاستدامة الزراعية أن تساعد في مكافحة أزمة المناخ؟

وفي الواقع، تلبى الزراعة المستدامة احتياجات اليوم دون المساس بالموارد الطبيعية للأجيال القادمة. إنها تعارض الزراعة الإنتاجية التي تضعف البيئة باستخدام الأسمدة الكيماوية ومبيدات الأعشاب ومبيدات الفطريات والمبيدات الحشرية ومبيدات الآفات. ولذلك فإن الزراعة المستدامة تعتمد على مفهوم التنمية المستدامة وتقوم على نظام دائري يكون فيه للموارد المأخوذة وقت للتجديد.

ومن ناحية أخرى، تساعد الزراعة المستدامة في الحفاظ على الموارد المائية. وفي الواقع، تستهلك الزراعة ما يقرب من 70% من مياه الشرب في العالم. سوف تميل فترات الجفاف إلى التكاثر في السنوات القادمة وسوف تتزامن مع فترات هطول الأمطار الغزيرة. الحلول الممكنة والسريعة متاحة للمزارعين للاستجابة: تخزين المياه واستخدام مياه الصرف الصحي وتكنولوجيا الري الرائدة والاصطناعية. وبالتالي فإن التنمية المستدامة والزراعة يسيران جنباً إلى جنب لتشكيل زراعة مستدامة. وبهذه الطريقة، فإن التغيير في النموذج الزراعي سوف يستجيب بشكل فعال لحالة الطوارئ المناخية.

إن أفضل استراتيجية لتقليل البصمة الكربونية للمحاصيل تعتمد على التحول إلى الزراعة المستدامة. وتشمل هذه اختيار الزراعة المحافظة على الموارد، وتحسين كفاءة استخدام الطاقة، واستخدام الأسمدة المستدامة أو الحد من استخدام الأراضي. ولذلك، ووفقاً لهذه الاستراتيجية، يمكن للزراعة أن تصبح مخزناً للكربون باستخدام تقنيات وتقنيات مبتكرة جديدة.

Discours à la cérémonie de clôture du Symposium international, CIMEE24

Transition vers une agriculture durable : un rôle important dans l'atténuation du changement climatique

Chers participants, permettez-moi de discuter avec vous du rôle central du secteur agricole et de ses effets directs et indirects sur le changement climatique.

La plus grande menace pour la sécurité mondiale est le changement climatique, mais cette instabilité climatique, qui affecte de nombreux aspects de la vie sur Terre, n'est plus considérée principalement comme un problème environnemental mais génère un problème économique. Le changement climatique a des conséquences qui touchent au cœur de la sécurité mondiale.

Les problèmes de sécurité associés au changement climatique comprennent les impacts sur les approvisionnements alimentaires, en eau et en énergie, la concurrence accrue pour les ressources naturelles, la perte des moyens de subsistance, ainsi que les catastrophes et les perturbations économiques liées au climat (les coûts économiques du changement climatique). En fait, au cours des dernières années, le monde a été témoin d'une augmentation de la menace et des impacts des risques liés au climat ou à l'environnement. En conséquence, les conflits armés se sont multipliés dans plus d'une région de la planète.

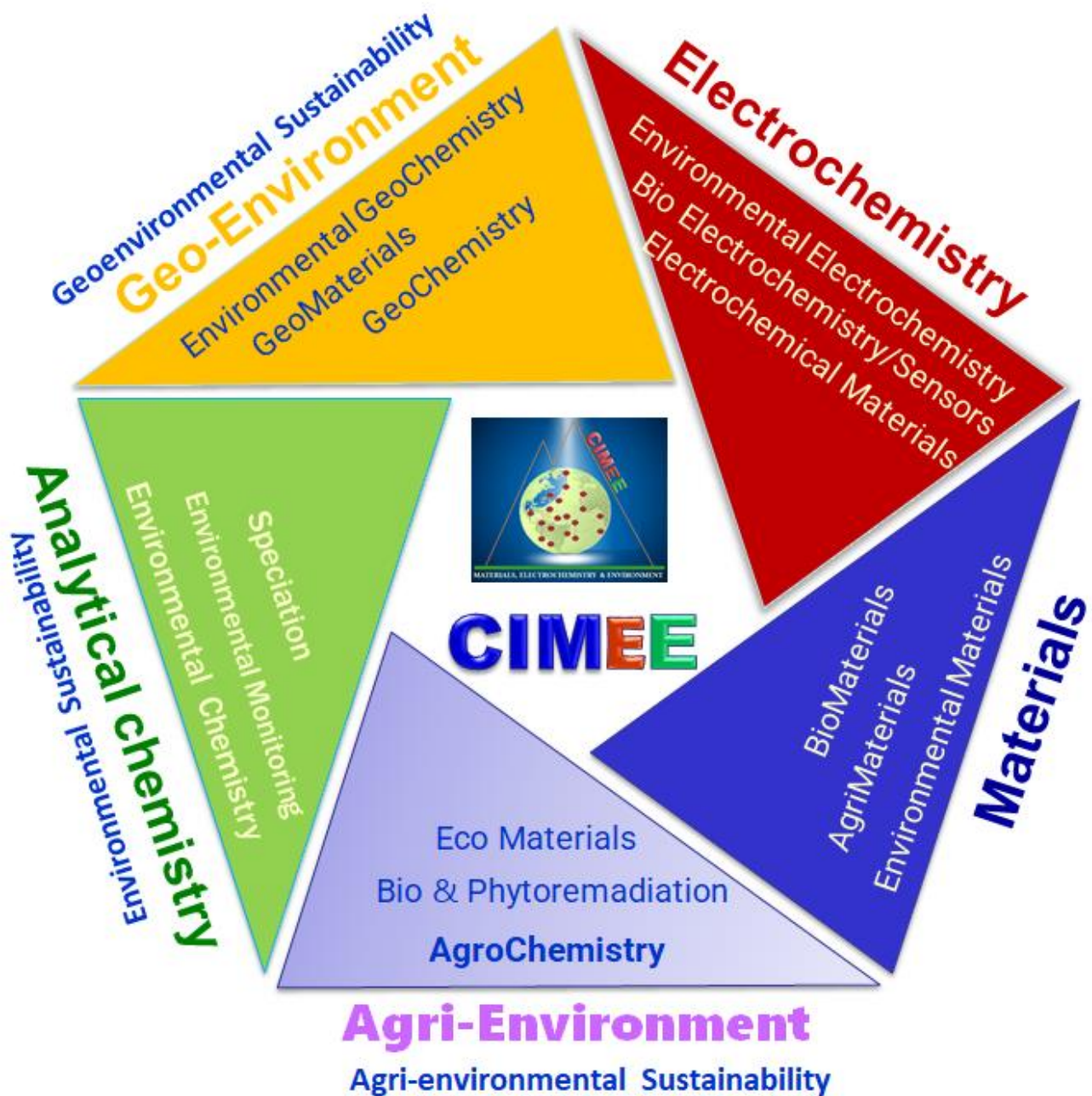
Il ne s'agit pas de sécurité nationale, mais de sécurité collective dans un monde de plus en plus fragile et interconnecté. Le plus tragique, c'est qu'une fois de plus, ceux qui sont les plus vulnérables et les moins armés pour faire face à cette situation sont les premières victimes.

Étant donné qu'un quart des émissions mondiales de gaz à effet de serre sont provoquées par des pratiques agricoles et d'élevage qui utilisent par ailleurs 75 % des ressources en eau, la durabilité occupe la première place parmi les solutions à cette crise climatique. Compte tenu de cette relation entre la durabilité environnementale et le changement climatique. La question : Comment la durabilité agricole peut-elle contribuer à lutter contre la crise climatique?

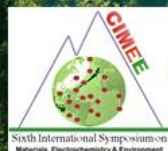
En fait, l'agriculture durable répondre aux besoins d'aujourd'hui sans remettre en cause les ressources naturelles pour les générations futures. Elle s'oppose à une agriculture productiviste fragilisant l'environnement avec l'usage d'engrais chimiques, de traitements herbicides, de fongicides, d'insecticides, de pesticides. L'agriculture durable se fonde donc sur le concept de développement durable et s'appuie sur un système circulaire dans lequel les ressources prélevées ont le temps de se régénérer.

D'un autre côté, l'agriculture durable contribue à préserver les ressources en eau. En effet, l'agriculture consomme près de 70% de l'eau potable au niveau mondial. Les périodes de sécheresse tendront à s'intensifier dans les années à venir et qui vont cohabiter avec des périodes de fortes pluies. Des solutions possibles et rapides sont disponibles pour que les agriculteurs puissent réagir : stockage de l'eau et utilisation des eaux usées en tête et technologie d'irrigation artificielle. Développement durable & agriculture font donc la paire pour former une exploitation durable. De cette façon, le changement de modèle agricole répondra efficacement à l'urgence climatique.

La meilleure stratégie pour réduire l'empreinte carbone des cultures se repose sur la transition vers une agriculture durable. Il s'agit notamment, d'opter pour une agriculture de conservation, d'améliorer l'efficacité énergétique, d'utiliser des engrais durables ou de réduire l'utilisation des terres. Par conséquent, selon cette stratégie, l'agriculture peut devenir un puits de carbone en utilisant des nouvelles technologies et techniques innovantes.



CLOSING CEREMONY

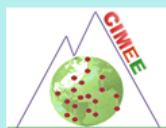


6th INTERNATIONAL Symposium on
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CLOSING REMARKS & CONFERENCE CONCLUSION (Lebanon, 26 October 2024)

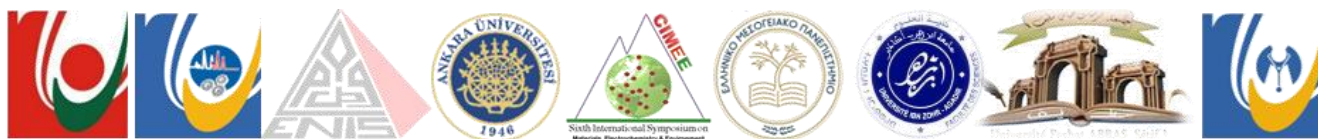


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Closing Session
Conclusion and perspectives



CLOSING SESSION

SIXTH INTERNATIONAL SYMPOSIUM ON MATERILS, ELECTROCHEMISTRY AND ENVIRONMENT

Sixième Colloque International sur les Matériaux, l'Electrochimie et l'Environnement, CIMEE24

October 24 – 26, 2024 - **LEBANON**

CLOSING SESSION & CONCLUSIONS

Theme: Environmental Sustainability through Green Chemistry and renewable Energy

6th International Symposium on Materials, Electrochemistry and Environment (CIMEE 2024)

Speech at the Closing Ceremony of the International Symposium, CIMEE24

Transition to sustainable agriculture as significant role in climate change mitigation

Respected colleagues, ladies and gentlemen,

As the conference draws to a close, I would like to express my sincere appreciation to all participants, speakers and partners who contributed to the roundtables and discussions.

The greatest threat to global security is climate crisis, but this climate instability, which affects many aspects of life on Earth, is no longer seen primarily as an environmental problem, but is creating an economic problem. Climate change has consequences that go to the heart of global security.

Security issues associated with climate change include impacts on food, water and energy supplies, increased competition for natural resources, loss of livelihoods, and climate-related disasters and economic disruption (the economic costs of climate change). In recent years, the threat and impact of climate-related or environmental hazards have increased worldwide. As a result, armed conflicts have increased in more than one region of the planet.

This is not about national security, but about collective security in an increasingly fragile and interconnected world. The most tragic thing is that, once again, those who are most vulnerable and least equipped to deal with this situation are the first victims.

Given that a quarter of global greenhouse gas emissions are caused by agricultural and livestock practices, which also consume 75% of water resources, sustainability is at the forefront of solutions to this climate crisis. Given this relationship between environmental sustainability and climate change. The question: How can sustainable agriculture help combat the climate crisis?

Indeed, sustainable agriculture meets today's needs without jeopardizing natural resources for future generations. It contrasts with productivist agriculture, which weakens the environment through the use of chemical fertilizers, herbicides, fungicides, insecticides and pesticides. Sustainable agriculture is therefore based on the concept of sustainable development and relies on a circular system in which the resources extracted have time to regenerate.

On the other hand, sustainable agriculture helps to conserve water resources. In fact, agriculture consumes almost 70% of the world's drinking water. Droughts will tend to increase in the coming years and coexist with periods of heavy rainfall. Farmers have possible and quick solutions at their disposal to respond to this: Water storage and the use of treated wastewater and artificial irrigation technology. Sustainable development and agriculture thus go hand in hand and form a sustainable business. In this way, changing the agricultural model will be an effective response to the climate emergency. The best strategy to reduce the carbon footprint of crops is based on the transition to sustainable agriculture. This includes opting for conservation agriculture, improving energy efficiency, using sustainable fertilizers or reducing land use. According to this strategy, agriculture can therefore become a carbon sink through the use of new technologies and innovative techniques.

The final declaration of the conference included an urgent call for more work to address the deteriorating environmental situation in a group of Middle Eastern countries, using innovative scientific methods based on the principle of circular economy and green economy. Participants in the conference activities issued a declaration that included a number of scientific recommendations to help organize investment in scientific projects to develop the agricultural sector and contribute to reducing emissions, and called for more solidarity and joint work among all researchers. Encourage experts and researchers and strengthen academic work to conduct applied research that contributes to the preservation of the environment and agriculture while relying on the green economy, in addition to the sustainable use of natural resources, the treatment of pollution, as well as the preservation of ecosystems, with a focus on international cooperation between universities in the Middle East, Europe and North Africa. All this can efficiently contribute to finding appropriate solutions for the environment and agriculture, especially in countries suffering from wars and conflicts.

Here are some suggestions on new technologies and sustainable strategies to achieve carbon neutrality as a solution to climate change and the well-being of our planet.

Thank-You Letter CIMEE 2024

Dear colleagues, participants and friends,

We would like to express our sincere thanks to all our colleagues. Your kindness and support have had a positive impact on the organization and success of this event. We are very grateful for your time and commitment during the 3 days of the conference. Our sincere thanks go to the support of all partners from Algeria, Greece, Morocco, Turkey, Tunisia and all other countries who gave us the opportunity to host this symposium, as well as the participation of all participants. We would like to take this opportunity to wholeheartedly thank our keynote speakers and all the speakers who made the conference a good and generous experience.

We hope that all the experts and guests attending this symposium can deepen friendship and strengthen cooperation, so that we can jointly promote the sustainable development of the environment. We also sincerely hope that all the distinguished guests and researchers here can participate in the great efforts to publish the best papers in partner journals. We look forward to seeing you again at the next edition of CIMEE'25 on September 25-27, 2025.

Many thanks to all of you!

Best regards



Book of Abstracts & Program

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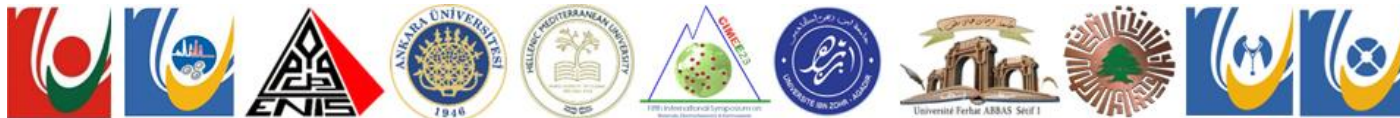
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Theme of the meeting:

Environmental Sustainability through Green Chemistry and renewable Energy
SYMPOSIUM PARTNERS



6th INTERNATIONAL Symposium on
Materials, Electrochemistry & Environment

October 24. - 26, 2024 | Lebanon

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This book composes the abstracts of the plenary, keynote, oral and poster presentations of the 6th International Symposium on Materials, Electrochemistry and Environment, CIMEE24, held in AUF, Lebanon, from 24 - 26 October 2024. The abstracts are reproduced as accepted by the Scientific Committee of the meeting.

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Colloque International sur les matériaux, l'électrochimie & l'environnement

DOI: 10.13140/RG.2.2.25256.58887

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