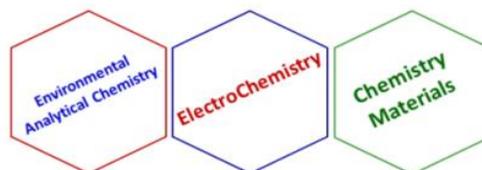


# 7<sup>th</sup>

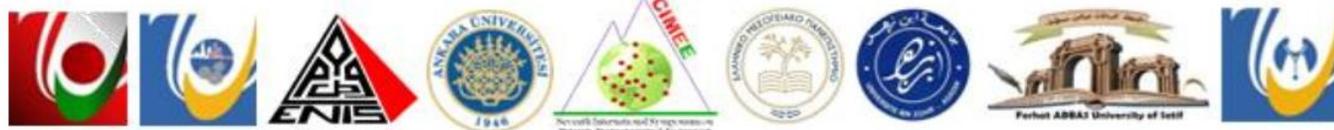
## International Symposium on Materials, Electrochemistry & Environment

September 25. - 27 2025 | Lebanon

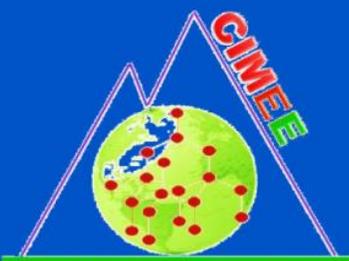
CIMEE'25



Theme Advancing sustainability through Materials,  
Electrochemistry & Green Energy



## BOOK of ABSTRACTS & PROGRAM



Seventh International Symposium on  
Materials, Electrochemistry & Environment

[cimee-science.org](http://cimee-science.org)

BOOK OF ABSTRACTS, SEVENTH INTERNATIONAL SYMPOSIUM, CIMEE25

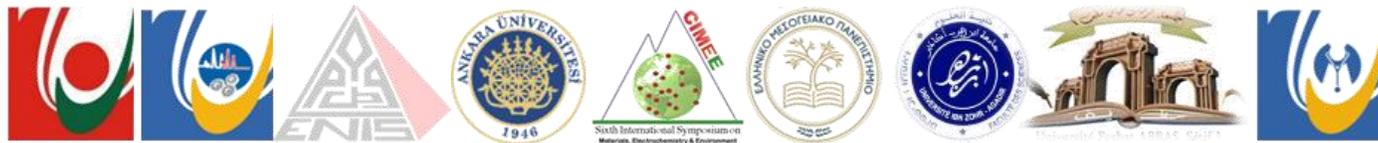


BOOK OF ABSTRACTS & SCIENTIFIC PROGRAM



**C I M E E**

INTERNATIONAL SYMPOSIUM ON MATERIALS, ELECTROCHEMISTRY & ENVIRONMENT



**BOOK OF ABSTRACTS & SCIENTIFIC PROGRAM**

**7<sup>th</sup> International Symposium on Materials Chemistry, Electrochemistry and Environment, CIMEE 25**  
7th International Symposium on Materials, Electrochemistry and Environment (CIMEE 2025)

**September 25– 27, 2025 | Lebanon**

The 7th International Virtual Conference on Materials Chemistry, Electrochemistry and Environmental Analytical Chemistry, invites participants from around the globe to engage in a collaborative environment dedicated to novel research, technology, and applications in the field. This conference is designed to unite experts in Materials Chemistry, Electrochemistry and Environmental Analytical Chemistry, as well as related disciplines such as AgroGeochemistry, Agroenvironment, Biowaste/bioenergy, physical chemistry, biological chemistry and green chemistry. Attendees will have the opportunity to connect, share ideas, and exchange the latest research results and advanced methods in these areas.

Organized by Lebanese university and 5 universities in Middle East, Europe and North Africa, this virtual event will feature a range of engaging activities, including plenary/keynote sessions, oral presentations, and poster presentations. Participants will have the chance to network with researchers from various institutions, universities, laboratories, and industries, fostering discussions and insights that can propel scientific discoveries. The conference aims to provide a platform for sharing knowledge and expanding research collaborations, making it a unique opportunity for professionals in the field to enhance their understanding and explore new approaches in Materials Chemistry, Electrochemistry and Environmental Analytical Chemistry.



In the face of growing global challenges—climate change, pollution, and resource scarcity—innovation is essential to ensure a sustainable and climate-resilient environment. CIMEE 2025 is an attempt to spark constructive dialogue, foster collaboration, and showcase groundbreaking technologies that advance sustainability and resource security, thereby creating a better and green future.

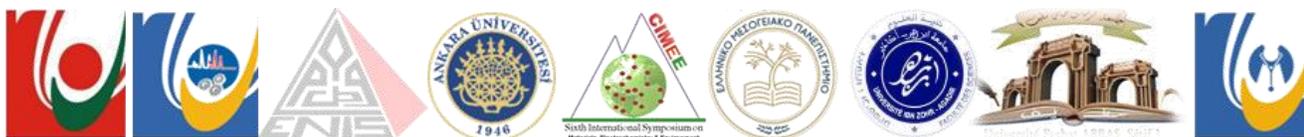




**CIMEE'25 SEPTEMBER 25-27, 2025, LEBANON**



THE WORLD EVENT IN INNOVATION CHEMISTRY & SUSTAINABLE ENVIRONMENTAL REMEDIATION

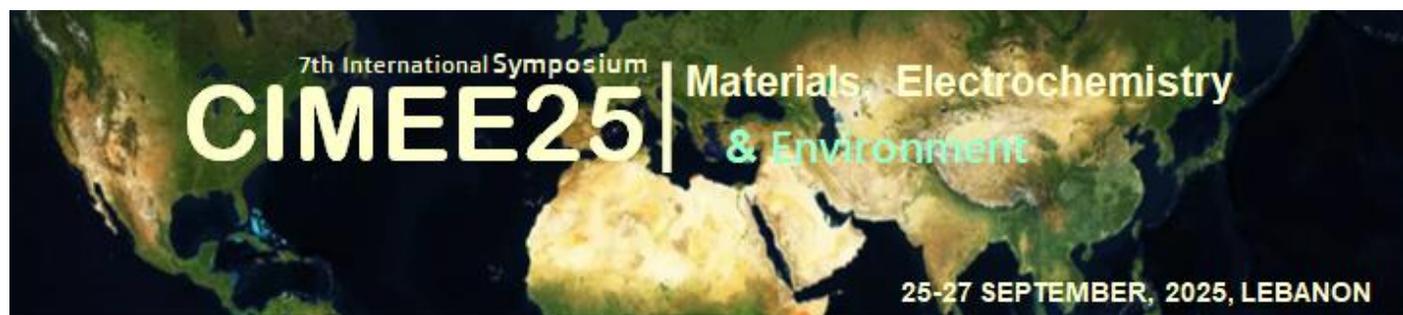


CIMEE25, THEME: ADVANCING SUSTAINABILITY THROUGH MATERIALS, ELECTROCHEMISTRY AND RENEWABLE ENERGY

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 Materials Technology and Photonics, Hellenic Mediterranean University, Heraklion, Crete, Greece	Lab. of Applied Chemistry & Environment, National School of Applied Sciences, ENSA, University of Ibn Zohr, Agadir, Morocco	Department of analytical Chemistry, Faculty of Pharmacy, Tandogan, Ankara University, Turkey
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### Conference Overview

Climate change and air pollution are indeed major problems that have serious and interconnected impacts on human health, resource availability, and ecosystems, and therefore require urgent action. Therefore, combating climate change, reducing waste and energy consumption, and maintaining a clean environment are urgent requirements for a sustainable global society.

Under the theme "Advancing Sustainability through Materials, Electrochemistry, and Green Energy," the CIMEE25 conference focuses on developing innovative solutions to reduce greenhouse gases (GHGs) and combat all forms of pollution, emphasizing the importance of sustainable natural resource management to build a healthier and more environmentally friendly future.

The partners have established themselves as leading platforms within the scientific community, each with a rich history of advancing knowledge and fostering innovation in the study of environmental problems using materials science, electrochemistry, and environmental analytical chemistry. This year, the focus has been on creating a unique forum to exchange the latest research, share cutting-edge technologies, and explore practical solutions to some of the most pressing environmental challenges of our time. The conference is a forum where world-renowned scientists in the fields of materials chemistry, electrochemistry, and environmental analytical chemistry present their latest research, perspectives, and cutting-edge technologies. Interactions exist between various disciplines, including ecotoxicology, atmospheric and earth sciences, agrochemistry, geochemistry and biogeochemistry, environmental technologies, and analytical chemistry.

We warmly invite you to join us as we work together to catalyze change toward a sustainable future.

# Welcome Message from Chairs

## WELCOME MESSAGE FROM SCIENTIFIC COMMITTEE CHAIR

### CIMEE25, SCIENTIFIC PROGRAM

#### Scientific Committee Chair

**THEME: ADVANCING SUSTAINABILITY THROUGH MATERIALS, ELECTROCHEMISTRY AND GREEN ENERGY**

#### Message from Scientific Committee Chair

Dear all,

On behalf of the Scientific Committee, I am pleased to welcome you to the seventh edition of CIMEE conference. At this unique conference, CIMEE'25 will provide a space for the presentation of high-quality technical papers in various research fields related to materials, electrochemistry, and the environment. It is important to note that the conference is technically co-sponsored by renowned international universities including:

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

Furthermore, the conference shall host a special session that provides a platform for relevant organizations to display their contributions, Experiences.

We received 80 initial abstract submissions to the conference, with authors from 18 countries worldwide. From those abstracts, 58 were recommended by a specialist-panel to proceed towards the next stage of submitting full papers. A peer-review process was used that consisted of 19 international reviewers. The oral presentations are organized into 17 technical sessions. All oral and poster papers are included in the conference proceedings. We are also pleased to have distinguished invited speakers for plenary and keynote talks and panel discussions from Algeria, Austria, France, Poland, Spain, Syria, UAE, Finland, Greece, Tunisia, Morocco, Pakistan, Romania, India, Ireland, Denmark and UAE.

Finally, I would like to take this opportunity to extend my gratitude to the technical program committees for his support for this conference as well as the all members of the Scientific Committee for their consistent and sincere efforts. Without all these efforts, this conference would not have become a reality. I hope that you will enjoy the conference program during your participation in this Edition. As a final note, all who has made this conference a successful and prosperous achievement for the service of the planet health.

*Scientific Committee Chairperson*  
*ELMOLL Ahmad*

## WELCOME MESSAGE FROM THE PROGRAM COMMITTEE CHAIR

### Message from the program committee chair

On behalf of the Technical Program Committee, it is my great pleasure to welcome you to the CIMEE25. Under the theme of “Advancing sustainability through Materials, electrochemistry and Green energy”. CIMEE25 brings together researchers from all over the world to discuss the latest advances in Materials, electrochemistry and environmental technology.

The technical program of CIMEE25 consists of 18 sessions as well as a special session entitled: Combined technologies for water, energy and solute recovery from industrial process streams. The conference also features 20 interesting keynote and plenary speakers who will highlight the state-of-the-art advancements in Materials chemistry, electrochemistry and environmental analytical chemistry. Together, all these forums present cutting-edge advances of both the scientific and industrial developments in environmental chemistry innovations. This edition, CIMEE25, 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 CIMEE25, 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 all 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



7<sup>th</sup> International Symposium On  
Materials, Electrochemistry &  
Environment

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

Dear Colleagues and Friends,

It is our great honor and pleasure to welcome you to the 7th International Symposium, CIMEE25, which will take place in Lebanon, from 25 to 27 September 2025.

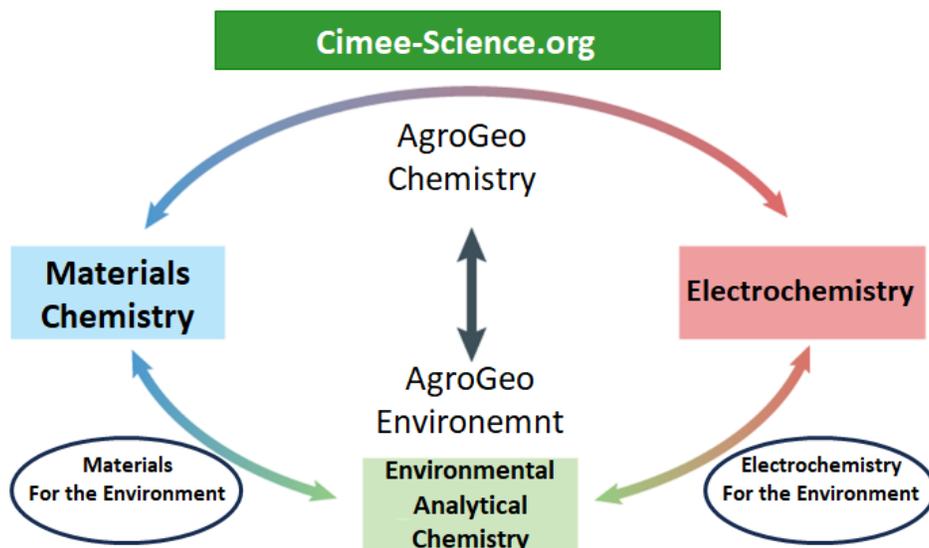
Climate change is accelerating in the Mediterranean, a hotspot where rising temperatures and altered rainfall patterns deplete vital natural resources like water, soil, and forests. Increased water scarcity, desertification and severe forest fires exacerbate soil erosion and forest degradation, threatening agriculture and creating a vicious circle where the vulnerability of ecosystems is increased by these phenomena. This environmental stress, combined with unsustainable resource use, creates a dangerous cycle that threatens the region's agriculture, food security, human health, and overall long-term sustainability.

This situation pushed us to adopt a theme for this conference: **Advancing sustainability through Materials, electrochemistry and green energy**. Three-days international symposium devoted to the main scientific areas in Materials chemistry, Electrochemistry and environmental analytical chemistry. A good number of participants from more than 25 countries around the world contributed to this edition of CIMEE25, and it is hoped that their research work is leading to solutions regional and global sustainability within planetary boundaries.

We promise you a rich scientific program composed of plenary and invited lectures. And several sessions (Regular & special sessions) between Materials chemistry, Electrochemistry, and environmental chemistry.

With warmest regards,

El Moll Ahmad, Ass. professor  
Conference Chair



## WELCOME MESSAGE FROM THE CONFERENCE CO-CHAIR



### 7<sup>th</sup> International Symposium On Materials, Electrochemistry & Environment

Dr. Konstantinos Plakas, Chemical  
Engineer, PhD / Senior, CERTH,  
Thessaloniki , Greece.

Dear Colleagues,

As Co-Chair of the Conference and Chair of the Advisory and Review Committee, it is my honor and pleasure to welcome you to the Seventh International Symposium, CIMEE25, which will take place in Lebanon, from 25 to 27 September 2025.

The Mediterranean basin, which connects 21 countries across Europe, Africa, and Asia, is a region defined by its climate and its sea, forming a homogeneous geographical and ecological space. However, it is considered a climate crisis hotspot, subjected to pressures from human activities, that have a severe impact on the ecosystem. These impacts include more frequent and intense heatwaves, droughts, wildfires, and rising sea levels, affecting ecosystems, economies, and communities. Moreover, the pollution of the environment, especially of the aquatic one, has no borders and affects all the neighboring countries, so regional co-operation is needed to solve it. Tackling these problems requires a multi-dimensional approach, including the use of innovative materials and sustainable processes that promote the long-term ecological balance.

At this symposium, we will focus on the investigation of innovative electrochemical processes, advanced materials and analytical methods to develop innovative solutions and technologies to tackle environmental issues. We look forward to your participation and hope you will take this opportunity to attend a conference focused on cutting-edge research in the fields of materials chemistry, electrochemistry, and the environment.

With warmest regards,

## 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.

CIMEE25 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](mailto:cimee16@ul.edu.lb)

We look forward to welcoming you soon!

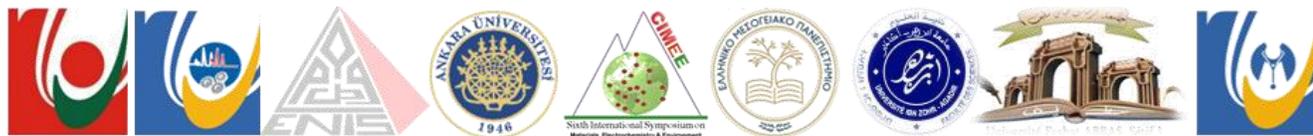
The organizing committee,

Ahmad A. El Moll

CIMEE25 Chairman



## CONFERENCE SCOPE & TOPICS



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

### CIMEE'25 TOPICS

<b>T 1. MATERIALS &amp; THE ENVIRONMENT</b>	<b>T 3. ATMOSPHERIC CHEMISTRY &amp; ENVIRONMENTAL POLLUTION</b>	<b>T 5. AGRO GEOENVIRONMENT, AGROCHEMISTRY &amp; BIOGEOCHEMISTRY</b>	<b>T 7. CLIMATE CHANGE, COASTAL &amp; MARINE ECOSYSTEM</b>
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Theme : Advancing sustainability through Materials, electrochemistry and green energy

<b>T 2. ELECTROCHEMISTRY, BIOELECTROCHEMISTRY &amp; ENVIRONMENT</b>	<b>T 4. STRUCTURAL, ANALYTICAL &amp; PHYSICAL CHEMISTRY</b>	<b>T 6. BIOTECHNOLOGY &amp; PHYTOCHEMISTRY FOR ENVIRONMENTAL SUSTAINABILITY</b>	<b>T 8. BIO-GREEN-ENERGY SCIENCE, WASTE TREATMENT &amp; TECHNOLOGY</b>
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<p><b>T 1. MATERIALS &amp; THE ENVIRONMENT</b></p> <ol style="list-style-type: none"> <li>1.1. Nanomaterials, Nanostructures &amp; Environment.</li> <li>1.2. Nanomaterial-based biosensors for pollutants detection</li> <li>1.3. Nanotechnology &amp; Nanobiotechnology for Environmental Remediation</li> <li>1.4. Carbon Nanotubes-Based Nanomaterials &amp; Their Applications</li> <li>1.5. Advanced Textile Materials for Composite Applications</li> </ol> <p>Energy, Developing new materials to clean energy cycles</p> <p><b>T 2. ELECTROCHEMISTRY, BIOELECTROCHEMISTRY &amp; ENVIRONMENT</b></p> <ol style="list-style-type: none"> <li>2.1. Electrochemistry for the Environment</li> <li>2.2. Electrochemical and environmental sensors, Biosensors technology</li> <li>2.3. Organic electrochemistry &amp; Bioelectrochemistry</li> <li>2.4. Electrochemical nanosensors and their application.</li> </ol> <p><b>T 3. ATMOSPHERIC CHEMISTRY &amp; ENVIRONMENTAL POLLUTION</b></p> <ol style="list-style-type: none"> <li>3.1. Aerosols, Air Pollution and Meteorology</li> <li>3.2. Atmospheric aerosols and their role in climate change</li> </ol> <p><b>T 4. STRUCTURAL, ANALYTICAL &amp; PHYSICAL CHEMISTRY</b></p> <ol style="list-style-type: none"> <li>4.1. Environmental chemistry, Analytical chemistry</li> <li>4.2. Air quality, Pesticides &amp; environmental monitoring,</li> <li>4.3. Bioremediation &amp; Phytoremediation of environmental Pollutants.</li> <li>4.4. Remediation Technologies Applied in the Environment</li> </ol>	<p><b>T 5. AGRO GEOENVIRONMENT, AGROCHEMISTRY &amp; BIOGEOCHEMISTRY</b></p> <ol style="list-style-type: none"> <li>5.1. AgroGeoenvironment &amp; Geomaterials</li> <li>5.2. Biomaterials, Waste &amp; biomass valorization</li> <li>5.3. Atmospheric Chemistry, air pollution, Geochemistry &amp; Earth Materials</li> <li>5.4. Agro-materials, &amp; Environmental geochemistry</li> <li>5.5. Agroecology and soil biology, Geochemistry &amp; Earth Materials.</li> </ol> <p><b>T 6. BIOTECHNOLOGY &amp; PHYTOCHEMISTRY FOR ENVIRONMENTAL SUSTAINABILITY</b></p> <ol style="list-style-type: none"> <li>6.1. Blue Carbon Ecosystems &amp; Climate Change Mitigation</li> <li>6.2. Role of Blue Carbon in Climate Change Mitigation</li> <li>6.3. Biomonitoring using biosensors for detection of environmental contaminants</li> <li>6.4. Sustainability through the valorization of agricultural and food waste</li> <li>6.5. Biotechnological innovations. Nano-formulations, biopesticides, biofertilizers &amp; soil health</li> </ol> <p><b>T 7. CLIMATE CHANGE, COASTAL &amp; MARINE ECOSYSTEM</b></p> <ol style="list-style-type: none"> <li>7.1. Coastal ecosystems, wetlands &amp; carbon sequestration</li> <li>7.2. Marine ecosystems, marine pollution &amp; Marine species</li> <li>7.3. Sustainable management practices in fisheries &amp; global warming</li> </ol> <p><b>T 8. BIO-GREEN-ENERGY SCIENCE, WASTE TREATMENT &amp; TECHNOLOGY</b></p> <ol style="list-style-type: none"> <li>8.1. Reducing global carbon emissions and transitioning to renewable energy</li> <li>8.2. Waste-to-energy conversion, biogas, biodiesel, bioalcohol, and bioelectricity</li> <li>8.3. Green technology, photoelectrochemical splitting for sustainable hydrogen production</li> </ol>
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# C I M E E

INTERNATIONAL SYMPOSIUM ON MATERIALS, ELECTROCHEMISTRY & ENVIRONMENT



SEPTEMBER 25 - 27, 2025 | LEBANON

**Technical programme committee members**

Confirmed technical programme committee members

Najla Fourati, CNAM, Paris, France

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

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

**PROGRAM AND BOOK OF ABSTRACTS**



## COMMITTEES

### COMMITTEES

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Dr. Ahmad El Moll, Faculty of public Health, Faculty of Science, DSST, Lebanese University, Lebanon

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Pr. Emmanuel Koudoumas, Dept. of Electrical & Computer Engineering, Hellenic Mediterranean University, Greece

Dr. Didier Hauchard, Institute of Chemical Sciences of Rennes, CNRS, High National School of Chemistry, Rennes, France

Pr. Kamel Ouari, Electrochemistry, Molecular Engineering & Redox catalysis Laboratory, LEIMCR, University of F. Abbas, Algeria

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Dr. Halim Hammi, LVMU, National Center for Research in Materials Sciences, Sousse, Tunisia

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Pr. Majeti N V Prasad, School of Life Sciences, University of Hyderabad, Hyderabad, India

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Dr. Marzena Smol, Head of Division of B.R M, Mineral & Energy Economy Research Institute, Polish Academy of Sciences, Poland

Pr. Mirela Suche, CEMATEP, Hellenic Mediterranean University, Heraklion, Greece [2] NIR&D in Microtechnologies, București, Romania

Pr. Ilkay Erdogan Orhan, Depart. of Pharmacognosy, Faculty of Pharmacy, Gazi University, Ankara, Turkey

Pr. Aziz Amine, Department of engineering and processes of Environment, FST, University Hassan II, Morocco

Dr. Lobna Elleuch, Wastewater & Environment Laboratory, Water Research & Technologies Center CERTE Soliman, Nabeul, Tunisia

 <b>CIMEE25 Scientific Program</b>	
Final Program Day 1 – Thursday September 25, 2025 (Morning session)	
<b>Opening Session, Lebanon time (GMT+3)</b>	
08h30 – 09h00	Registration
09h00 – 09h40	<b>Official Opening Ceremony:</b> Lebanese National Anthem and LU anthem  Speech by Professor Elie Hadchiti, the Dean of Faculty of public Health, Lebanese University,  Speech by Najat Aoun Saliba, Member of the Lebanese Parliament, Professor at the American University of Beirut and specializing in analytical chemistry, air pollution, environment, and chemical sciences.  Speech by Rachid Salghi, Professor at the National School of Applied Science, Ibn Zohr University, Agadir, Morocco. Negative Impacts of Climate Change on the Mediterranean Agricultural Sector & Innovative Solutions.  Speech by Konstantinos Plakas, Senior researcher at the Centre for Research & Technology-Hellas, CERTH, Thessaloniki, Greece Technological Innovation and Treatment Processes: Towards Smarter, Cleaner, and More Sustainable Water Resources management
Opening Plenary Session: Advancing sustainability through Materials, Electrochemistry and Green energy	
09h40 – 10h10	Opening plenary session. Advancing sustainability through Materials, Electrochemistry and Green energy Assoc. Prof. Ahmad El Moll, Lebanese university, Lebanon
Plenary Session I: Wastewater treatment & sustainable environment , Chair/Co-chairs A. El Moll, K. Plakas	
10h10 – 10h40	PL 1: Plenary Lecture: Treatment & reuse of industrial wastewater with the aid of Advanced Membrane Processes Dr. Konstantinos Plakas, Senior researcher, Centre for Research & Technology-Hellas, CERTH, Thessaloniki, Greece
Keynote Session I: Waste Biomass, management valorization & Circular Economy Chair/Co-chairs A. El Moll, K. Plakas	
10h40 – 11h40	KL 1: Hydrothermally Carbonised Biomass: Applications to Water Decontamination Pr. Najma Memon, National Centre of Excellence in Analytical Chemistry, University of Sindh, Jamshoro, Sindh, Pakistan  KL 2: Decision supporting tool to implement water reuse technologies Pr. Marzena Smol, Mineral & Energy Economy Research Institute of the Polish Academy of Sciences, Cracow, Poland  KL 3: Blue laccases for green textile wastewater treatment Pr. Susana Rodríguez-Couto, Lappeenranta-Lahti University of Technology LUT, Finland  KL 4: New approaches to wastewater treatment by coupling biological and photocatalytic technologies Dr. Lobna Elleuch, Wastewater & Environment Laboratory, Water Research & Technologies Center CERTE Soliman, Nabeul, Tunisia
Keynote Session II: Structural, analytical & physical chemistry	
11h40 - 13h20	KL 5 : Detecting Deception in Dietary Supplements: The Pivotal Role of Advanced Analytical Techniques Pr. Ilkay Erdogan Orhan, Dean at Lokman Hekim University, Faculty of Pharmacy, Ankara, Turkey, Turkish Academy of Sciences, Ankara, Turkey  KL 6 Future of bioanalytical chemistry: the potential role of miniaturized separation techniques & sustainability Pr. Marcello Locatelli, Depart. of Science, University “G. d’Annunzio” of Chieti-Pescara, Via dei Vestini 31, Chieti, Italy  KL 7 Environmental Metallomics : between essential & toxic metals in biological systems Pr. Ahmad El Moll, Faculty of Public Health, Faculty of Science, DSST, Lebanese University, Lebanon
13h20 – 13h30	Break Networking, Roundtable Discussion, Official Photo sessions
Keynote Session III: Waste management & sustainable Energy, Chair/Co-Chairs: K. Plakas, A. El Moll	
13h30 - 14h30	KL 8: BioH <sub>2</sub> production from biodegradable waste: opportunities and challenges Pr. Raffaella Pomi, Depart Civil engineering, University of Roma “La Sapienza”, Rome, Italy  KL 9: Nanofluids: Advanced Heat Transfer Fluids for Sustainable Energy Systems Dr. Zafar Said, Depart. of Mechanical & Aerospace Engineering, United Arab Emirates University UAEU, Al Ain, UAE Not Presented
14h30 – 14h45	Light Lunch Break, Roundtable Discussion, Official Photo sessions

Afternoon Sessions	
<b>Oral Session I: Structural, analytical &amp; physical chemistry Chair/Co-Chairs: K. Plakas, A. El Moll</b>	
14h45 – 15h45	<p><b>OP 1:</b> Determination of Reproductive Period and Sex Inversion of Migratory Species <i>Pagellus bogaraveo</i> in Syrian marine waters. Not Presented Waad George Sabour, Zoology Depart., Faculty of Sciences, Lattakia University, Lattakia, Syria</p> <p><b>OP 2 :</b> AI-Guided High-Energy PIXE for Multilayer Materials: Fast In-Air Elemental Profiling and Thickness Retrieval. Not Presented Diana El Hajjar Ragheb, Lebanese University, Faculty of sciences, Tripoli, Lebanon</p> <p><b>OP 3:</b> Climate change and implications in high Aflatoxin Contamination Incidence in maize, the situation in Albania. Not Presented Griserda Topi, Faculty of Natural Sciences, Depart. of Chemistry, University of Tirana, Tirana, Albania</p>
15h45 – 16h00	Break, Networking, Roundtable Discussion, Official Photo sessions
<b>Special Session I: Insights from CORNERSTONE EU project: chair/Co-Chairs: K. Plakas, A. El Moll</b> Combined technologies for water, energy and solute recovery from industrial process streams	
16h00 – 17h45	<p><b>OP4:</b> Introduction to CORNERSTONE project Ass. Prof. Cejna Anna Quist-Jensen, Center for Membrane Technology, Depart. of Chemistry &amp; Bioscience, Aalborg University, Denmark</p> <p><b>OP5:</b> Industrial wastewater treatment with hollow fiber nanofiltration for water reuse Saravidis V.C., Plakas K.V., Petsi P.N., Sioutopoulos D.C., Patsios S.I., Chemical Process &amp; Energy Resources Institute, CPERI, Centre for Research &amp; Technology – Hellas, CERTH, Greece</p> <p><b>OP6:</b> High-Purity water production from industrial wastewater using direct contact membrane distillation <b>Bousrih I.,</b> Díaz-Quezada S., Quist-Jensen C.A., Ali A., Center for Membrane Technology, Depart. of Chemistry &amp; Bioscience, Aalborg University, Denmark</p> <p><b>OP7:</b> Oscillatory flow-enhanced membrane distillation (OMD) for industrial water treatment applications <b>Hoefer C.,</b> Pane M.F., Sullmann L., Jeges C., Muster-Slawitsch B., AEE – Institute for Sustainable Technologies, Austria</p> <p><b>OP8:</b> Valorization of Industrial wastewater with Bipolar Electrodialysis for NaOH and HCl Recovery <b>Petsi P.N.,</b> Sioutopoulos D.C., Saravidis V.C., Patsios S.I., Plakas K.V., Chemical Process &amp; Energy Resources Institute, CPERI, Centre for Research &amp; Technology – Hellas, CERTH, Greece</p> <p><b>OP9:</b> Recovery of solutes from industrial wastewater using membrane crystallization <b>Díaz-Quezada S.,</b> Bousrih I., Quist-Jensen C.A., Ali A., Center for Membrane Technology, Depart. of Chemistry &amp; Bioscience, Aalborg University, Denmark</p> <p><b>OP10:</b> Industrial Adoption of Water Circularity Technologies – Analysis of Economic, Social and Environment. Barriers and Enablers <b>O'Connor A.,</b> Hennessy A., Gaskin C., 20FIFTY partners, Ireland</p>
17h45– 18h30	Official Photo sessions, Chair's Closing Remarks & End of Conference Day 1

## Special Session I:

### Combined technologies for water, energy and solute recovery from industrial process streams



		<b>Day 2: Friday September 26, 2025 (GMT + 3)</b>
08h30 – 09h00	Registration	
<b>Morning Sessions</b>		
<b>Plenary Session II: Electrochemistry and the Environment, Chair/Co-Chairs: A. El Moll, K Plakas</b>		
09h00 – 09h30	PL 2 : Molecularly imprinted polymers for the detection & remediation of emerging pollutants: Strengths, limitations, & future perspectives Pr. Najla Fourati, CNAM-Paris, France	
<b>Keynote Session IV: Nanomaterials for Environmental Sensing and Remediation N. Fourati, A. El Moll, K Plakas</b>		
09h30 - 10h40	KL 11: Environmental sustainability and the role of nanostructured films in sensing. Not presented. Pr. Osvaldo N. Oliveira Jr., Sao Carlos Institute of Physics, University of Sao Paulo, Brazil. Not presented Tailoring Surface and Optical Properties of Trivalent Metal-Doped ZnO Thin Films for Environmental Sensing and Remediation KL 12: Pr. Mirela Petruta Sucheai, National Institute for Research & Development in Microtechnologies - IMT Bucharest, Romania Center of Materials Technology & Photonics, (HUM), Heraklion, Crete, Greece KL 13: Performance evaluation of various Proton Exchange Membrane (PEMs), cathodes, anodes & factors affecting the performance of the Microbial Fuel Cell (MFC) Not presented. Dr. Balendu Shekher Giri, School of Advanced Engineering, University of Petroleum & Energy Studies, UPES, Dehradun, India	
<b>Plenary Session III: Structural, analytical &amp; physical chemistry, Chair/Co-Chairs: N. Fourati, A. El Moll, K Plakas</b>		
10h40 – 11h10	PL 3 : Quantum Materials, technologies and Key applications Pr. Kamel Besbes, Centre for Research on Microelectronics & Nanotechnology, CRMN, Sousse Technopole, Tunisia	
<b>Keynote Session V: Nanomaterials &amp; sustainable environment, Chair/Co-Chairs: N. Fourati, A. El Moll, K Plakas</b>		
11h10 – 12h30	KL 14: Smart Catalysts for Water Disinfection: Bimetallic Metal-Organic Frameworks and Advanced Oxidation Processes Synergy Pr. Marta Pazos Currás, CINTECX, Depart. of Chemical Engineering. Universidade de Vigo, Spain KL 15: From Curcumin to Catalysts: Green Nanomaterials & Spectroscopic Strategies for a Sustainable Future Pr. Patra Digambara, Depart. of Chemistry, American University of Beirut, Beirut, Lebanon KL 16: Synergistic Advanced Chemical Processes for water and wastewater treatment applications Pr. Grzegorz Boczkaj, Gdańsk University of Technology, Faculty of Civil & Environmental Engineering, Gdańsk, Poland KL 17: Bioactive Polymers from Marine Diatoms: A Multifunctional Platform for Lead Removal and Water Treatment Applications Dr. Jihen Elleuch, Labo. of Enzyme Engineering & Microbiology, National School of Engineers of Sfax ENIS, Sfax, Tunisia	
12h30 – 13h30	Light Lunch - Break Networking, Official Photo sessions	
<b>Afternoon Sessions</b>		
<b>Oral Session II: Structural, analytical &amp; physical chemistry, Chair/Co-Chairs: A. El Moll, K Plakas</b>		
13h30 – 15h00	OP 11: Exploring Atmospheric Composition and Climate Extremes in the Mediterranean and Surrounding Regions Using Satellite Observations Sarah Safieddine, LATMOS/IPSL, Sorbonne Université, UVSQ, CNRS, Paris, France OP 12: Molecular docking studies to elucidate the structure of a novel Bacillus thuringiensis toxin to be used as a biopesticide Fatma Driss, Laboratory of Biopesticides, Centre of Biotechnology of Sfax, Sidi Mansour Road km 6, Sfax, University of Sfax, Tunisia. OP 13: Harnessing Green Chemistry for Environmental Remediation: BiVO <sub>4</sub> -Polyaniline Hybrid as a High-Performance Visible-Light Photocatalyst. Not presented Divya Sharma Amity Institute of Applied Sciences, Amity University, Sector 125, Noida, Uttar Pradesh, India	
<b>Poster Session I : Structural, analytical &amp; physical chemistry Chair/Co-Chairs: A. El Moll, K Plakas</b>		
15h00 – 16h00	PP 1: First Record of the Parasite Nematodes Anisakis simplex in the migratory Fish Species Pagellus bogaraveo in Syrian Marine Waters. Not presented Mai M Masri, Department of Marine Biology, High Institute of Marine Research, fish biology and biodiversity, Lattakia - Syria. PP 2: Ultrasound-assisted extraction of tangerine peels – polyphenol profile and antioxidant activity. Not presented Biljana Lončar, University of Novi Sad, Faculty of Technology Novi Sad, Novi Sad, Serbia Not presented	
<b>Oral Session III: Bio-Green-Energy Science, Waste treatment &amp; Technology Chair/Co-Chairs: N. Fourati, A. El Moll</b>		
16h00 - 16h30	OP 14: Tripoli wastewater treatment plants: advanced technology for sewage sludge valorization	

	Issa Mohammad B., Kahil Abde Rahim, Omar Ahmad M., Ahmad El Moll, Energetic Physics M2, Faculty of science S3, Lebanese University, Lebanon OP 15: Study and implementation of a geothermal heating system for the Lebanese University in Tripoli Diana Abdallah Owaida, Faculty of science S3, Lebanese University, Lebanon
16h03– 17h30	Official Photo sessions, Chair's Closing Remarks & End of Conference Day 2

	<b>Day 3: Saturday September 27, 2025 (GMT + 2)</b>
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08h30 – 09h00	Registration
<b>Morning Sessions</b>	
<b>Plenary Session IV: Hydrogen &amp; energy transition, Chair/Co-Chairs: A. El Moll</b>	
09h00 – 09h30	PL 4: Transition to Hydrogen Economy: integrating strategy for Climate & energy solutions Pr. M.N.V. Prasad, Depart. of Plant Sciences, University of Hyderabad, Telangana, India
<b>Keynote Session VI : Water Energy and Materials for Sustainable Agriculture. Chair/Co-Chairs: A. El Moll</b>	
09h30 - 11h00	KL 18: Climate Change & Water Resources in Morocco: Challenges & Innovative Solutions Pr. Rachid Salghi, Labo. of Environmental Engineering & Biotechnology, National School of Applied Science, Ibn Zohr University, Morocco KL 19: Exploring the Role of Materials and Energy in Sustainable Agriculture Dr. Md. Habibur Rahman, Novel Global Educational Foundation, Australia KL 20: Metal modified Bismuth based Photocatalyst for Efficient Photodegradation and CO2 Reduction. Not Presented Dr. Seema Garg, Dept. of Chemistry, Amity Institute of Applied Sciences, Amity University, Noida. India
<b>Keynote Session VII: Biotechnology, biomaterials &amp; Sustainable Agriculture, Chair: A. El Moll,</b>	
11h00 – 12h00	KL 21: Circular Bioeconomy for Sustainable Agriculture through biopesticides development Pr. Slim Tounsi, Laboratory of Biopesticides, Centre of Biotechnology of Sfax, University of Sfax, Tunisia. KL 23: Effects of Edible coating materials on storage life and quality of apples Dr. Dalila Hammiche, University of Béjaïa, Faculty of Technology, Lab. of Advanced Polymer Materials, Algeria
12h00 – 12h30	Lunch Break – Networking, Official Photo sessions
<b>Afternoon Sessions</b>	
<b>Keynote Session VII: Waste valorization and Hydrogen production, Chair: A. El Moll</b>	
12h30 – 13h30	KL 24: Advanced Catalytic Systems for Large Scale H2 Production via Solar Water Splitting Pr. Tokeer Ahmad, Depart. of Chemistry, Jamia Millia Islamia, Jamia Nagar, New Delhi, India. KL 22: Utilization of Nanocomposites in Environmental Pollution Cleanup Pr. Ayşegül Pala, Faculty of Engineering, Depart. of Environmental Engineering & Division of Nanoscience & Nanoengineering, Tunaztepe Campus, Buca, Izmir, Turkey KL 25: Urban air quality: towards innovative sensor technologies & the potential use of Artificial Intelligence Pr. Ahmad El Moll, Faculty of Public Health, Faculty of Science, DSST, Lebanese University, Lebanon
13h30 – 14h00	Refreshments - Break Networking, official photo session
<b>Workshop: Innovative technology for water resources conservation and sustainable Energy Chair/Co-Chairs: A. El Moll</b>	
14h00 – 15h00	Workshop: Floating solar technology as an innovative approach to simultaneously boost electricity generation & conserve vital water resources. Dr. Benramel Mostafa, Ecological Minarets Association for Development and Climate, Kenitra, Morocco
<b>Workshop: Advancing sustainability through Materials &amp; electrochemistry, Chair A. El Moll</b>	
<b>Workshop A: Electrochemistry &amp; Environmental Sustainability</b>	
15h00 – 16h00	<b>Workshop A: Electrochemistry &amp; Environmental Sustainability</b> I- Electrochemistry & Environmental Sustainability II- Advances in Nanotechnology for Carbon Capture & Environmental Sustainability III -Improving water governance for long-term sustainability by integrating decentralized systems, nature-based solutions (NBS), & circular economy approaches.
<b>Workshop B: Nanoremediation Technologies: Innovative solutions for sustainable Environment</b>	
16h00 – 17h30	I - Nanomaterials & Nanotechnologies for Environmental sustainability: A - Nanoremediation technologies for climate change mitigation B - Nanotechnology approaches to agricultural soil pollution remediation II- Agricultural chemistry: developing innovative solutions to Achieving Sustainability in the Agro-Environment III- Improving food security and reducing the environmental impact of agriculture: the role of Technological solutions
17h30 – 18h00	Closing session, recommendations, Perspectives and brainstorming
<b>Closing Ceremony</b>	

CIMEE25 OFICIAL OPENING CEREMONY

Opening Ceremony

Opening Ceremony, - Thursday 25 September 2025

OPENING SESSION

CIMEE | International Symposium on Materials,  
Electrochemistry & Environment | 2025



Advancing sustainability through Materials, Electrochemistry & Green Energy

Opening Ceremony

Thursday, September 25, 09 AM

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

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

**Speech by the Dean of the Faculty of Public Health at the Lebanese University, Professor Dr. Elie Hadchiti**



We welcome all researchers from around the world.

The Dean highlighted the essential role of the Faculty of Public Health at the Lebanese University in strengthening the healthcare system in Lebanon, through health centers and public institutions, particularly during times of economic crisis and various social challenges. He emphasized the Faculty's goal of contributing to the development of public health by improving students' learning and discovery skills, enabling them to acquire competencies and develop their abilities throughout their academic and research careers.

He added that the presence of the Faculty of Public Health at the Lebanese University is essential to the development of the healthcare sector, strengthening this role through cooperation at the local and international levels, and providing all the necessary resources to ensure an environment conducive to scientific research and skills development, which constitute the pillars of community health and safety.

We greatly appreciate this pioneering role of the Faculty of Public Health and are committed to supporting it in its development strategies and local and international scientific cooperation. We hope that the proceedings of this international scientific conference, CIMEE25, will be an opportunity to explore the latest advances in various fields of health and the environment, with renowned speakers from around the world.

# Opening Ceremony

Speech by Professor Dr. Najat Aoun Saliba, Member of the Lebanese Parliament, Lebanon



الجمهورية اللبنانية  
مجلس النواب



Speech by Professor Najat Aoun Saliba, Professor at the American University of Beirut and Member of the Lebanese Parliament, specializing in analytical chemistry, air pollution, environment, and chemical sciences.

The speech began by welcoming the participants, scholars and experts at the Seventh International Symposium, CIMEE25.

She highlighted the importance of pollution-related diseases and the damage they cause to human health in Lebanon. She also emphasized the impact of pollution on the competitiveness and growth of national economies, as well as greenhouse gases and the effect of climate change on the planet. She therefore emphasized the importance of supporting efforts to preserve the pillars of a healthy society: from the right to breathe clean, unpolluted air to the right to drinking water, including waste management, incineration, and illegal dumping. This requires cooperation with specialists and experts in Lebanon and around the world to enact laws and create mechanisms and decrees for their effective implementation, according to a scientific, clear, and transparent methodology that serves the entire community. She emphasized the importance of working for the well-being of people, their health and safety, the development of institutions in Lebanon, and the preservation of its environment, whether through legislation and laws in Lebanon or through cooperation with international organizations, such as the World Health Organization and the United Nations Environment Program, in order to preserve natural resources, protect the environment, and avoid risks and disasters. She then stated that the port explosion was one of the most difficult circumstances Beirut experienced in 2020, in terms of the number of victims, destruction, and pollution it caused. In her speech, she emphasized the importance of the commitment to continue work and intensify efforts to achieve sustainable development. She stated that this determination is the most eloquent message of hope for preserving the environment and improving the quality of life. She hoped that the conference's recommendations would contribute to the formulation of innovative solutions to improve air quality, how to address the damage caused by pollutants, the role of technology in solving environmental challenges and the mechanism for international cooperation to contribute to reducing carbon emissions.

# Opening Ceremony

Speech by Professor Rachid Salghi, Professor at Ibn Zohr University, Morocco



## Negative Impacts of Climate Change on the Mediterranean Agricultural Sector and Innovative Solutions

Welcome to the 7th International Symposium on Materials Science, Electrochemistry, and the Environment, we are pleased and honored to meet you at this edition of the conference. This event serves as a meeting point for research collaboration and academic exchange among participants specializing in diverse fields. It also combines cutting-edge research and technological innovations.

Climate change is one of the greatest challenges facing humanity in the 21st century. It threatens the stability of ecosystems and global economies and impacts all forms of life on the planet. Today, climate change has become a tangible reality experienced daily by farmers around the world, particularly in the Mediterranean basin. The Middle East and North Africa region is extremely vulnerable to climate change-related risks, with 60% of its population living in areas subject to severe water stress, a situation expected to worsen in the near future. Morocco, like other Mediterranean countries, faces significant environmental challenges, ranging from extreme heat waves to devastating floods, prolonged droughts, and changing rainfall patterns, threatening the agricultural sector, a key economic sector and source of employment. The drought, now in its sixth year, has become one of the most significant challenges facing the agricultural sector, a pillar of the country's gross domestic product. According to statistics from the Ministry of Agriculture, Morocco's agricultural sector contributes approximately 12% of the country's gross domestic product (GDP) and is the primary source of income for 40% of the country's working population.

Thanks to rapid technological advances, artificial intelligence has emerged as a powerful tool for developing more sustainable agricultural practices. It analyzes soil and climate data to determine the appropriate amounts of water and fertilizer, thereby reducing waste and negative environmental impacts. It also predicts agricultural disasters, such as droughts and pest infestations, allowing farmers to take preventive measures to preserve their crops and reduce losses. In Morocco, the adoption of smart drip irrigation systems has begun. These systems use sensors to measure soil moisture and nutrient levels, allowing the right amount of water and fertilizer to be delivered directly to plant roots. This technology improves crop quality and reduces the use of chemical fertilizers. We propose three recommendations:

- Strengthen regional and global cooperation by adopting an adaptation approach that transcends national borders.
- Diversify food sources and provide the necessary financing to implement climate change adaptation measures.
- Support regional cooperation to develop monitoring and early warning systems for climate-related disasters, and engage in regional cooperation and dialogue on food production systems.

We hope that the conference recommendations will provide insights that will contribute to combating climate change, reducing carbon emissions, preserving natural resources, addressing waste-related pollution, and achieving sustainability.

# Opening Ceremony

Speech by Dr. Konstantinos Plakas, Senio researcher at CERTH, Thessaloniki, Greece



**CERTH**  
CENTRE FOR  
RESEARCH & TECHNOLOGY  
HELLAS

## Technological Innovation and Treatment Processes: Towards Smarter, Cleaner, and More Sustainable Water Resources management

Water scarcity is a major and growing global problem, and climate change is expected to exacerbate this problem with increased frequency, spread, and severity of droughts. A number of countries around the world lack access to safely managed sanitation services, and 80% of the world's wastewater is inadequately treated and flows into rivers, lakes, and seas. Up to 36% of the world's population lives in areas experiencing water scarcity.

Providing water and sanitation services is among the greatest threats to economic progress, poverty eradication, and sustainable development. The availability of reused water is an investment opportunity and a valuable resource for many sectors, such as industry and agriculture, reducing demand on limited water resources. Power plants, refineries, and factories can use recycled water. At the same time, it is now well known that effective wastewater management contributes to improved resilience to climate change by reducing greenhouse gas emissions. Proper wastewater management also contributes to lower levels of wastewater-related pollution of coastal and environmental conditions. Wastewater treatment is now based on the principles of a circular economy, climate neutrality, and low-carbon water treatment, as part of international efforts. Over the last decade, advances in membrane technology have intensified the implementation of WWRFs, with related research and innovation activities focusing on compact, hybrid processes that combine membrane processes with biological and advanced redox techniques. Typical examples are the membrane bioreactors (anaerobic and aerobic), the photocatalytic membrane reactors and the reactors combining powdered carbon adsorption with ultra- or nanofiltration, for which extensive research efforts have been undertaken in the authors' laboratory in the framework of competitive national, European, Euro-Mediterranean and industrial projects. Extensive exchange of experiences is underway in Europe and a number of international research centers, and lessons learned from research and development efforts in the field of wastewater treatment technologies, and recommendations for future research priorities.

The Eastern Mediterranean region can benefit from these experiences and make wastewater management more effective, coasts free of pollution and emissions, as well as transform wastewater into an alternative source of clean water and energy capable of irrigating agricultural lands.

We look forward to this conference being a platform for innovative ideas and scientific solutions, and a step toward a closer partnership among all partners and participants for a better environment and a safer world. I wish you fruitful discussions.

Thank you

## OPENING KEYNOTE LECTURE

Welcome Speech by El Moll on the CIMEE25 Opening ceremony



Dear attendees, esteemed researchers and friends,

Welcome to this wonderful day, where we celebrate together the launch of the 7th International Symposium, CIMEE25.

Our world today faces multifaceted crises, exacerbated by pollution, the negative impacts of climate change, and global conflicts on the planet. In fact, the severity of effects caused by climate change depend primarily on the trajectory of human activities. It has become clear that Science, technology, and innovation are fundamental to addressing the world's environmental and climate challenges. Therefore, it is essential to highlight the role of materials science, electrochemistry, technology, and innovation in tackling these challenges, such as pollution, climate change, and the depletion of natural resources. This is why the theme for this edition CIMEE25 was chosen "Advancing Sustainability through Materials, Electrochemistry & Green Energy"

Our conference attracts a diverse audience, including researchers, scientists, academics and industry professionals, all coming together to exchange ideas and insights on the broad landscape of chemistry. From seasoned chemists to renowned electrochemists, from industry experts to eager learners, our gathering provides a platform for collaboration and exploration.

We explore a wide range of topics, encompassing materials chemistry, electrochemistry, analytical and bioanalytical chemistry, nanotechnology, and much more. We delve into discussions on the role of chemistry, electrochemistry, geochemistry, agriculture, and environmental sustainability in finding solutions to environmental problems, offering opportunities for learning, advancement, and development of solutions in areas such as solid waste, wastewater management and clean energy production.

This event serves as a leading platform for presenting and discussing research findings among colleagues, academics, and experts, thus contributing to the development of senior and young researchers' skills and encouraging their engagement in an active and interdisciplinary scientific environment. It also aims to strengthen collaboration between research laboratories and centers both within Lebanon and internationally. This conference, which seeks to foster a culture of scientific research, has gained increasing national, regional, and international recognition over its previous editions, and this year witnessed broad participation from leading universities in Lebanon, the Middle East, and around the world.

A comprehensive program of presentations, workshops, and panel discussions will be tailored to diverse interests and experience levels. Through the theme chosen for this edition, we are interested in exploring the challenges and opportunities presented by technological advancements in materials chemistry, as well as the role of electrochemistry in environmental applications. In this way, the conference contributes to resource conservation and the reduction of carbon emissions as well as environmental pollution. Furthermore, participants will have the opportunity to present their latest research, establish collaborations, and explore innovative approaches to addressing global challenges.

Through the chosen theme of this edition, we would like to ask two questions:

1) How can we leverage this opportunity to discuss all available methods and processes for reducing carbon emissions, conserving natural resources, and addressing the pollution problems caused by solid waste and wastewater worldwide? Undoubtedly, we need a comprehensive approach that focuses on transitioning to a circular economy, investing in renewable energy, and implementing sustainable waste and water management practices.

2) How can we achieve sustainability through the application of materials science, electrochemistry, and green energy technologies? The answer can be summarized in 3 key points:

i) Materials science, electrochemistry, and green energy are converging to drive sustainability by enabling cleaner energy production, efficient storage, and environmental remediation. Recent advancements highlight the critical role of electrochemical technologies in carbon capture, water purification, and the production of green hydrogen and ammonia, all essential for a low-carbon future.

ii) Furthermore, Electrochemical innovations are pivotal for environmental sustainability, offering efficient and adaptable solutions for water treatment, carbon capture, and the electrochemical valorization of pollutants, thereby supporting a circular economy. Moreover, the development of advanced electrode materials and electrocatalysts is crucial for improving the efficiency of processes like electrochemical water treatment, CO<sub>2</sub> reduction, and hydrogen production.

iii) Finally, green energy technologies are central to achieving sustainability by reducing reliance on fossil fuels and mitigating climate change. Key solutions include especially biomass energy. The Biomass energy is a key component in achieving sustainability through green energy technologies, offering a renewable and versatile resource derived from organic materials such as agricultural residues, forestry by-products, organic waste, and sludge. This renewable energy source can be converted into heat, power, and biofuels using various technologies, including combustion, gasification, pyrolysis, anaerobic digestion, and fermentation, which are crucial for reducing dependence on fossil fuels and mitigating climate change. Recent advancements in biomass conversion technologies have significantly improved efficiency and output. Innovations in bioreactor design, biocatalysts and nanotechnology have boosted biofuel and bioenergy production.

It is my honor to express my gratitude to all partners as well as everyone who contributed to making our project a reality, whether through planning, implementation, or by offering suggestions, support, and advice. I wish you all success and good fortune in the proceedings of this conference, and we hope that its decisions and recommendations will reflect the significant responsibility we all share to ensure a better life and a cleaner environment for the Middle East, the Mediterranean region, and the world

Good luck

# OPENING PLENARY SESSION

## Advancing sustainability through Materials, Electrochemistry & Green Energy

Ahmad El Moll<sup>1</sup>

<sup>1</sup>Faculty of public health, faculty of science, Doctoral School for science & Technology, Lebanese university

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*Thematic Area: Materials, electrochemistry and environment*

### Abstract

In the face of the triple global crisis, a fundamental transformation of economic and environmental systems is necessary to ensure a sustainable future. Thus, integrating decarbonization, the circular economy, and sustainable energy will be a key strategic response, including waste reduction, pollution treatment, and ecosystem restoration, essential for strengthening ecological resilience and environmental sustainability. Achieving sustainability through materials, electrochemistry, and green energy involves leveraging innovative technologies to address environmental challenges and support sustainability. Sustainability in the fields of materials, electrochemistry, and green energy relies on a profound transformation of industrial processes, guided by the principles of the circular economy and the objective of decarbonization. Innovation in the principal sectors, particularly in the design of more sustainable materials and low-impact production processes, is essential to achieving global climate goals. These advances are generally part of a global approach aimed at replacing fossil resources with renewable materials, optimizing energy consumption and designing products so that they are harmless at the end of their life. All this will be developed through three key areas: • Sustainable materials: Research is moving towards bio-sourced and biodegradable polymers, particularly from household waste or glycerol, to reduce dependence on oil and plastic pollution. • Electrochemistry and Energy Storage: Approaches aim to reduce greenhouse gas emissions by developing efficient processes for wastewater treatment and sludge [1], environmental remediation, and carbon capture and storage. Innovations such as renewable organic electrodes and molecularly imprinted polymers are also being explored. [2] • In terms of green energy, the decarbonization of industries is supported by levers such as decarbonized hydrogen, carbon capture and storage, and the optimization of energy processes. Bioenergy thus represents an essential short- and medium-term solution to combat climate change by replacing fossil fuels and contributing to sustainable development. Biomass is essential for the transition to sustainable energy systems, while meeting global energy demand and supporting sustainability. The integration of green energies is central to these advances, as electrochemical systems, particularly electrolysis devices, convert renewable electrical energy into green hydrogen, a key solution to addressing the challenges of the energy transition and a clean fuel for transportation and industrial processes. Fuel cells, for their part, efficiently convert hydrogen back into electricity. Finally, the transition from laboratory research to industrial applications requires interdisciplinary collaboration and the optimization of catalysts, electrode materials, and system design. [2] [8] Ultimately, the convergence of materials science, electrochemistry, and renewable energy is essential to creating a sustainable environment.

**Keywords:** sustainability, Materials chemistry, Electrochemistry, green Energy, environment

### References:

[1] Najla Fourati, 2025, Molecularly imprinted polymers for the detection and remediation of emerging pollutants: Strengths, limitations, and future perspectives, plenary session CIMEE'25 conference

[2] Ahmad El Moll, 2025, Valorization of wastewater and sludge for green hydrogen production, (Chap 4) in the Book: Accelerating the Transition to a Hydrogen Economy: Achieving Carbon Neutrality, Elsevier.

**PLENARY SESSION I:**

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

7<sup>th</sup> International Symposium on Materials, Electrochemistry and Environment – CIMEE25**Treatment & reuse of industrial wastewater with the aid of advanced membrane processes**Plakas KV\*, Sioutopoulos DC, Patsios SI, Sarasidis VC, Petsi P, Karanasiou A, Karabelas AJ

*Natural Resources and Renewable Energies (NRRE) Lab., Chemical Process & Energy Resources Institute (CPERI),  
Centre for Research and Technology Hellas (CERTH), 6<sup>th</sup> Km Harilaou-Thermi Road, Thermi, Thessaloniki, Greece*

\* Corresponding author E-mail [kplakas@certh.gr](mailto:kplakas@certh.gr)*Thematic Area: Waste Treatment & Technology***Abstract**

Industry is one of the largest consumers of freshwater, as water is used for various purposes in industrial production processes (e.g. for cleaning plant and equipment, for cooling purposes and for the personal use of workers). At the same time, water stress is a major and growing global problem, while climate change is expected to exacerbate the problem as droughts become more frequent, larger and more severe. Consequently, it is a fact that the world needs to use water efficiently, reduce pressure on freshwater resources and seek alternatives to reuse treated wastewater. In this sense, the water industry is increasingly shifting from wastewater treatment plants, where compounds such as organic matter, nitrogen and phosphorus are removed, to wastewater resource recovery facilities (WWRFs), where wastewater is seen as an important source for the recovery of water, energy and valuable solutes, with digitalisation being an important tool to promote the industrial sector's transition to circularity and climate neutrality. Over the last decade, advances in membrane technology have intensified the implementation of WWRFs, with related research and innovation activities focusing on compact, hybrid processes that combine membrane processes with biological and advanced redox techniques. Typical examples are the membrane bioreactors (anaerobic and aerobic), the photocatalytic membrane reactors and the reactors combining powdered carbon adsorption with ultra- or nanofiltration, for which extensive research efforts have been undertaken in the authors' laboratory in the framework of competitive national, European, Euro-Mediterranean and industrial projects. Experiences and lessons learnt from the relevant R&D efforts are shared and recommendations for future research priorities are given.

**Keywords:** water reuse, circular economy, zero liquid discharge, advanced membrane processes**References:**

- [1] Karanasiou A. et al. (2025) *Membranes* 15: 189
- [2] Sarasidis V.C. et al. (2021) *J. Chem. Eng. Res. Updates* 8: 60-72
- [3] Petsi P.N. et al. (2021) *J. Env. Manag.* 298: 113526
- [4] Patsios S.I. et al. (2021) *J. Chem. Tech. Biotechnol.* 96(4): 1030–1039

## KEYNOTE SESSION I:

Waste & Biomass valorization,

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

## Hydrothermally Carbonised Biomass: Applications to Water Decontamination

Najma Memon

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*Thematic Area: Applications of agricultural biomass/waste materials in the remediation of environmental pollutants*

### Abstract

Hydrothermally carbonised (HTC) biomass has emerged as a sustainable and versatile material for addressing the global water crisis through effective decontamination. Derived from agro-wastes and organic residues, HTC biomass possesses unique physicochemical properties including high porosity, tunable surface functionality, and chemical stability, making it ideal for adsorption-based purification. This work underscores the transformation of natural and waste biomass into functional carbonaceous adsorbents—particularly sawdust, keratin, and cellulose—enhanced via thermal and chemical modification. These materials demonstrate exceptional performance in removing heavy metals (e.g., cadmium, chromium, thallium), pharmaceutical residues, and synthetic dyes from aqueous media. Optimized through techniques like response surface methodology (RSM) and functional group engineering, HTC-derived sorbents not only offer high adsorption capacities but also support circular economy principles by repurposing industrial by-products. This work involves integration of green chemistry with waste valorisation, making HTC biomass a promising frontier for scalable and eco-efficient water treatment technologies.

**Keywords:** Hydrothermal carbonization, Sustainable water purification, Carbonaceous adsorbents from waste, Agro-waste derived sorbents, Green chemistry in wastewater treatment

**Acknowledgements:** The research work carried out under this topic is funded by the Higher Education Commission of Pakistan under various programs.

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7<sup>th</sup> International Symposium on Materials, Electrochemistry and Environment – CIMEE25

## Decision supporting tool to implement water reuse technologies

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*Thematic Area: Wastewater technology and sustainability*

### Abstract

The dynamic development of the information technology (IT) industry is creating new opportunities to support the transformation towards a circular economy (CE). IT technologies enable the creation of innovative solutions for resource management, waste minimization, and the implementation of CE models. Paper presents one example of this approach that is used in the international ReNutriWater project, which is developing the "WaterSafe" IT tool. This tool aims to support municipal wastewater treatment plant (WWTP) operators in selecting water recovery technologies, in accordance with European Commission Regulation (EC) No. 741/2020 on water reuse in agriculture. "WaterSafe" offers three main functions: a technology selection calculator, a compendium of knowledge on water management and EU regulations, and recommendations for specific cases. This tool provides decision-making support for entities planning to implement water recovery, aligning with the EU's sustainable development goals. This IT tool is used to support the decision-making process of selecting a specific wastewater treatment method. It can be used not only by WWTP operators but also by all interested stakeholders and target groups considering implementing water recovery methods in their enterprises. As part of the project, the tool's functionality was tested on participants of a pilot "Safe Water" mentoring program, which is an integral part of the project. Further work on improving the IT tool will continue until the end of 2025.

**Keywords:** IT tools, water recovery, water sector, circular economy

**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).



## Blue laccases for green textile wastewater treatment

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*Thematic Area: Dyed Wastewater and environmentally friendly treatment*

### Abstract

Dyed wastewater is responsible for 20% of global water pollution. Various synthetic dyes are toxic, mutagenic, teratogenic, and carcinogenic. Dyes used in the textile industry have an environmental impact and cause algal blooms (aquatic flora and fauna), degrade soil quality, and pollute groundwater. Traditional physicochemical and activated sludge processes are ineffective. Furthermore, emerging technologies are expensive, energy-intensive, and generate toxic sludge and by-products. Therefore, new, economical, efficient, and environmentally friendly technologies are needed, particularly ligninolytic enzymes. Laccases exhibit broad substrate specificity. They are green enzymes that work with molecular oxygen (readily available in the air) and produce water as their only by-product. They operate under mild reaction conditions. They are produced in an environmentally friendly manner from living microorganisms. They are naturally biodegradable. Fungal laccases are primarily extracellular enzymes, possessing a high redox potential ( $E_0 > 720$  mV) and broad substrate specificity. Their glycosylation (10-25%) gives them stability and protects them from proteolysis. They degrade dyes into phenolic compounds instead of generating toxic amines like other oxidases. Laccase catalysis: Direct oxidation of an aromatic compound. Indirect oxidation of non-laccase substrates in the presence of a redox mediator and polymerization will be developed in this presentation. Numerous challenges prevent the use of laccases for textile wastewater treatment: Poor operational stability and shelf life. Commercially available products have limited applications due to their low redox potential. Laccases can be deactivated under harsh wastewater conditions. And complex recovery and reuse. The benefits of laccase immobilization will be discussed. In conclusion, fungal laccases offer considerable potential for treating textile wastewater efficiently and environmentally friendly. Immobilization is essential for the development of continuous laccase-based wastewater treatment processes. Further research under real-world conditions is needed to assess the true potential of laccase enzymes for textile wastewater treatment.

**Keywords:** textile wastewater treatment, Blue laccase; water pollution, environmentally friendly treatment

## New approaches to wastewater treatment by coupling biological and photocatalytic technologies

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*Thematic Area: Materials & The Environment*

### Abstract

The generation of wastewater due to human activities are the main responsible for environmental problems. These problems are caused by the large amount of organic and inorganic compounds related to the presence of complex and toxic pollutants [1]. This study investigates the performance of different processes coupling biological and photocatalytic technologies for the removal of toxic pollutants from landfill leachate, olive oil mill wastewater and cheese effluents. Nanoparticles were synthesized using the sol-gel method and characterized by several techniques. The optimal conditions of combined processes were determined and after wastewater treatments, the removal of organic matter and toxic compounds from wastewaters were evaluated. The impact of the treated olive oil mill wastewater on the morpho-physiological parameters of barley seeds and seedlings and young olive plants was evaluated, and the obtained results suggest its potential reuse as a biofertilizer.

**Keywords:** Biofertilizer, Hybrid process, Nanoparticles, Wastewater, photocatalytic technologies

**Acknowledgements:** The study on landfill leachate and olive oil mill wastewater was supported by the Tunisian Ministry of Higher Education and Scientific Research. The research on cheese effluents was financially supported by the Tunisian-Moroccan Cooperation Program, under the Scientific Research and Development Project, Edition 2020 (20/PRD-06).

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## KEYNOTE SESSION II:

Structural, analytical & physical chemistry

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

7<sup>th</sup> International Symposium on Materials, Electrochemistry and Environment – CIMEE25

## Detecting Deception in Dietary Supplements: The Pivotal Role of Advanced Analytical Techniques

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*Thematic Area: Structural Analytical & Physical Chemistry*

### Abstract

The surging popularity of dietary supplements highlights a growing interest in proactive health management. However, this expanding market faces substantial challenges related to product quality and authenticity. A primary concern is the adulteration of dietary supplements, where products may contain undisclosed ingredients, inaccurate dosages, or be falsely represented in their composition. Ensuring the safety and trustworthiness of these products necessitates robust and precise detection methods. Standard analysis techniques such as high-performance liquid chromatography (HPLC), gas chromatography-mass spectrometry (GC-MS), and liquid chromatography-mass spectrometry (LC-MS) are indispensable for identifying these issues. Analytical methodologies are crucial in this endeavor, providing the means to meticulously examine the chemical makeup of dietary supplements and pinpoint instances of adulteration. Beyond these established techniques, other analytical approaches like nuclear magnetic resonance (NMR) spectroscopy, various spectroscopic methods (UV-Vis, FTIR, Raman/SERS), electrophoretic techniques such as capillary electrophoresis (CE), immunochemical assays like ELISA, X-ray powder diffraction (XRPD), and DNA-based methods are also utilized. These are often employed for specific types of adulteration or as supplementary analyses. Notably, DNA barcoding is also employed to uncover adulteration in food supplements, particularly those of herbal and botanical origin. This method can confirm if the stated ingredient is indeed present and is the correct species. Certain categories of dietary supplements, notably those marketed for weight loss, sexual enhancement, and muscle building, exhibit a higher prevalence of adulteration. Adulteration frequently involves the incorporation of undeclared substances, which can include synthetic pharmaceuticals or their analogs, to bolster the perceived effects of the supplement. If DNA barcode analysis reveals plant species not listed on the label, it signals adulteration. This could signify substitution with a less expensive plant, the addition of fillers, or contamination. Our analyses of dietary products available in the Turkish market, as well as studies reporting adulteration in dietary supplements from numerous global regions, indicate a significant rate of adulterated or mislabeled products.

**Keywords:** Adulteration, dietary supplements, analysis, analytical methods, chromatography.

## Green Analytical Chemistry and Green Sample Preparation: State of the Art and Perspectives

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*Thematic Area: Green analytical chemistry: innovative solutions towards development of sustainable technologies*

### Abstract

Nowadays, there is an increasing focus on reducing the impact of human activities on the environment, together with greater protection of human health. In this area, much has been done in chemistry and analytical chemistry, especially through the development of the principles of Green Chemistry (GC) and Green Analytical Chemistry (GAC). Recently, also in terms of sample preparation, the most important and "problematic" step in the analytical field, we have witnessed the enunciation of the principles of Green Sample Preparation (GSP). These principles, which represent a milestone in the development of new procedures and devices, allow us to evaluate and review chemical activities (at all levels) and to review them in order to reduce the effects on the environment and on health. Today, several tools are available that, following these principles, allow both a standardized and visual assessment of the impact. An essential element in this field is represented by the miniaturization of techniques and separation procedures, which simultaneously allow to maintain high sensitivity of the analysis, as well as to reduce the amount of sample required, the production of waste and the consumption of solvents. In this invited presentation, I would like to present the state of the art in GC, GAC and GSP and related instruments precisely in relation to this aspect and we will see together what future perspectives await us in this increasingly important field of research.

**Keywords:** miniaturization, separation techniques, GAC, GC, GSP, tools.

7<sup>th</sup> International Symposium on Materials, Electrochemistry and Environment – CIMEE25

## Environmental Metallomics : between essential & toxic metals within biological systems

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Thematic Area: Analytical chemistry & sustainable environment

### Abstract

Environmental metallomics explores the complex interactions between essential and toxic metals within biological systems, focusing on their influence on living organisms and ecosystems. It links metal pollution to its effects on public health and the environment by examining metal concentrations, speciation, distribution, and toxicity. However, understanding the transport mechanisms of dissolved metals is crucial for predicting their accumulation and toxicity in living organisms. This knowledge makes it possible to anticipate risks associated with metal contamination and implement effective protection strategies for ecosystems and human health. To this end, this study focuses on the importance of understanding metal transport mechanisms, which will be studied by considering several points: accumulation prediction, environmental contamination management, toxicity assessment, and human health protection. These points will be essential for developing contamination management and public health protection strategies. On the other hand, in the context of monitoring, analyses relating to the detection and quantification of trace metal elements are generally carried out by measuring the "total" element. However, in environmental toxicology, the presence of a metal in "total" form does not reflect its real bioavailability or toxicity, because the latter depends on its oxidation state, its charge and its complexes with other substances. The study of speciation therefore makes it possible to evaluate the assimilation and the real dangers of an element for living beings, rather than its simple presence. In order to understand toxicity, the different forms (species) that a chemical element can take in a system (speciation) must be studied since the chemical form of an element strongly influences its bioavailability, its transport, and its fate in the environment, as well as its effects on health. To further understand the mechanisms of metal transport, the importance of speciation in toxicology will be studied to reveal the chemical form in which a metal exists in a given environment (e.g., soil, water) and which determines its transport, absorption and interaction with living organisms.

**Keywords:** Environmental metallomics, Speciation in toxicology, biological systems, metal transport mechanisms.

Key Aspects of Environmental Metallomics:

Essential vs. Toxic Metals:	Metal Speciation & Distribution:	Bioavailability & Toxicity:	Analytical Techniques:	Metabolic Pathways:	Environmental Applications:	Human Health:
Metallomics distinguishes between metals that are vital for biological functions (like iron or zinc) and those that can be harmful at high concentrations (like lead or mercury).	It investigates the different chemical forms of metals (speciation) and their distribution within cells, tissues, & the environment.	Metallomics helps understand how environmental factors influence the availability of metals for uptake by organisms and how this impacts their toxicity.	It utilizes advanced techniques like mass spectrometry (ICP-MS), chromatography, & spectroscopy to analyze the metal content and speciation in biological samples.	Metallomics also investigates how metals influence metabolic pathways & how these changes can be used as indicators of metal exposure and toxicity.	It has applications in bioleaching, phytoremediation, and understanding the effects of metal pollution on ecosystems.	Metallomics research is also crucial for understanding the role of metals in human health, including their involvement in disease development and potential as biomarkers.
1	2	3	4	5	6	7

Graphical abstract

## KEYNOTE SESSION III:

Waste management & sustainable Energy,

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

## BioH<sub>2</sub> production from biodegradable waste: opportunities and challenges

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*Thematic Area: Materials & the Environment*

### Abstract

The concept of biorefinery based on anaerobic digestion (AD) process that converts various wastes from easily degradable to challenging materials as well as carbon dioxide into many valuable products. Anaerobic digestion produces volatile fatty acids, biohydrogen, biogas, and bio-sludge. The drivers for implementing biorefineries are economic, environmental, political, social, and technical issues. Two concepts underlie the biorefinery approach: First, the cascade principle (a multi-stage process aimed at maximizing product yields while maintaining the positive economic balance of the entire process). Second, sustainability and environmental friendliness, this involves assessing the net impacts on human health, environmental quality, and natural resource consumption of the production and utilization stages of a biorefinery, compared to a conventional fossil fuel-based refinery. Organic fraction of municipal solid waste as feedstock, producing, bioplastics, biopesticides and other high value products. Moreover, agro-industrial waste biorefineries leverage anaerobic digestion (AD) to convert organic residues into multiple valuable products, aligning with circular economy principles. This presentation will explore the integrated processes for bio-H<sub>2</sub> production. Based on the mode of H<sub>2</sub> generation, the biological routes for H<sub>2</sub> production are categorized into five groups: Dark Fermentation, Dark Fermentation with PhotoFermentation, Dark Fermentation with biopolymers synthesis, Dark Fermentation with MEC, Bioelectrofermentation with anaerobic digestion and a combination of these processes.

**Keywords:** biohydrogen production, biorefinery, Organic waste, dark fermentation, photofermentation, MEC, Bio-electro-fermentation, anaerobic digestion

## Nanofluids: Advanced Heat Transfer Fluids for Sustainable Energy Systems

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Not Presented

*Thematic Area: T3. Atmospheric Chemistry & Environmental Pollution*

### Abstract

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With the growing global demand for effective and sustainable energy systems, the development of new heat transfer fluids has been a major field of study. Nanofluids, made up of well-designed colloidal suspensions with nanoparticles in conventional base fluids, have tremendous potential in this field. By exploiting the increased thermal conductivity, tunable thermophysical properties, and improved convective performance associated with nanofluids, researchers have achieved remarkable improvement in the performance of thermal management systems that are useful in a wide range of applications, from solar collectors and nuclear reactors to electronics cooling and industrial heat exchangers. The present lecture will give an overview of the basic principles controlling the behavior of nanofluids, such as the nanoscale heat transfer mechanisms, stability, and influences of nanoparticle morphology, concentration, and dispersion methods. The latest developments in hybrid nanofluids and phase-change nanofluids will be discussed with emphasis on their energy conversion and storage system efficiency. The session will also critically address the challenges of nanofluid implementation—long-term stability, scalability, cost-effectiveness, and environmental impact—and suggest research directions towards their commercialization and incorporation into next-generation energy infrastructure. Through the combination of the advances in nanotechnology and the principles of thermal engineering, nanofluids have the potential to revolutionize the control of heat in energy systems and provide more efficient, compact, and sustainable technologies to achieve a low-carbon future.

**Keywords:** Nanofluids, Heat Transfer, Fluids, Sustainable Energy

## ORALL SESSION I:

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

## Determination of Reproductive Period and Sex Inversion of Migratory Species *Pagellus bogaraveo* in Syrian marine waters

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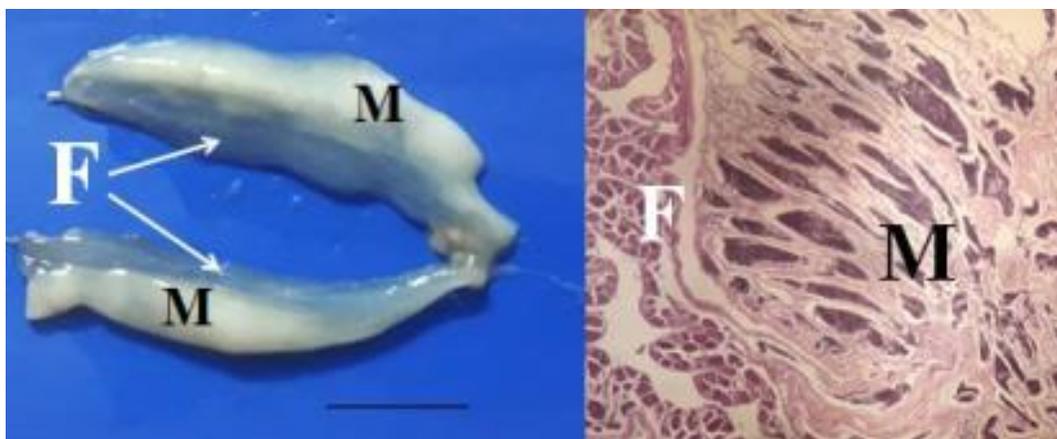
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Nor presented

Thematic Area: Climate change, Marine & coastal ecosystem

### Abstract

This study was carried out on /306/ individuals fish of *Pagellus bogaraveo*, which were caught from the Syrian marine waters, with the various fishing methods used locally at a depth of up to 300 m, from May 2020 to May 2021 to identify of evolution stages of maturation sexual (morphological and Histological), and determine the period and the peak of sexual maturity. The results showed that fish species *P. bogaraveo* begin to reach sexual maturity from the beginning of February and extend until May, with a single peak of sexual maturity in March, where the highest average value of the gonado-somatic index (GSI%) was  $(2.45 \pm 0.43)\%$  for the males and  $(3.46 \pm 0.33)\%$  for female. The results of the morphological and histological study of the stages of development of maturity of male and female gonads agreed with the breeding season of this fish species. some of individuals appeared in the stage of sex inversion of the Protandry type.



**Keywords:** *Pagellus bogaraveo*, reproductive period, Sex Inversion, Syrian marine waters.

**Acknowledgements:** We thank the laboratories of Lattakia University, and the funding provided by the researchers.

7<sup>th</sup> International Symposium on Materials, Electrochemistry and Environment – CIMEE25

## AI-Guided High-Energy PIXE for Multilayer Materials: Fast In-Air Elemental Profiling and Thickness Retrieval

Diana El Hajjar Ragheb<sup>1</sup>, Mostafa Ragheb<sup>1</sup>, Omar El Koussa<sup>1</sup>, Ibrahim Rifaii<sup>1</sup>

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Nor presented

*Thematic Area:* Materials Characterization

### Abstract

High-Energy Particle Induced X-ray Emission (HE-PIXE) provides a powerful, non-destructive method for detecting multiple elements in thick, multilayered materials. However, spectral complexity due to attenuation, scattering, and peak overlap makes accurate thickness and composition retrieval challenging. In this study, we present an AI-assisted, simulation-driven HE-PIXE framework for multilayer analysis. A Python-based forward simulator incorporates K-shell ionization cross-sections, fluorescence yields, self-absorption, air path attenuation, detector efficiency, and counting noise to model in-air experiments with 30–70 MeV protons. Synthetic datasets with controlled layer compositions and thicknesses were generated to train machine learning models. Supervised learning features included continuum slopes,  $K\beta/K\alpha$  ratios, and peak integrals. Random Forest regression, trained on 10,000 Fe–Cu multilayer spectra, achieved mean absolute errors near 0.8  $\mu\text{m}$  for elemental thickness prediction. Feature importance analysis highlighted  $K\alpha$  intensities as key predictors, linking AI decisions to underlying physical processes. Sensitivity analyses confirmed model robustness to thickness variation, layer order, and counting statistics. The approach enables rapid, realistic HE-PIXE dataset creation, reducing beam time requirements. While the Random Forest baseline demonstrates proof-of-concept, future work will explore full-spectrum convolutional neural networks for enhanced accuracy and generalization. This fusion of AI and physics modeling offers a promising route for high-throughput, non-destructive characterization in materials science, cultural heritage, and industrial quality control.

**Keywords:** Artificial Intelligence, Elemental Profiling, HE-PIXE, Multilayer Analysis, Non-Destructive Testing, Simulation.

**Acknowledgements:** This research was supported by the Lebanese University, Faculty of Sciences. The authors gratefully acknowledge the computational resources and technical support provided by the Physics Department.

## Climate change and implications in high Aflatoxin Contamination Incidence in maize, the situation in Albania

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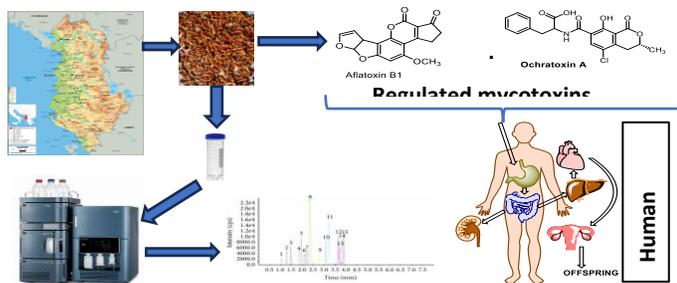
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Nor presented

Thematic Area: Environmental & Agricultural Chemistry

### Abstract

Anthropogenic activity over the past two centuries has profoundly impacted the planet, primarily through greenhouse gas emissions, the diminishing forest areas, and the reduction of arable land- all of which contribute to rising temperatures and are directly linked to climate change phenomena. Extreme weather events, such as heavy rainfall and droughts, increase plant stress, making cereals more susceptible to fungal infections and mycotoxin contamination, which consequently leads to lower yields and economic losses. These concerns extend beyond human health to animals as well. Climate change has been identified as a driver of emerging food and feed safety issues worldwide, and its expected impact on the presence of mycotoxins in food and feed raises great concern [1]. Different climate change scenarios predict a temperature increase of 2–3°C in temperate regions, including the European continent, which alters the presence of various fungi species and genera. *Aspergillus flavus*, a predominant fungus in tropical and subtropical areas, is spreading to southern Europe. This has led to aflatoxin contamination of cereals and nuts. Aflatoxin synthesis is inhibited when temperatures reach 37–40°C. Studies from the last decade indicate a high incidence of aflatoxin contamination in maize in Albania, as well as elevated occurrence levels [2,3]. Immediate intervention is necessary to address this issue [4]. Implementing good agricultural practices will assist farmers, and another intentional strategy involves applying atoxigenic *Aspergillus* species during crop planting.



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## SPECIAL SESSION I:

Special Session I: Insights from CORNERSTONE EU project:

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

Combined technologies for water, energy and solute recovery from industrial process streams

Special Session I: 

Combined technologies for water, energy and solute recovery from industrial process streams



7<sup>th</sup> International Symposium on Materials, Electrochemistry and Environment – CIMEE25

## Introduction to CORNERSTONE project

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*Thematic Area: Waste valorization & sustainable environment*

### Abstract

Industry is one of the main water users in Europe, accounting for about 40% of total water abstractions. Hence, water plays an essential role above all in the primary and secondary sectors and therefore also influences downstream value chains. It serves as an energy source, a component of products, a carrier medium for raw materials, and a cleaning medium. Complex wastewater streams are generated in EU member states. The discharge of industrial wastewater streams (either as direct discharge to water bodies or indirect discharge to municipal wastewater treatment plants) is associated with significant water footprints. Their management is further associated with high operating expenditures (OPEX) in chemicals and energy consumption. Additionally, the demand for water is forecasted to increase and is significantly influenced by climate change. The "European Innovation Partnership on Water" and the "Blueprint for the Protection of European Water Resources" prioritize the reuse of treated wastewater. CORNERSTONE is an EU-funded project which focuses on water, energy, and solute recovery, targeting end-users in the steel, P&P, and chemical industries. These industries are crucial in realizing the objectives of P4Planet to transform European process industries, making them circular and achieving overall climate neutrality at the EU level by 2050, thus enhancing their global competitiveness. Sixteen partners from eight European member states form a multidisciplinary consortium, which includes large enterprises, academia and research & technology organisations. CORNERSTONE's global goals are to achieve  $\geq 90\%$  reduction in wastewater,  $\geq 50\%$  reduction in carbon footprint, aiming for Zero Liquid Discharge solutions. For this scope, CORNERSTONE's specific objectives are:

- Test, advance, and optimize novel water treatment modules on a laboratory scale and design project systems in combination with existing industrial processes.
- Test, advance, and optimize smart monitoring tools for the digitalization and intensification of industrial processes.
- Integrate and validate cornerstone system configurations at three demonstration sites (steel, pulp & paper and chemical industries).
- Quantify the sustainability of cornerstone's solutions in environmental, economic, and social dimensions.
- Develop decision support tools for digitally enabled industrial water, energy, and resources stewardship.

**Keywords:** industrial process streams, water, energy and solute recovery, digitalization, transversal strategies

**Acknowledgements:** The Authors acknowledge the financial support of the EU Horizon under the projects CORNERSTONE "Combined technologies for water, energy, and solute recovery from industrial process streams" (HORIZON-CL4-2023-TWIN-TRANSITION-01-40, Grant Agreement No. 101072449).

7<sup>th</sup> International Symposium on Materials, Electrochemistry and Environment – CIMEE25

## Industrial wastewater treatment with hollow fiber nanofiltration for water reuse

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*Thematic Area: Waste valorization & sustainable environment*

### Abstract

Nanofiltration (NF), as a well-established membrane process, has made major progress over the last decades, finding numerous applications beyond brackish water treatment and desalination. Among others, drinking water purification, water reuse, micropollutant removal and increasing use in food and pharmaceutical processing, are the current leading applications. Nevertheless, the separation of multivalent ions (e.g. hardness) from various wastewaters and industrial process streams still plays a central role. This work investigates the treatment of two real industrial wastewater streams (pH 6.9-8.2, eC 1.9-2.5 mS/cm, 11-150 mg/L COD, 117-146 mg/L Ca<sup>2+</sup>, 11-13 mg/L Mg<sup>2+</sup>, 156-249 mg/L SO<sub>4</sub><sup>2-</sup>, 99-472 mg/L Na<sup>+</sup>, 16-227 mg/L K<sup>+</sup>, 189-316 mg/L Cl<sup>-</sup>), originating from a steel and a pulp & paper industry (Samples A and B respectively), using NF process. The aim was to recover high quality water for recycling in the production plants and to evaluate the performance of hollow fiber NF membranes while mitigating potential membrane fouling and/or scaling. A series of batch mode cross-flow filtration experiments were conducted, in a fully automated laboratory pilot unit, under various key operating parameters, including initial applied pressure, cross-flow velocity and water recovery. Two commercial hollow fiber NF membranes were tested, differing only in their molecular weight cut-off (MWCO), values of 400 and 800 Daltons respectively. Experimental results showed that NF membranes can successfully treat both industrial wastewater streams, achieving high rejection rates of divalent ions (82-89% Ca<sup>2+</sup>, 82-87% Mg<sup>2+</sup>, 85-95% SO<sub>4</sub><sup>2-</sup>), under optimal conditions, even in high water recoveries of up to 87%, rendering NF process suitable for water softening and reuse. Moreover, the higher MWCO membrane exhibited better performance in achieving the simultaneously desirable low rejection of monovalent ions (Na<sup>+</sup>, K<sup>+</sup>, Cl<sup>-</sup>), while a rather low fouling/scaling tendency of the membranes was recorded, with only minor exceptions when treating Sample B, as indicated by the temporal variation of transmembrane pressure. Ongoing work focuses on optimizing the process through screening tests with commercial flat-sheet loose NF membranes aiming to sustain water productivity, enhance solute recovery (high selectivity towards divalent ions) and minimize energy consumption.

**Keywords:** cross-flow nanofiltration, industrial water softening, membrane fouling, water recycling.

**Acknowledgements:** The study is part of the CORNERSTONE project funded by the European Union. Horizon Europe under Grant Agreement No. 101138504.

7<sup>th</sup> International Symposium on Materials, Electrochemistry and Environment – CIMEE25

## High-Purity water production from industrial wastewater using direct contact membrane distillation

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*Thematic Area: Waste valorization & sustainable environment*

### Abstract

The pulp & paper industry and the steel industry generate large volumes of complex wastewater streams, often characterized by high salinity, organic load, and the presence of process-specific contaminants. Conventional treatment technologies are often insufficient to achieve high water recovery or to meet stringent discharge requirements, making advanced separation processes necessary. Membrane distillation (MD), a thermally driven process, offers the potential to produce high-purity water from such challenging industrial effluents. In this study, a laboratory-scale direct contact membrane distillation (DCMD) system was used to evaluate the performance of industrial wastewater samples from the steel industry and pulp & paper industry using a polypropylene (PP) hollow fiber membrane (pore size of 0.2 and porosity of 73%). The experiments were conducted at three different feed temperatures varying from 40 to 60°C, while keeping other operating parameters constant. System parameters, including flux, conductivity, pH, and recovery factors, were continuously monitored using a Streametric box. Baseline experiments with deionized water established reference flux values. When operated with industrial wastewater, the DCMD system produced high-purity permeate with conductivity consistently below 5  $\mu\text{S}/\text{cm}$ , while maintaining a stable flux across all tested temperatures until a recovery factor of 80% was achieved. Extended operation at 60 °C further demonstrated the ability to reach 93% recovery without signs of pore wetting, confirming both the robustness of the membrane and the stability of process performance. These results demonstrate the potential of DCMD for treating industrial wastewater while achieving high recovery and excellent permeate quality, highlighting its suitability for sustainable water management in industrial applications

**Keywords:** Direct contact membrane distillation, Industrial wastewater treatment, Permeate purity, Thermally driven process, Water recovery.

**Acknowledgements:** The authors acknowledge the financial support of the EU Horizon under the projects CORNERSTONE “Combined technologies for water, energy, and solute recovery from industrial process streams” (HORIZON-CL4-2023-TWIN-TRANSITION-01-40, Grant Agreement No. 101072449).

## Oscillatory flow-enhanced membrane distillation (OMD) for industrial water treatment applications

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*Thematic Area: Waste valorization & sustainable environment*

### Abstract

Membrane distillation is a thermal separation process, where clean water can be generated from e.g. industrial wastewater while at the same time the wastewater can be concentrated. It is characterized by the high specific thermal energy consumption with a typical trade-off between high transmembrane flux and specific energy demand. To increase the energy efficiency of the MD process, turbulent, oscillatory flow is used in this work to minimize the thermal losses across the membrane. Currently, MD uses constant laminar flow resulting into poor mixing of the fluid in the channels, and high temperature polarization within the membrane modules. Constant flow requires high flow velocity to overcome the temperature polarization resulting into high electric energy consumption and high risk of membrane wetting. Positive effects of oscillatory flow on mass transfer in membrane contactors have been studied, however, the application of such flow to industrial wastewater using MD has not yet been documented yet. In the Cornerstone project, a novel oscillatory flow-MD lab test facility was designed, built and commissioned at AEE INTEC's laboratory in Austria. The set-up has been applied to wastewater from pulp and paper and steel industry and parameters such as membrane length, oscillation frequency and oscillation amplitude have been varied. First results demonstrated stable OMD operating conditions at the laboratory scale. We found pronounced transmembrane flux enhancement when using oscillation compared to constant flow. In the project, two chemically different industrial wastewater flows were tested and effects on oscillatory flow to membrane distillation performance assessed at various operating conditions to characterize OMD as water treatment and resource recovery technology. Key advantage of oscillatory flow MD is expressed in enhanced mass flux at lower recirculation rates (i.e. little electric energy demand for pumping). Future work will focus to deploy the advantages of oscillatory flow MD to waste waters at higher salt concentrations and higher particulate matters presence, thus reducing pretreatment efforts. High shear by the oscillatory flow at the membrane surface also may imply less scaling and fouling probability.

**Keywords:** oscillatory flow, membrane distillation, novel lab-test facility, industrial wastewater

**Acknowledgements:** The study is part of the CORNERSTONE project funded by the European Union. Horizon Europe under Grant Agreement No. 101138504.

7<sup>th</sup> International Symposium on Materials, Electrochemistry and Environment – CIMEE25

## Valorization of Industrial wastewater with Bipolar Electrodialysis for NaOH and HCl Recovery

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*Thematic Area: Waste valorization & sustainable environment*

### Abstract

In recent decades, a significant increase in the amount of saline wastewater from various industries such as oil and gas, pulp and paper, etc. has been observed. The treatment of this wastewater is therefore an important issue, as the discharge of highly saline wastewater can cause serious problems for the coastal ecosystem and micro-organisms. For this reason, the EU has adopted stricter regulations for the disposal of this type of wastewater and scientists focused their interest on researching and developing innovative methods for the valorisation of these streams, in line with the spirit of the EU Circular Economy Strategy. Electrodialysis is an innovative separation process in which negatively or positively charged membranes are used for the enrichment of cations ( $\text{Na}^+$ ,  $\text{K}^+$ , etc.) or anions ( $\text{Cl}^-$ ,  $\text{SO}_4^{2-}$ , etc.) in different streams. The introduction of bipolar membranes (BPM) into these systems contributes to the valorisation of this cation and anion enrichment and to the production of acidic or basic solutions through the dissociation of water molecules ( $\text{OH}^-$  and  $\text{H}^+$ ) that takes place on the BPM. In this work, a commercial bipolar electrodialysis system (BED) was used for the production of NaOH and HCl from a synthetic NaCl solution. The aim was to evaluate and optimise the performance of different commercial cation (negatively charged) and anion (positively charged) exchange membranes (CEM and AEM). Initially, the performance of seven commercial CEMs and six commercial AEMs was investigated, with all experiments conducted under the same operating conditions. Their performance was evaluated in terms of the recovery of  $\text{Na}^+$  or  $\text{Cl}^-$ , their current efficiency and the energy consumption for the production of NaOH and HCl. In both cases, NaOH and HCl production, MEGA-RALEX delivered the best results, namely 82% recovery of  $\text{Na}^+$  and 100% recovery of  $\text{Cl}^-$  with 13.8 kWh/KgNaOH and 14.1 kWh/KgHCl. The DESIGN EXPERT<sup>®</sup> software was then used to optimise the most important operating conditions. The optimum operating conditions for the successful recovery of acidic and alkaline solutions from target wastewater streams from the pulp and paper and steel industries are currently tested.

**Keywords:** bipolar electrodialysis, cation exchange membranes, anion exchange membranes, effluent valorization, NaOH and HCl production

**Acknowledgements:** This work was performed in the context of the CORNERSTONE project that received funding from the European Union's Horizon Europe Research & Innovation framework programme under Grant Agreement No 101138504.

7<sup>th</sup> International Symposium on Materials, Electrochemistry and Environment – CIMEE25

## Recovery of solutes from industrial wastewater using membrane crystallization

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Thematic Area: Waste valorization & sustainable environment

### Abstract

Industrial wastewater streams often contain valuable solutes and reagents that are typically lost in conventional treatment processes. Membrane crystallization (MCr), a thermally driven separation technology derived from direct contact membrane distillation (DCMD), enables simultaneous water recovery and selective solute crystallization, depending on solubility, crystal growth, and nucleation. The process relies on a hydrophobic microporous membrane to establish a vapor pressure gradient between a heated feed and a cooler permeate stream, while controlled supersaturation drives solute crystallization (Fig. 1a). In this study, a laboratory-scale hollow fiber module operated in outside-in mode and placed vertically was evaluated to promote favorable hydrodynamics and facilitate crystal removal (Fig. 1b). Aqueous solutions representative of industrial wastewater from Pulp and Paper industry, rich in calcium, were concentrated until crystallization occurred, with experiments performed at feed temperatures up to 60 °C. High water recovery factors of up to 93% were achieved without pore wetting, and stable permeate fluxes were maintained throughout operation. The crystallization step produced solids, mainly as CaCO<sub>3</sub>, with variable particle size distributions depending on the degree of supersaturation, confirming the feasibility of coupling high recovery with controlled solid formation (Fig. 1c). These results demonstrate the potential of MCr for sustainable water management by enabling both water reuse and solute recovery, offering a circular economy approach for industrial wastewater treatment.

**Figure 1.** (a) MCr process diagram (b) MCr lab setup (c) Crystals obtained at 60°C with 93% Water recovery.



**Keywords:** Membrane crystallization, Industrial wastewater, Water recovery, Solute recovery, Supersaturation, thermally driven process

**Acknowledgements:** The Authors acknowledge the financial support of the EU Horizon under the projects CORNERSTONE “Combined technologies for water, energy, and solute recovery from industrial process streams” (HORIZON-CL4-2023-TWIN-TRANSITION-01-40, Grant Agreement No. 101072449).

7<sup>th</sup> International Symposium on Materials, Electrochemistry and Environment – CIMEE25

## Industrial Adoption of Water Circularity Technologies – Analysis of Economic, Social and Environment Barriers and Enablers

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*Thematic Area: Waste valorization & sustainable environment*

### Abstract

**Background:** Industrial water use currently accounts for 40% of freshwater use in Europe, making accelerated investment in circular water technologies crucial to the future resilience of both Europe and its industrial sector. In this work, we present a study on current industrial water engagement and activity in sustainable practices including water efficiency, water re-use and water stewardship. **Methods:** Data was collected using an online survey, comprised of 17 questions based on a desk review conducted as part of CORNERSTONE. Respondents were recruited via consortium partners' industrial water user networks from Jan-Feb 2025. A sample of 41 European-based industrial water users completed the survey, including Food & Beverages, Life Sciences & Pharmaceuticals and Manufacturing sectors. Quantitative data analysis was conducted in Excel and SPSS, with this work presenting findings on drivers, enablers and barriers to investment in circular water practices. **Results:** Key external drivers for investment in circular water practices are national / local authority effluent discharge regulations and environmental policies, and mandatory / voluntary sustainability reporting. Key internal drivers are cost reduction of wastewater treatment and discharge, identification of resource shortages / competition for resources and maintaining supply chain resilience. The greatest barriers are high capital, operation and maintenance costs, followed by the risk of products becoming contaminated. Key enablers are the ability to build a strong business case for new circular water technologies, site/organizational roadmaps for water circularity and information on potential external funding/investment. **Discussion:** A key takeaway from this study is that industrial investment decisions are driven by immediate benefits to operations and finances, as opposed to future potentialities/opportunities.

**Keywords:** circular water solutions, circular water technologies, investment decision making, business drivers, barriers, enablers, decision support, business case development.

**Acknowledgements:** This work was performed in the context of the CORNERSTONE project that received funding from the European Union's Horizon Europe Research & Innovation framework programme under Grant Agreement No 101138504.

## CLOSING REMARKS BY THE CHAIR, DAY 1

### Chair's Closing Remarks & End of Conference Day 1

As the first day of the conference draws to a close, allow me, as chair, to deliver a closing address.

The first day of this conference was marked by the large number of participants and their collective efforts to present innovative scientific solutions to environmental problems, through intense discussions, lively debates, and a growing number of participants. Allow me to share some thoughts on this topic. During the general discussion, we noted a keen interest in renewable energies, particularly green hydrogen, as well as presentations focused on the development of materials to combat water and soil pollution, and a special session led by a team with extensive experience in industrial wastewater treatment. Given this growing number of speakers, I would like to express my sincere thanks and gratitude to all delegates for their contribution to the success of this conference.



# DAY 2

Prof. 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: A. El Moll, K. Plakas

The screenshot shows a Zoom meeting interface. On the left, a presentation slide titled "Conservatoire National des Arts et Métiers (Le Cnam) National Conservatory of Arts and Crafts" is displayed. The slide includes three images: "Localization" (a map of Paris), "The entrance" (a photograph of the building's facade), and "Our library: former monks' refectory" (an interior photograph of a library). On the right, a grid of video feeds shows participants: "Najla Fourati" (with a large 'N' icon), "Moderator 202" (a man at a table with flags), "Fatma Driss", "Najla Fourati" (a woman with glasses), and "Ahmad EL MOLL" (a man with glasses). A small number "3" is visible in the bottom right corner of the slide area.

7<sup>th</sup> International Symposium on Materials, Electrochemistry and Environment – CIMEE25

## Molecularly imprinted polymers for the detection and remediation of emerging pollutants: Strengths, limitations, and future perspectives

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*Thematic Area: Electrochemistry, Bioelectrochemistry & Environment*

### Abstract

Molecularly imprinted polymers (MIPs) have emerged as highly selective, robust, and versatile materials for the detection and remediation of emerging pollutants, combining the recognition precision of biological receptors with the stability and reusability of synthetic polymers. Advances in molecular imprinting technology (MIT) have enabled tailored recognition sites capable of binding specific contaminants in complex matrices, including pharmaceuticals, endocrine disruptors, pesticides, heavy metals, and microplastics. Recent developments in multi-target MIP sensors, hybrid materials (e.g., MIP–MOF composites), and stimuli-responsive designs have expanded detection capabilities, enabling simultaneous quantification of multiple analytes in environmental samples with high sensitivity and specificity. Green chemistry principles are increasingly integrated into MIP synthesis, employing bio-based monomers, renewable crosslinkers, deep eutectic solvents, and solvent-free polymerization methods to minimize environmental impact. Biomass-derived MIPs, biodegradable composites, and computationally guided monomer selection have contributed to more sustainable and efficient recognition platforms. Eco-friendly fabrication approaches, such as microwave-assisted polymerization and aqueous-phase imprinting, have also improved scalability and safety. Despite remarkable laboratory performance, several challenges limit large-scale deployment, including incomplete template removal, cross-reactivity, reduced recognition in real-world samples, and the lack of standardized evaluation protocols. Furthermore, the commercial adoption of MIP-based remediation systems remains slow due to production costs, regeneration efficiency, and integration issues with continuous monitoring devices. Future research should focus on: i) coupling MIPs with multi-transduction systems (such as electrochemical, optical, and gravimetric) for real-time multi-analyte monitoring; ii) improving the imprinting process via theoretical modelling and AI-assisted design; and iii) adopting circular-economy strategies in MIP production and disposal. By bridging the gap between laboratory innovation and field application, MIPs can play a decisive role in safeguarding environmental and public health through sustainable pollutant detection and remediation.

**Keywords:** Chemical sensors, Emerging pollutants' detection, Molecularly imprinted polymers, Remediation.

## KEYNOTE SESSION IV:

**Nanomaterials for Environmental Sensing and Remediation**

**Chair/Co-Chairs: N. Fourati, A. El Moll,**

## Environmental sustainability and the role of nanostructured films in sensing

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**Nor Presented**

*Thematic Area: Environmental & Agricultural Chemistry*

### Abstract

Continuous environmental monitoring requires the convergence of two major technologies: sensing with nanostructured films and artificial intelligence for data processing. Additional key requirements include the development of low-cost sensors that can be deployed in diverse settings, particularly in agricultural fields and outdoor environments. These needs closely align with those for health monitoring, which also relies on sensing and biosensing, especially through wearable devices. This lecture will provide an overview of various nanoarchitectures employed for sensing pesticides and emerging pollutants that pose risks to the environment, human health, or animal health. Some of these sensors are wearable, enabling continuous monitoring. Specific examples include nanostructures made of carbon-based materials for detecting hormones in water sources [1] and organic frameworks for identifying pesticides in the urine of rural workers. Additionally, machine learning and other artificial intelligence methodologies for sample classification and diagnosis will be discussed.

**Keywords:** artificial intelligence, biosensors, environment monitoring, nanotechnology, sensors, sustainable materials.

**Acknowledgements:** CNPq, INEO and FAPESP (2018/22214-6) from Brazil.

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- [2] Thiago S Martins, Fábio JFS Henrique, Willian G Birolli, José L Bott-Neto, Henrique CS Silveira, Pierre M Esteves, Osvaldo N Oliveira Jr, Printed strips coated with a reticular organic framework for Non-Enzymatic detection of pesticides in the urine of rural workers, *Chem. Eng. J.*, 496, 154027 (2024).

7<sup>th</sup> International Symposium on Materials, Electrochemistry and Environment – CIMEE25

## Tailoring Surface and Optical Properties of Trivalent Metal-Doped ZnO Thin Films for Environmental Sensing and Remediation

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*Thematic Area: Materials & The environment*

### Abstract

The development of advanced oxide materials with tunable surface and optical characteristics is critical for next-generation environmental sensing and photocatalytic remediation technologies. This presentation highlights a systematic investigation of ZnO thin films doped with trivalent metal ions ( $\text{Cr}^{3+}$ ,  $\text{Fe}^{3+}$ ,  $\text{Sm}^{3+}$ ,  $\text{La}^{3+}$ , and  $\text{Al}^{3+}$ ) at low concentrations (0.1–1 at.%), synthesized via spray pyrolysis. The study focuses on tailoring crystallite size, surface morphology, and strain to modulate functional performance. Detailed XRD and Raman spectroscopy analyses reveal dopant-specific effects on lattice distortion and defect-related vibrational modes, particularly LO phonon behavior. Optical characterization goes beyond conventional bandgap estimation, employing absorption maxima as a sensitive tool to detect sub-band transitions and energy level perturbations. These tailored properties directly impact light–matter interaction and surface reactivity, essential for photocatalytic pollutant degradation and gas detection under real-world conditions. The results demonstrate that precise doping strategies can engineer the physicochemical landscape of ZnO, offering a platform for sustainable applications in environmental monitoring and clean-up. This work contributes to the broader vision of using innovative materials chemistry to address global environmental challenges.

**Keywords:** ZnO thin films, trivalent metal dopants, surface tailoring, environmental sensors, photocatalysis.

**Acknowledgements:** IMT's contribution was partially supported by the Romanian Ministry of Research, Innovation and Digitalisation through the  $\mu$ NanoEI, Cod: 23 07 core Programme and 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.

7<sup>th</sup> International Symposium on Materials, Electrochemistry and Environment – CIMEE25

## Performance evaluation of various Proton Exchange Membrane (PEMs), cathodes, anodes and factors affecting the performance of the Microbial Fuel Cell (MFC)

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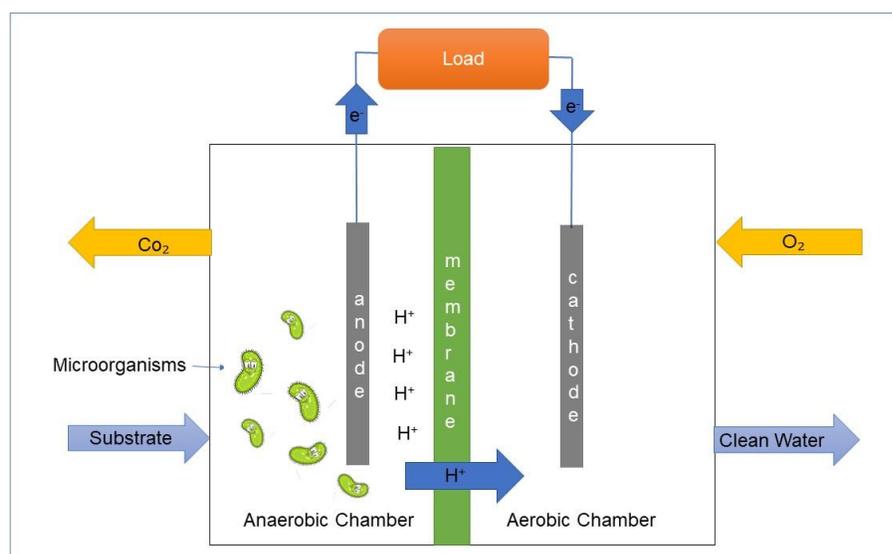
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Thematic Area: Materials & The environment

### Abstract

Water pollution and energy shortage are two different areas that are correlated to each other and are the major concerns for the deterioration of the environment. New researchers are continuously working on to find solutions to both water pollution and energy. A microbial fuel cell (MFC) is a new emerging technology that serves as a solution for both water pollution and energy shortage by conserving energy and treating wastewater simultaneously. But while scaling up this technique on a commercial scale, it must be a feasible and cost-effective investment with low maintenance, higher stability, and recyclability. Electrodes, construction materials of electrodes, design, configuration, and operating conditions have been reviewed extensively in this paper for the performance and application of MFC as a source of bioenergy. It was observed that at lower temperatures, the larger surface area of the cathode and a higher concentration of substrate in the anode chamber lead to an increase in the performance of MFC. Also, due to catalytic activity at the air-cathode, it shows four-electron reduction pathways, resulting in the best performance of MFC with the air-cathode than the other known cathodes.

**Keywords:** Microbial Fuel Cell, Proton Exchange Membrane, Anode, Cathode.



Graphical abstract

## PLENARY SESSION III:

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

Quantum Materials, technologies and Key applications

Prof. Kamel Besbes, Centre for Research on Microelectronics & Nanotechnology, CRMN,  
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7<sup>th</sup> International Symposium on Materials, Electrochemistry and Environment – CIMEE25

## Quantum Materials, Technology & Key application

Kamel Besbes,

Centre for Research in Microelectronics & Nanotechnology, Sousse Technopole, Microelectronics & Instrumentation Lab, University of Monastir, Tunisia

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Thematic Area: Quantum materials & multidisciplinary applications

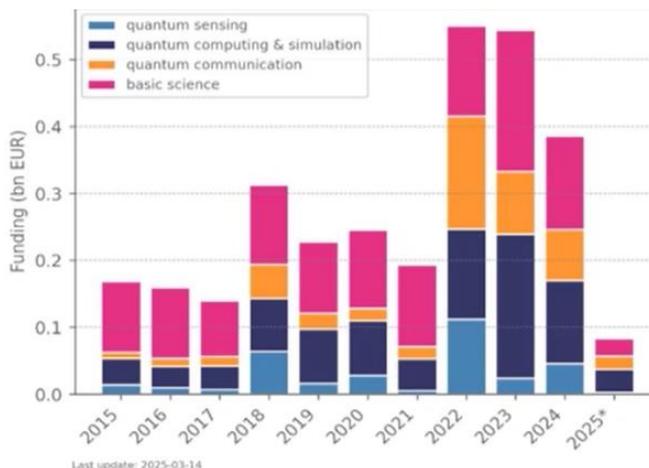
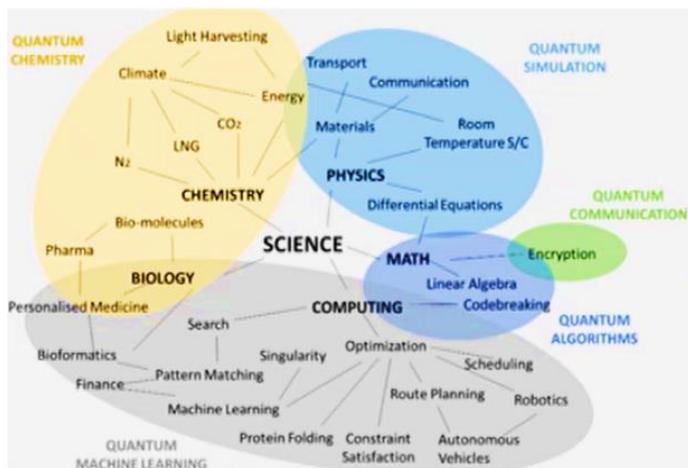
### Abstract

The conference provides a comprehensive overview of the second quantum technology revolution. It begins with an introduction to the fundamentals of quantum mechanics, including a survey of key principles such as superposition, entanglement, interference, and decoherence. The talk then delves into the practical applications of quantum technology, highlighting advancements in quantum materials, architectural elements of quantum computation, and quantum communication and the use of quantum key distribution (QKD) protocols for enhanced cybersecurity. The role of quantum technology in space communication and its potential impact on future networks like 6G and 7G are also explored. It addresses both the threats and opportunities of quantum computing to technologies like blockchain. Finally, it presents the application of quantum technology for global environment understanding and worldwide financial efforts to develop R&D in quantum technologies. It will be concluded by outlining the technological, economic, and societal challenges facing the field.

**Keywords :** Quantum Materials, Quantum sensors, Quantum computation, quantum technologies, quantum and artificial intelligence force, quantum communication.

P1 : <https://youtu.be/9n6pgNfzgec>

P2 : <https://youtu.be/yfLSusrj8aA>



Graphical abstract: Research fields map in quantum Technologies

## KEYNOTE SESSION V:

**Nanomaterials & sustainable environment,**

**Chair/Co-Chairs: N. Fourati, A. El Moll,**

## Smart Catalysts for Water Disinfection: Bimetallic Metal-Organic Frameworks and Advanced Oxidation Processes Synergy

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Thematic Area: Materials & the Environment

### Abstract

The increasing presence of pathogens in treated wastewater has become a major concern, especially following global health emergencies. Conventional treatment systems often fail to fully eliminate these microorganisms, prompting the development of more efficient technologies. Among them, Advanced Oxidation Processes (AOPs) stand out for their ability to generate reactive species, such as hydroxyl and sulfate radicals, that degrade pollutants and inactivate pathogens. This study explores the use of bimetallic Metal-Organic Frameworks (MOFs), synthesized via solvothermal methods, as heterogeneous catalysts to generate reactive species in two AOP strategies: electro-Fenton and sulfate radical-based processes. A bimetallic Zn-MIL53(Fe) was synthesized [1] and applied in electro-Fenton reactions, achieving complete inactivation of *Pseudomonas aeruginosa* and *Lactobacillus crispatus* within 5 min at 25 mA, with a catalyst dose of 4.32 g/L. Its reusability across multiple cycles highlights its potential for sustainable water disinfection. In parallel, a series of CuFe-based MOFs with varying metal ratios (Fe:Cu=3:1, 2:1 and 1:1) were synthesized [2] and evaluated for their ability to activate peroxymonosulfate (PMS) and generate sulfate radicals. Among them, Cu<sub>1</sub>Fe<sub>1</sub>-(BDC-NH<sub>2</sub>), under 0.1 mM PMS and a catalyst dose of 0.25 g/L, exhibited superior antibacterial activity against *Escherichia coli*. These findings demonstrate the catalytic advantages of bimetallic MOFs over monometallic ones, including enhanced stability and efficiency. Therefore, the results support their integration into advanced wastewater treatment systems.

**Keywords:** Metal Organic Frameworks, Advanced Oxidation Processes, Disinfection.

**Acknowledgements:** This work has been funded by MICIU/AEI/10.13039/501100011033 project PID2023-146133NB-I00. Also, Antía Fdez-Sanromán and Daniel Terrón thank the Ministry of Science and Innovation (PRE2021-098540) and Universidade de Vigo (PREUVIGO-24), for their respective predoctoral fellowships.

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## From Curcumin to Catalysts: Green Nanomaterials and Spectroscopic Strategies for a Sustainable Future

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*Thematic Area: Structural, Analytical & Physical Chemistry*

### Abstract

Curcumin, a natural compound derived from turmeric, is widely used in food, cosmetics, industry, and biomedical applications due to its non-toxic and safe profile. In recent years, it has gained attention as a green reagent for nanoparticle synthesis, as it significantly reduces toxic waste. Curcumin can act both as a reducing agent and a stabilizer, making it an effective component in the green synthesis of various nanoparticles. Using curcumin, different nanoparticles such as gold (Au NPs), silver (Ag NPs), and copper oxide (CuO NPs) have been synthesized. For example, curcumin-conjugated gold nanowires (Au NWs) demonstrate excellent catalytic performance, with the reduction rate of 4-nitrophenol being ~10 times higher than that of conventional Au NPs. This highlights that catalytic efficiency can be tuned by controlling the size and shape of gold nanostructures. Similarly, in curcumin-conjugated silver nanoparticles, smaller particle sizes exhibit superior catalytic activity in reduction reactions. In the case of curcumin-conjugated CuO nanograins, the particles show high efficiency in reducing methylene blue, with nanograins outperforming spherical nanoparticles, underscoring the importance of shape in catalytic performance. Beyond catalysis, curcumin-based nanoparticles also hold promise in optical biosensing, where their unique structural and photophysical properties can be exploited for sensitive detection using different strategies.

**Keywords:** Green synthesis, curcumin, reducing agent, stabilizing agent, metallic nanoparticles, Au NPs, Ag NPs, CuO NPs, optical sensing

7<sup>th</sup> International Symposium on Materials, Electrochemistry and Environment – CIMEE25

## Synergistic Advanced Chemical Processes for water and wastewater treatment applications

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*Thematic Area: Environmental engineering, Chemical Engineering, Wastewater treatment*

### Abstract

Synergistic Advanced Chemical Processes based on Advanced Oxidation Processes (AOPs) and Advanced Reduction Processes (ARPs) often assisted by photolysis or cavitation phenomenon provide effective method for water and wastewater treatment. These processes form reactive radical species suitable for effective degradation of emerging organic pollutants [1-3]. This presentation will discuss fundamentals of such technologies, phenomena responsible for synergistic effects and recent advancements in the targeted water and wastewater treatment applications. Main achievements include the successful degradation of various contaminants found in both water and industrial effluents, while some processes can result in co-generation of useful chemicals [4-6]. Challenges and new types of processes to solve the existing environmental issues will be highlighted.

**Keywords:** cavitation, persulfates, ozonation, percarbonate, dithionate, oxidative radicals, reductive radicals.

**Acknowledgements:** Prof. Grzegorz Boczkaj gratefully acknowledge financial support from the National Science Centre, Warsaw, Poland for project OPUS nr UMO-2021/41/B/ST8/01575.

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7<sup>th</sup> International Symposium on Materials, Electrochemistry and Environment – CIMEE25

## Bioactive Polymers from Marine Diatoms: A Multifunctional Platform for Lead Removal and Water Treatment Applications

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Thematic Area: Materials & the Environment

### Abstract

The increasing need for sustainable water treatment solutions, especially for heavy metal removal, has focused attention on bio-based functional materials. Extracellular polymeric substances (EPS) from marine diatoms, notably *Amphora coffeiformis* and *Navicula salinicola*, are promising biopolymers composed of polysaccharides, proteins, and sulfated groups, offering high chemical reactivity and environmental compatibility. EPS extracted from these species demonstrated exceptional lead (Pb<sup>2+</sup>) adsorption capacities, exceeding 2000 mg/g for *N. salinicola*. Spectroscopic and kinetic analyses identified functional groups (carboxyl, hydroxyl, phosphate, carbonyl) as key in metal binding. Additionally, these EPS showed strong flocculation (~70% removal of kaolin at 15 mg/L) and emulsifying (>88%) activities across various pH values. Optimization *via* response surface methodology enhanced their multifunctionality. These results underscore diatom-derived EPS as renewable, biodegradable materials for integrated water treatment, combining metal adsorption, turbidity reduction, and emulsion stabilization. Their low cost and electrochemical compatibility make them attractive for green technologies. The presentation will explore EPS structure–function relations, production scale-up, and integration into hybrid systems like electrochemical treatment and membrane filtration.

**Keywords:** Marine diatoms, Extracellular polymeric substances, Lead biosorption, Flocculation, Emulsification, Environmental biotechnology.

**Acknowledgements:** This work has been supported by the Tunisian Ministry of Higher Education and Scientific Research.

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## ORAL SESSION II:

**Structural, analytical & physical chemistry**

**Chair/Co-Chairs: N. Fourati, A. El Moll**

7<sup>th</sup> International Symposium on Materials, Electrochemistry and Environment – CIMEE25

## Exploring Atmospheric Composition and Climate Extremes in the Mediterranean and Surrounding Regions Using Satellite Observations

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*Thematic Area: Structural, analytical & physical chemistry*

### Abstract

The Infrared Atmospheric Sounding Interferometer (IASI) on board the Metop series of Satellite provides over 17 years of consistent, high-resolution thermal infrared measurements, enabling extensive applications in atmospheric composition monitoring and climate studies. This presentation will highlight the versatility of IASI data through a series of regional case studies, with a particular focus on the Mediterranean Basin and adjacent areas. We will showcase the use of IASI for monitoring tropospheric ozone levels across the Mediterranean, a region of complex photochemical activity influenced by anthropogenic emissions, natural sources, and long-range transport. Our analysis reveals seasonal and interannual variability in ozone concentrations, underscoring the impact of regional pollution and climatic drivers. Additionally, we will present recent developments in using IASI-derived variables to characterize heat stress, including the wet-bulb temperature over the Arabian Peninsula—a region experiencing increasing frequency of extreme temperature and humidity events. These observations are crucial for assessing climate-related health risks and informing adaptation strategies. The combination of IASI's spectral sensitivity, long temporal coverage, and global daily revisit makes it an indispensable tool for understanding atmospheric processes and supporting climate resilience in vulnerable regions such as the Mediterranean and the Middle East.

**Keywords:** Satellite Observations, Mediterranean Basin, monitoring tropospheric ozone level, anthropogenic emissions, climate resilience

7<sup>th</sup> International Symposium on Materials, Electrochemistry and Environment – CIMEE25

## Molecular docking studies to elucidate the structure of a novel *Bacillus thuringiensis* toxin to be used as a biopesticide

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Thematic Area: Pesticides, sustainable agriculture & environmental monitoring

### Abstract

In the frame of food security, human health, and environmental safety, the bacterium *Bacillus thuringiensis* (Bt) has become an alternative to chemical insecticides in commercial agriculture to control pests and mosquitoes. The discovery of novel Bt toxins is a continuous action to warrant effective pest control and prevent pest resistance. **Methods:** A novel *cry* gene encoding a toxin from a novel Bt isolate was cloned and sequenced. The encoded toxin was subjected to *in silico* structural studies. The toxin-receptor complex formed during the insecticidal process was investigated by molecular docking studies. **Results:** The bioinformatics analysis showed that the gene encodes for a novel 134.67 kDa Cry1Ca toxin termed Cry1Ca17. Five conserved domains, typical features of the Lepidoptera-active crystal proteins, were detected. Molecular docking studies were carried out using the 600 aa-trypsin-activated toxin. The key residues involved in the toxin-receptor interaction at the receptor toxin binding (toxin-binding site) and the catalytic (toxin-catalytic site) sites were identified and compared to those of the to-date known toxin-receptor complexes. **Conclusion:** The structure of a novel Bt toxin called Cry1Ca17 was elucidated. The differences in residues involved in the toxin-receptor complex, compared to the known ones to date, could be an asset for using this toxin and its mother strain for pest control and prevention of pest resistance. Such biopesticides are in favor of the environment, food security, and Human health.

**Keywords:** *Bacillus thuringiensis*, Cry1Ca17, Insecticide activity, Molecular docking

**Acknowledgements:** The authors would like to express their deep gratitude to the Ministry of Higher Education and Scientific Research (Tunisia) within the framework of the Contract Program LB-CBS, code grant no.: LR15CBS04 (2019-2022).

7<sup>th</sup> International Symposium on Materials, Electrochemistry and Environment – CIMEE25

## Harnessing Green Chemistry for Environmental Remediation: BiVO<sub>4</sub>–Polyaniline Hybrid as a High-Performance Visible-Light Photocatalyst

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Not presented

*Thematic Area: Pesticides, sustainable agriculture & environmental monitoring*

### Abstract

The development of sustainable photocatalysts for solving environmental problems is gaining attention, especially through green synthesis methods. In this work, we created a new composite of bismuth vanadate (BiVO<sub>4</sub>) and polyaniline (PANI) using a turmeric extract-based green route. This was followed by in-situ oxidative polymerization of PANI. The BiVO<sub>4</sub>/PANI hybrid showed impressive photocatalytic efficiency, achieving almost complete degradation (about 100%) of methyl orange (MO) dye at concentrations up to 100 ppm under visible light. The improved performance comes from better charge carrier separation, a larger surface area, and strong interactions between BiVO<sub>4</sub> and PANI. Moreover, the composite showed high effectiveness in degrading persistent pesticides, such as emamectin benzoate, dinotefuran, and thiamethoxam. This study highlights the promise of eco-friendly synthesis methods for making multifunctional photocatalysts with wide-ranging uses in wastewater treatment and the detoxification of agrochemicals.

**Keywords:** BiVO<sub>4</sub>, Green synthesis, Photocatalysis, Pesticide degradation, Polyaniline, Wastewater treatment

**Acknowledgements:** The authors gratefully acknowledge the Amity Institute of Applied Sciences, Amity University, Noida, for providing laboratory facilities and research support.”

## POSTER SESSION I:

**Structural, analytical & physical chemistry**

Chair: A. El Moll

7<sup>th</sup> International Symposium on Materials, Electrochemistry and Environment – CIMEE25

## First Record of the Parasite *Anisakis simplex* in the migratory Fish Species *Pagellus bogaraveo* in Syrian Marine Waters

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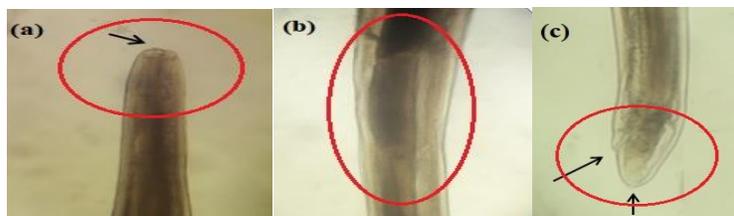
Thematic Area: Pesticides, sustainable agriculture & environmental monitoring

### Abstract

The black seabream *Pagellus bogaraveo* is an Atlantic migratory species recently recorded in Syrian marine waters. It has been exposed to internal parasites in its native habitat. The research was aimed to investigate the internal parasites that infect the fish species *P. bogaraveo* in the Syrian marine waters.

A total of 306 individuals were collected from Ras Al-Basit in the north to Tartous in the south during the period from May 2020 to May 2021. The internal organs of the fish individuals (stomach, intestines and gonads) were examined to detect infection with internal parasites.

The third larval of the parasite *Anisakis simplex*, which belongs to the phylum Nematoda, was isolated from the stomach and the gonads walls of *P. bogaraveo*.



Morphology of *A. simplex* Isolat from *P. bogaraveo*, caught in Syria marine waters

(a: Cephalic region, b: Digestive tract, c: Caudal region )

The current study is the first record of infection of *P. bogaraveo* with the parasite *A. simplex*, and the fourth record of this parasite among bony fishes in Syrian marine waters.

**Keywords:** *Pagellus bogaraveo*, internal parasites, *Anisakis simplex*, Syrian coast.

**Acknowledgements:** We thank the laboratories of Lattakia University, and the funding provided by the researchers.

## Ultrasound-assisted extraction of tangerine peels – polyphenol profile and antioxidant activity

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Not presented

*Thematic Area: Structural, analytical & physical chemistry*

### Abstract

Tangerines, valued for their distinctive tart sweet flavor, are often consumed fresh, while their peel, a primary by-product of the citrus processing industry, has recently gained interest for its potential functional and medicinal properties. The aim of this study was to investigate the composition and bioactivity of tangerine peel water extract obtained by ultrasound-assisted extraction (UAE). The extraction was performed at 80°C for 30 minutes and the obtained extract was analyzed in terms of total phenolic content (TPC), total flavonoid content (TFC), polyphenolic profile (HPLC) and antioxidant activity. TPC of the extract, determined according to Follin-Ciocalteu method, was 5.40 mg CAE/g. TFC, determined by a spectrophotometric method based on the AlCl<sub>3</sub> reaction, was 0.90 mg RE/g. Analysis by liquid chromatography with ultraviolet and mass detection revealed that the main constituents of the extract were the flavanone glycosides naringin and hesperidin. The extract showed a significant DPPH radical scavenging capacity with the IC<sub>50</sub> value of 3.95 mg/g. The Oyaizu Reducing Power test showed remarkable activity with an EC<sub>50</sub> value of 3.73 mg /g. UAE effectively extracted bioactive compounds from tangerine peel and provided high levels of total phenols and flavonoids, as well as significant antioxidant activity.



**Keywords:** Citrus processing industry, by-products, extractions, antioxidants.

**Acknowledgements:** This research was supported by the Science Fund of the Republic of Serbia, #GRANT No 7464, Novel Bio-linked Magnetite/geopolymer Composites in Phenol-containing Wastewater Treatment: Toward Zero-waste Technology - BioCompWaterClean

## ORAL SESSION III:

Bio-Green-Energy Science, Waste treatment & Technology

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

7<sup>th</sup> International Symposium on Materials, Electrochemistry and Environment – CIMEE25

## Tripoli wastewater treatment plants: advanced technology for sewage sludge valorization

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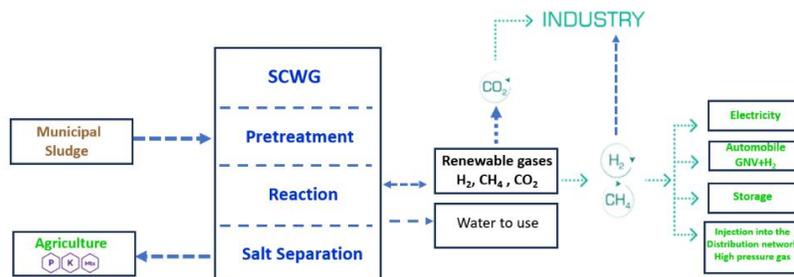
\* Corresponding author E-mail : aelmoll@ul.edu.lb

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

### Abstract

Many wastewater treatment plants in Lebanon are not operational, and the sanitation network in urban areas has incomplete infrastructure and is still waiting for modern, innovative, and dynamic water management systems. Urban sewage sludge is the main waste produced by a wastewater treatment plant from liquid effluent. The plant, serving Tripoli, Minyeh, Beddawi, and Qalamoun, has a processing capacity of 135,000 cubic meters per day. The population served is 1,000,000 population equivalents. Its area is 120,000 m<sup>2</sup>. It is located on the north coast. The plant consists of several stages: pretreatment, primary treatment, and secondary treatment. It also includes an anaerobic digester for sludge treatment. However, the water is currently treated only during the pretreatment phase because the plant is not connected to the sewer system, where it is filtered of sand and debris of various sizes, from small to large, without chemical or biological treatment. The water is discharged untreated into the sea 1.6 km away through an outfall 1,400 mm in diameter and 1,650 meters long, while the treatment residues are recovered in the form of sludge and then disposed of in the landfill near the Tripoli plant. Energy recovery from sludge can increase the share of renewable energy in an energy mix and avoid the need for landfills or incineration while promoting the circular economy. In addition, this process generates a gas rich in methane and hydrogen. It also allows the separation and recovery of metals, minerals (phosphorus, potassium, etc.), and nitrogen, which can be used, in particular, as fertilizers for agriculture and also as water for irrigation. Sustainable Sludge Management: The management of sludge from municipal wastewater treatment plants (WWTPs) is a global issue, but also an opportunity for circular reuse. Indeed, secure, cost-effective and environmentally friendly sludge management system, supercritical water gasification is a revolutionary process that is revolutionizing wet waste management and energy recovery. It offers several advantages: efficient treatment of materials with high water content (water content greater than 80%) and production of hydrogen-rich gas, thus offering an attractive solution for the treatment of Municipal sewage sludge.

**Keywords:** Sludge valorization, bioenergy; WWTP, Circular economy, Supercritical water gasification; Agriculture.



Graphical Abstract: Supercritical water gasification

7<sup>th</sup> International Symposium on Materials, Electrochemistry and Environment – CIMEE25

## Feasibility Study to Implement of a Cloacothermal Heating System for the campus of the Lebanese University in Tripoli

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

### Abstract

Building heating and cooling systems provide the greatest potential for energy consumption reduction in the world. These systems have gained immense interest for decades, garnering an extensive range of solutions and strategies to aimed at enhancing energy efficiency and sustainability. This project is part of the energy transition initiated by the Municipality of Tripoli, whose objective is to achieve carbon neutrality by 2040. It involves a feasibility study of a heating system using cloacothermics to supply the campus of the Lebanese University in Tripoli. Cloacothermics involves recovering the heat present in urban wastewater in order to generate energy through a heating network. The study aims to design a system capable of covering 100% of the university's heating needs, taking into account the technical characteristics of the site and the specific features of the sewerage network. The work includes the sizing of the main components such as the heat exchangers, the heat pump, the secondary hydraulic network, and any adaptations to the existing heating system. Beyond the technical aspects, the project highlights the environmental, economic, and social benefits of this innovative solution, directly linked to sustainable development goals. This study demonstrates the relevance of such technology for the Lebanese context and proposes a concrete approach for its local application.

**Keywords:** energy efficiency, cloacothermics, sewerage network, heat exchangers, heat pump

# DAY 3

## PLENARY SESSION IV: Hydrogen & Energy transition

Transition to Hydrogen Economy:  
integrating strategy for Climate & energy solutions  
Prof. Majeti Narasimha Vara Prasad

Chair: A. El Moll



## Transition to Hydrogen Economy: integrating strategy for Climate & energy solutions

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*Thematic Area: Bio-Green-Energy Science, waste treatment & technology*

### Abstract

The significant developments in green hydrogen, especially the oaths taken at COP29 held in November 2024 in Baku, Azerbaijan, are landmark decisions in the area of green energy. COP29 showcased the pivotal role of green hydrogen in global decarbonization efforts. COP29 Hydrogen Declaration is an ambitious initiative focusing Global Energy Storage and Grids Pledge with the Breakthrough Hydrogen Action Declaration. This talk would highlight the commitments made by participating nations, including the U.S., to scale up green hydrogen production, reduce emissions, and build the infrastructure needed for a sustainable energy future. From integrating hydrogen strategies into Nationally Determined Contributions (NDCs) to tackling hard-to-abate sectors like steelmaking and aviation, green hydrogen is leading the way in the fight against climate change. Further, this chapter also explore how these initiatives are shaping the future of energy and creating pathways to a net-zero world via green hydrogen innovation and international collaborations and partnerships. Hydrogen is the most abundant chemical substance in the universe, constituting roughly 75% of all normal matter. Global Hydrogen conferences and workshops held all over the world during 2023 and 2024 are more than 30. The Hydrogen valley project that was initiated the Department of Science and Technology (DST), Ministry of Science and Technology (MST), Government of India a few years ago made significant progress. Scientific priorities and challenges, commitment of the Indian Railways set to launch Hydrogen train in the early 2025 are covered in the lecture

**Keywords:** Bali action plan, building climate resilience, clean energy, Climate and energy solutions, Climate summit in Copenhagen, Flagship events at COP29, Hydrogen agenda, Hydrogen for decarbonization, ICHET, Net-Zero Transition, UNIDO, Versatile fuel

P1 <https://youtu.be/HmLGEPPQTQ0>

P2 <https://youtu.be/DDZrFDSNC24>

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## KEYNOTE SESSION VI:

Materials, Energy and sustainable Environment,

Chair: A. El Moll

7<sup>th</sup> International Symposium on Materials, Electrochemistry and Environment – CIMEE25

## Climate Change and Water Resources in Morocco: Challenges and Innovative Solutions

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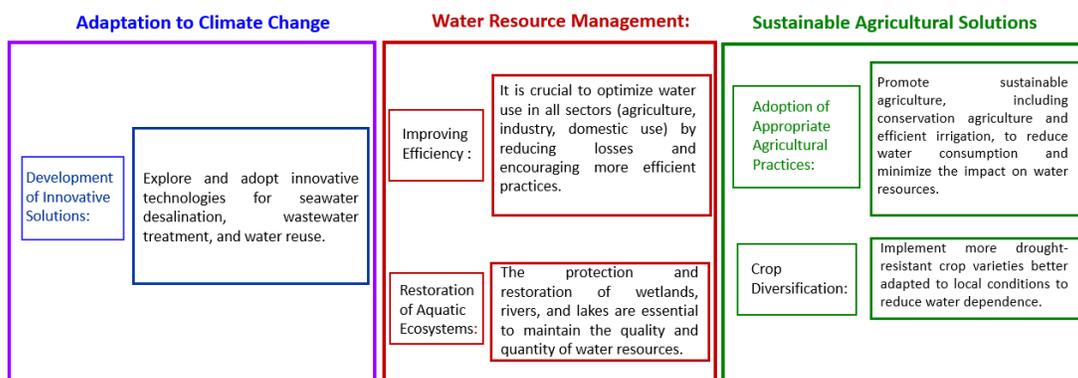
\* Corresponding author E-mail: salghi@uiz.ac.ma

Thematic Area: Water resources & sustainable environment

### Abstract

Water scarcity, particularly exacerbated by climate change, represents a major challenge for North Africa, particularly Morocco, where groundwater resources are threatened. Projected decreases in rainfall are exacerbating this situation, affecting agriculture, a vital sector heavily dependent on irrigation due to the low productivity of rain-fed crops. This crisis has prompted researchers, policymakers, and authorities to take significant steps to address this problem. An integrated approach involving water resource management, the development of sustainable agricultural solutions, and the implementation of climate change adaptation strategies will be necessary. Implementing this approach will have a significant impact on improving the resilience of the water sector to the effects of climate change. This presentation will discuss and develop innovative adaptation and mitigation solutions to reduce the effects of climate change on water resources. Innovative solutions, such as desalination, wastewater reuse, and efficient irrigation technologies, will be presented, which can be implemented to ensure sustainable water management. A diagram outlining the main approaches in each area will be presented:

### Climate Change & Water Resources in Morocco: Challenges & Innovative Solutions



By adopting this integrated approach, it is possible to address the challenges of water scarcity and build a more resilient future in the face of climate change. Regional and international cooperation is also essential to share knowledge and best practices in water management.

**Keywords:** water resources, climate change, agriculture, innovative solutions, Morocco

7<sup>th</sup> International Symposium on Materials, Electrochemistry and Environment – CIMEE25

## Exploring the Role of Materials and Energy in Agriculture

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*Thematic Area: Environmental & Agricultural Chemistry*

### Abstract

Modern agriculture increasingly relies on the efficient use of resources, such as materials and energy, to increase output while remaining sustainable. This study examines existing literature and case studies on agricultural energy usage patterns, material advances, and associated environmental implications. The findings indicate that novel material technologies, particularly nanomaterials and bio-based amendments, contribute to higher nutrient usage efficiency, crop yields, and pest management when compared to traditional techniques. The topic emphasizes that material improvements and energy diversity improve yields while simultaneously lowering environmental pressures and manufacturing costs. In conclusion, the literature emphasizes that the strategic adoption of advanced materials and renewable energy systems is essential for building resilient and sustainable agricultural practices. Future progress depends on integrating technological innovation with economic feasibility and environmental stewardship.

**Keywords:** Sustainable agriculture, Renewable energy, Nanomaterials, Resource efficiency, Crop productivity

**Acknowledgements:** Authors thanks Novel Global Educational Foundation, Australia and Southeast University for encourage to participate this international conference.

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## Metal modified Bismuth based Photocatalyst for Efficient Photodegradation and CO<sub>2</sub> Reduction

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Not presented

*Thematic Area: Materials for the Environment*

### Abstract

Facile synthesis of bismuth based photocatalyst that responds to visible light was fabricated through a hydrolysis reaction. pH and temperature studies of the pristine photocatalyst have been carried out and further tested for photodegradation of organic pollutants including methyl orange (MO) dye. Carbon dioxide hydrogenation was also carried out for the same. The optimisation of the as fabricated catalysts was carried out at three different pH (3, 7, and 12) levels, followed by their calcination at 700°C. The samples before calcination, with their extraordinarily large surface area, achieved most of the adsorption of MO dye with varying concentration (20, 50, 100, 500 ppm). Furthermore, after calcination, samples demonstrated remarkable photocatalytic performance, demonstrating their enhanced catalytic efficacy after visible light irradiation. Due to exceptional results up to 500 ppm MO dye, all analytes were tested for CO<sub>2</sub> hydrogenation. The results indicated that calcined BT analytes exhibited a substantial efficiency in CO<sub>2</sub> photoreduction capability due to the presence of 3 distinct crystal structures of BT family (sillenite Bi<sub>12</sub>TiO<sub>20</sub>, perovskite Bi<sub>4</sub>Ti<sub>3</sub>O<sub>12</sub>, polychlore Bi<sub>2</sub>Ti<sub>2</sub>O<sub>7</sub>) with continuous electron transport among the interfaces which possibly outperformed the process for the CO<sub>2</sub> conversion and reduction[1–4]. Furthermore, metal modification (copper, silver), of as optimised BT catalyst at acidic pH (after calcination) was carried out via similar method. Copper modification included copper oxide (CuO) formation as a secondary phase, promoting p-n heterojunction further enhancing CO<sub>2</sub> conversion (27.5 %) with superior methane selectivity up to 11.5%. Silver modification also remarkably enhanced CO<sub>2</sub> conversion of about 34% with methane selectivity up to 7%. Moreover, bimetallic effect was also procured in bismuth titanate including copper and silver both as co-metal dopants, which further led to an enhancement in CO<sub>2</sub> conversion % of 39% which is tremendously high as compared to pristine and mono metallic modified bismuth titanate, however, methane selectivity of only 8% was observed, which attributed to the enhanced oxygen vacancies which stabilized RWGS reaction after bimetallic incorporation into bismuth titanate lattice.

**Keywords:** photodegradation of organic pollutants, CO<sub>2</sub> conversion, photocatalytic performance, Metal modified Bismuth based Photocatalyst.

### References:

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## KEYNOTE SESSION VII:

Biotechnology, Biomaterials and sustainable agriculture

Chair: A. El Moll





## Circular Bioeconomy for Sustainable Agriculture through biopesticides development

Slim Tounsi

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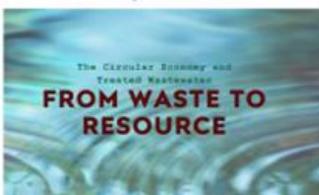
*Thematic Area: Environmental Biotechnology, Enzyme Technology*

### Abstract

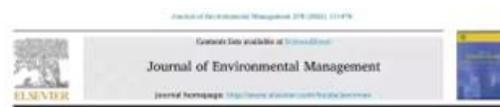
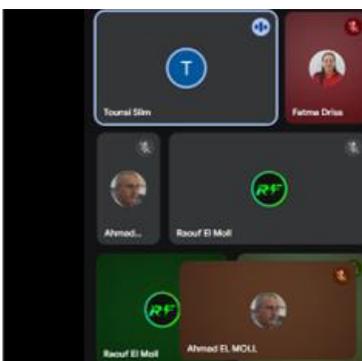
Unlike conventional chemical pesticides, biopesticides are derived from natural materials such as microbes and plants, making them less harmful to non-target organisms and promoting biodiversity. Their integration into farming practices can reduce reliance on synthetic chemicals, decrease soil and water pollution, and lower the risk of pesticide resistance. Biopesticide production is a critical step in sustainable agriculture, yet it often incurs high costs, which can limit widespread adoption. Utilizing agricultural and industrial waste as raw materials for biopesticide production can significantly reduce these costs, aligning with circular economy principles. By repurposing waste, we not only lower production expenses but also minimize environmental impact and resource consumption. This approach enhances the economic viability of biopesticides, promotes waste valorization, and supports a more sustainable agricultural system. Ultimately, integrating waste utilization into biopesticide production fosters a circular economy by closing nutrient loops and promoting resource efficiency, ensuring that pest management solutions are both effective and environmentally friendly.

**Keywords:** Biopesticide production, sustainable agriculture, circular economy, biodiversity

#### Transformation of wastewaters to value-added product : Biopesticides



Valorization of Tunisian industrial wastewaters (Tunisian Yeast Company) :  
Production of Biopesticides using the bacterium *Photobacterium* *temperata*



Research article  
Acidic pretreatment as a chemical approach for enhanced *Photobacterium* *temperata* bioinsecticide production from industrial wastewater  
Wafa Jaibouh<sup>1,2</sup>, Sahar Keskes<sup>3</sup>, Wassim Guidera<sup>4</sup>, Fatma Rezagui<sup>5</sup>, Sami Sayadi<sup>6</sup>, Slim Tounsi<sup>1\*</sup>

#### Work plan

- Wastewater characteristics
- Wastewater hydrolysis & Analysis
- Bioinsecticide production
- Insecticidal activity

7<sup>th</sup> International Symposium on Materials, Electrochemistry and Environment – CIMEE25

## Effects of Edible coating materials on storage life and quality of apples

Dalila Hammiche

*University of Bejaia, Faculty of Technology, Laboratory of Advanced Polymer Materials, Algeria*

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*Thematic Area: Environmental & Agricultural Chemistry*

### Abstract

This work focuses on the evaluation of edible films based on chitosan for the preservation of apples. Three treatments were tested: uncoated apples, apples coated with chitosan alone, and apples coated with a chitosan-essential oil blend. Several tests were carried out: HPLC to quantify gallic acid, CO<sub>2</sub> permeability to assess respiration, monitoring of weight loss to estimate dehydration, and visual observation of fruit evolution during storage. An FTIR analysis was also performed to examine the interactions between chitosan and the oil. The results showed that chitosan, especially when enriched with oil, improves polyphenol retention, reduces water loss, slows visual degradation, and demonstrates good molecular compatibility. These films offer promising potential as a sustainable alternative to plastic packaging.

**Keywords:** Chitosan, Edible film, Apple, Preservation, Polyphenols, HPLC, CO<sub>2</sub> permeability, FTIR

Presented By  
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Université de Bejaia, 06899 Bejaia, Algérie

LMPA

Effects of Edible coating materials on  
storage life and quality of apples

Sara Bezgh

5 others

Ahmad EL MO...

## KEYNOTE SESSION VIII:

Waste valorization and Hydrogen production

Chair: A. El Moll

7<sup>th</sup> International Symposium on Materials, Electrochemistry and Environment – CIMEE25

## Advanced Catalytic Systems for Large Scale H<sub>2</sub> Production via Solar Water Splitting

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*Thematic Area: Waste valorization and Hydrogen production*

### Abstract

Advanced materials based heterogeneous catalysis involving photochemical and photoelectrochemical water splitting is an ultimate source of hydrogen generation as renewable green energy for tackling the ongoing fuel crisis. Carbon based materials are ideal for overall water splitting as a result of the excellent alignment of its band edges with water redox potentials. However, a single catalyst with a limited number of active sites does not exhibit significant photo/electrocatalytic activity for hydrogen production. Therefore, we have developed the semiconductor heterostructures of carbon materials with oxides, sulphides, selenides, other TMCs/TMDs NPs and QDs as the highly efficient nanocatalysts for enhanced hydrogen evolution reactions. The monophasic heterostructures have been designed in different weight ratios with fairly uniform distribution of nearly spherical particles and high specific surface area which creates an interfacial charge transfer between two semiconductors. As prepared heterostructures showed significant hydrogen evolution which is evident by observing high apparent quantum yield, low onset potential, lower overpotential and high electrochemical active surface area that will be presented in detail.

**Keywords:** photoelectrochemical water splitting, hydrogen generation, Carbon based materials, water splitting, efficient nanocatalysts

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## Utilization of Nanocomposites in Environmental Pollution Cleanup

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*Thematic Area: Materials & the Environment*

### Abstract

Environmental pollution, driven by industrialization, urban expansion, and intensified agricultural practices, poses a significant threat to ecosystems and human health worldwide [1,2]. Conventional remediation approaches, such as chemical precipitation, adsorption using traditional materials, and biological treatments, often fail to achieve complete removal of complex contaminants [3,4]. Nanotechnology-based materials, particularly nanocomposites, offer a promising alternative due to their tunable physicochemical properties, multifunctionality, and high surface reactivity [5,6]. This study investigates the synthesis, characterization, and environmental application of nanocomposites for mitigating pollutants, including heavy metals, pesticides, dyes, pharmaceuticals, and antibiotic residues. Nanocomposites were synthesized using controlled chemical methods, characterized for surface area, functional group density, and magnetic responsiveness, and their performance was evaluated through adsorption, catalytic degradation, and recovery experiments under laboratory-simulated environmental conditions [7,8]. Results indicate that nanocomposites significantly enhance contaminant removal efficiency compared to conventional methods while maintaining high stability, recyclability, and regeneration potential over multiple cycles [5,9]. Ecotoxicological assessments suggest that, although generally effective, potential risks such as nanoparticle leaching and bioaccumulation require careful management through surface functionalization, environmentally friendly synthesis, and adherence to regulatory frameworks [4,10,11]. Overall, these findings highlight nanocomposites as a multifunctional, high-performance, and environmentally promising approach for pollutant remediation, bridging the gap between laboratory research and practical, large-scale environmental applications, while emphasizing the need for interdisciplinary research to balance efficacy, safety, and cost-effectiveness in future implementations [1,2].

**Keywords:** environmental pollution, nanocomposites, heavy metals, water remediation, sediment treatment, toxicology

**Acknowledgements:** Please include acknowledgements, including funding sources.

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7<sup>th</sup> International Symposium on Materials, Electrochemistry and Environment – CIMEE25

## Urban air quality: towards innovative sensor technologies and the potential use of artificial intelligence”

<sup>1</sup>EI Moll Ahmad

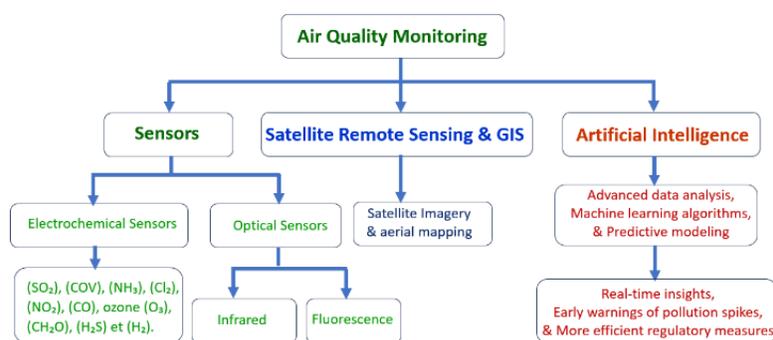
<sup>1</sup>Faculty of public Health, Faculty of science, Doctoral School for Science & Technology, Lebanese university, Lebanon

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Thematic Area: Analytical chemistry & sustainable environment

### Abstract

Cities are a key contributor to climate change, as urban activities are major sources of greenhouse gas emissions. Technological advances in artificial intelligence have introduced new paradigms for reducing urban pollution and improving environmental governance through green development, guiding the transformation and advancement of green and low-carbon urban initiatives. It is already estimated that they are responsible for 70% of global carbon dioxide emissions and 78% of energy consumption, and these figures could increase in an urbanizing world. Indeed, according to the UN, the proportion of people living in urban areas is expected to reach 68% by 2050. However, with unpredictable weather patterns and changing populations, many urban communities face increased climate-related health and economic risks. Hazards such as air pollution and natural disasters can be particularly acute in developing countries, where they threaten severe climate-related catastrophes, especially in cities in South Asia and the Middle East.



The development of artificial intelligence mitigates urban pollution emissions by improving production efficiency, minimizing energy consumption, and stimulating innovation in green technologies. In addition, artificial intelligence could potentially accelerate the search for urban climate solutions. For example, processing large amounts of data is a major obstacle to accurately modeling future climate scenarios and making informed planning decisions.

This session explores the latest technological advancements in air quality sensors focusing on their applications in monitoring a wide range of pollution and offering an efficient solution as well as the role of green technologies in providing a promising solution to reduce pollution in cities.

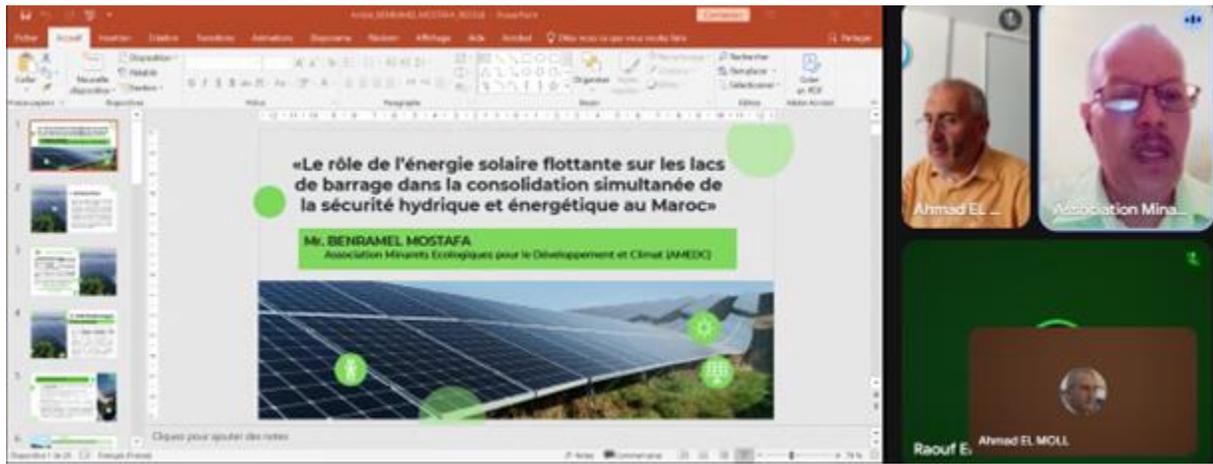
**Keywords:** agri-environmental technology innovation; sustainable ecosystems; bioremediation, phytoremediation Combined Remediation Techniques, biosensors.

Workshop: Innovative technology for water resources conservation and sustainable Energy

Chair: A. El Moll

Workshop: Floating solar technology as an innovative approach to simultaneously boost electricity generation & conserve vital water resources.

Benramel Mostafa, Ecological Minarets Association for Development and Climate, Kenitra, Morocco



# Workshops



7<sup>th</sup> International Symposium on Materials, Electrochemistry and Environment – CIMEE25

## The Middle East's water problem: innovative scientific solutions based on a floating photovoltaic system

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*Thematic Area: Water energy nexus, & sustainable environment*

### Abstract

Water stress, a global issue affecting more than 2 billion people, is driving the exploration of innovative scientific solutions, some of which rely on floating systems. One of the most promising approaches involves the deployment of water energy nexus. The Middle East is facing significant water scarcity, with several countries classified as below the water poverty line. To address water scarcity in the Middle East, the region is relying on innovative and scientific solutions such as wastewater recycling, seawater desalination, smart irrigation technologies, and water-efficient agriculture. However, floating photovoltaic (FPV) systems address the water-energy nexus by generating electricity from floating panels on water bodies. This approach also conserves water by reducing evaporation and land use, especially in arid regions. On the final day of the conference, Saturday, September 27, the CIMEE25 conference organizing committee will review the details of this important topic with the aim of leveraging this experience to benefit countries in the Middle East, such as Lebanon, Syria, Iraq, and Jordan. One of the most significant advantages of floating systems compared to land-based systems is the reduction of evaporation in water bodies, which contributes to solving the problem of water scarcity, especially in hot climates. Operating costs are reduced as the water takes over the task of washing the panels of dust. Site preparation and leveling, or even the construction of fences or other construction work, are eliminated. Furthermore, the vast expanses of water bodies are utilized. Floating systems also provide shaded areas above the surface of dams and lakes, which helps prevent algae growth and thus improve water quality. Moreover, the water continuously lowers the temperature of the solar panels, enhancing their efficiency.

**Keywords:** floating photovoltaic (FPV) systems, water-energy nexus, electricity generating, water scarcity, sustainability

7<sup>th</sup> International Symposium on Materials, Electrochemistry and Environment – CIMEE25

## Floating solar technology as an innovative approach to simultaneously boost electricity generation and conserve vital water resources. Case of Morocco

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*Thematic Area: Electrochemistry, bioelectrochemistry & environment*

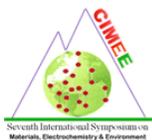
### Abstract

The installation of floating solar power plants on dam reservoirs represents a promising technological innovation that simultaneously addresses the challenges of the energy transition and the sustainable management of water resources. From an environmental perspective, these infrastructures contribute to reducing greenhouse gas emissions by promoting the production of renewable electricity, while limiting evaporation from reservoirs and thus preserving water resources. For example, in Morocco, a pilot project launched at the end of 2024 on the Oued Rmel dam (Tanger Med) aims to cover an area of 10 hectares with ~22,000 floating solar panels that could save around 1.2 million cubic meters of water per year (reducing evaporation estimated at ~30%) while producing ~13 MW of electricity to supply the Tanger Med port complex [1]. From an economic perspective, a study conducted in the Sebou Basin (Morocco) on four hydroelectric dams assessed the feasibility of floating photovoltaic systems (FPVS) under three coverage scenarios (5%, 10%, 15% of the reservoir area). The results show that with only 5% coverage, electricity could be supplied to nearly one million people (equivalent to ~87% of the population of the city of Fez). With 10% coverage, annual electricity production could increase by 185%, or an additional ~1270 GWh, while with 15% coverage, up to 11.93 million cubic meters of water could be saved per year. The Levelized Cost of Electricity is estimated at around 0.07 USD/kWh, with a positive net present value in all scenarios and an internal rate of return (IRR) exceeding 10%. [2]. Technologically, these systems require significant innovations: the design of floating structures resistant to water level variations and winds, sustainable materials, integration with the existing electricity grid, and sometimes tracking or cooling mechanisms to improve efficiency. For example, a study in India on artificial reservoirs with a 5 MW floating PV system showed that the addition of a single-axis tracking mechanism increased annual production by nearly 11%, with significant water savings and CO<sub>2</sub> emission reductions. [3]. Therefore, floating solar power plants on dams represent an integrated strategic approach capable of strengthening both energy and water security, while supporting overall sustainability and climate resilience objectives.

**Keywords:** Floating solar energy - Floating photovoltaics (FPV) - Dam reservoirs - Evaporation reduction - Climate resilience.

### Reference:

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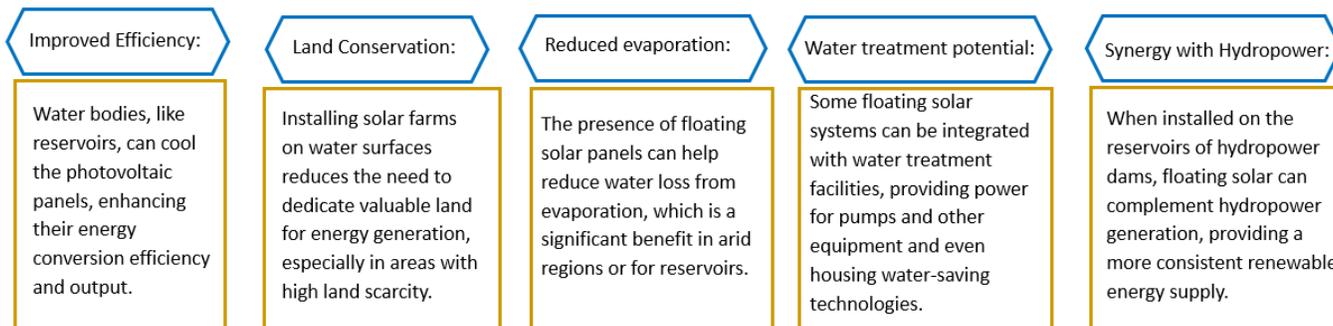


# CIMEE | International Symposium on Materials, Electrochemistry and Environment 2025

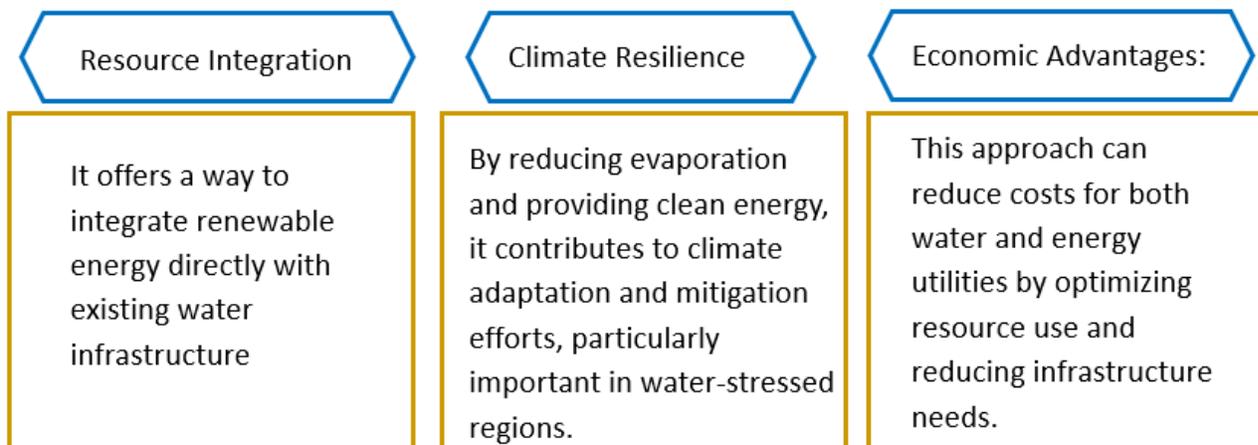
Advancing sustainability through Materials, Electrochemistry and Green Energy

Installing solar panels on water surfaces, or floating solar photovoltaics, is a technology that addresses the water-energy nexus by leveraging water's cooling effect to improve solar panel efficiency while conserving land resources.

How floating solar panels work with the water-energy nexus



## Benefits for the Water-Energy Nexus



In essence, floating solar panels embody the water-energy nexus by creating a mutually beneficial relationship where water bodies enhance energy production, and the energy generated supports water management and conservation efforts.

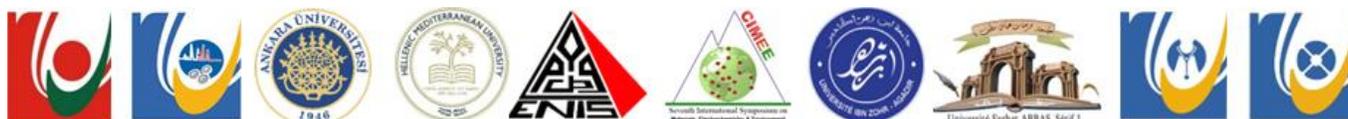
## Workshops II

Chair: A. El Moll

### Advancing sustainability through Materials & electrochemistry

WorkshopII: Advancing sustainability through Materials & electrochemistry, ChairA. El Moll

Chair: A. El Moll



#### Workshop A: Electrochemistry & Environmental Sustainability

##### Workshop A: Electrochemistry & Environmental Sustainability

- I- Electrochemistry & Environmental Sustainability
- II- Advances in Nanotechnology for Carbon Capture & Environmental Sustainability
- III -Improving water governance for long-term sustainability by integrating decentralized systems, nature-based solutions (NBS), & circular economy approaches.

#### Workshop A: Electrochemistry & Environmental Sustainability

Description: Electrochemistry has become an essential element of sustainable development. This science plays a central role in sustainability, particularly through its applications in the production, storage, and efficient use of energy. It is crucial for the conversion of renewable energy, such as in batteries and supercapacitors. Fuel cells, which convert hydrogen into electricity with water as the only byproduct, represent a promising technology for clean mobility.



## Workshop A: Electrochemistry & Environmental Sustainability

- I- Electrochemistry & Environmental Sustainability
- II- Advances in Nanotechnology for Carbon Capture & Environmental Sustainability
- III -Improving water governance for long-term sustainability by integrating decentralized systems, nature-based solutions (NBS), & circular economy approaches

Chair: A. El Moll

### Workshop: Electrochemistry & Environmental Sustainability.

Day 3, Saturday September 27, 2025

Electrochemistry plays a pivotal role in advancing environmental sustainability by offering versatile solutions for pollution control, resource recovery, and clean energy production

Conference Workshops (CWs) are integral parts of CIMEE25 conference. The workshop session describes the current research status and practical applications of electrochemical technology and sustainable energy.

This event includes sessions on topics related to applying electrochemistry to complex global challenges as well as renewable energy and storage

CIMEE25 conference workshops will expose three topics:

- I- Electrochemistry & Environmental Sustainability
- II- Advances in Nanotechnology for Carbon Capture & Environmental Sustainability
- III -Improving water governance for long-term sustainability by integrating decentralized systems, nature-based solutions (NBS), & circular economy approaches

Conference workshops include hands-on activities, collaborative problem-solving, and expert-led discussions. These workshops aim to provide participants with practical skills, new methodologies, and a deeper understanding of the topic.

Conference workshop description:

Electrochemistry plays a crucial role towards achieving a sustainable environment. Several processes and ecofriendly electrochemical technologies are a boon to the environment and of great interest for researchers across the globe.

This workshop session focuses on cutting-edge research and innovations at the intersection of electrochemistry, energy, and environmental sustainability. It invites contributions focusing on electrochemical technologies for renewable energy conversion and storage, such as fuel cells, batteries, and supercapacitors, as well as advancements in environmental applications, including electrochemical water purification, wastewater treatment, carbon capture, pollutant degradation, and resource recovery. Topics of interest also include electrocatalysis, redox flow systems, electrochemical sensors for environmental monitoring, and the development of novel electrode materials and electrolytes for sustainable energy and environmental management.

Keywords: Electrochemistry, wastewater treatment, water purification, carbon capture, electrocatalysis, renewable energy, energy storage, sustainable materials, environmental sustainability. Sensing monitoring, remediation pollutants

7<sup>th</sup> International Symposium on Materials, Electrochemistry and Environment – CIMEE25

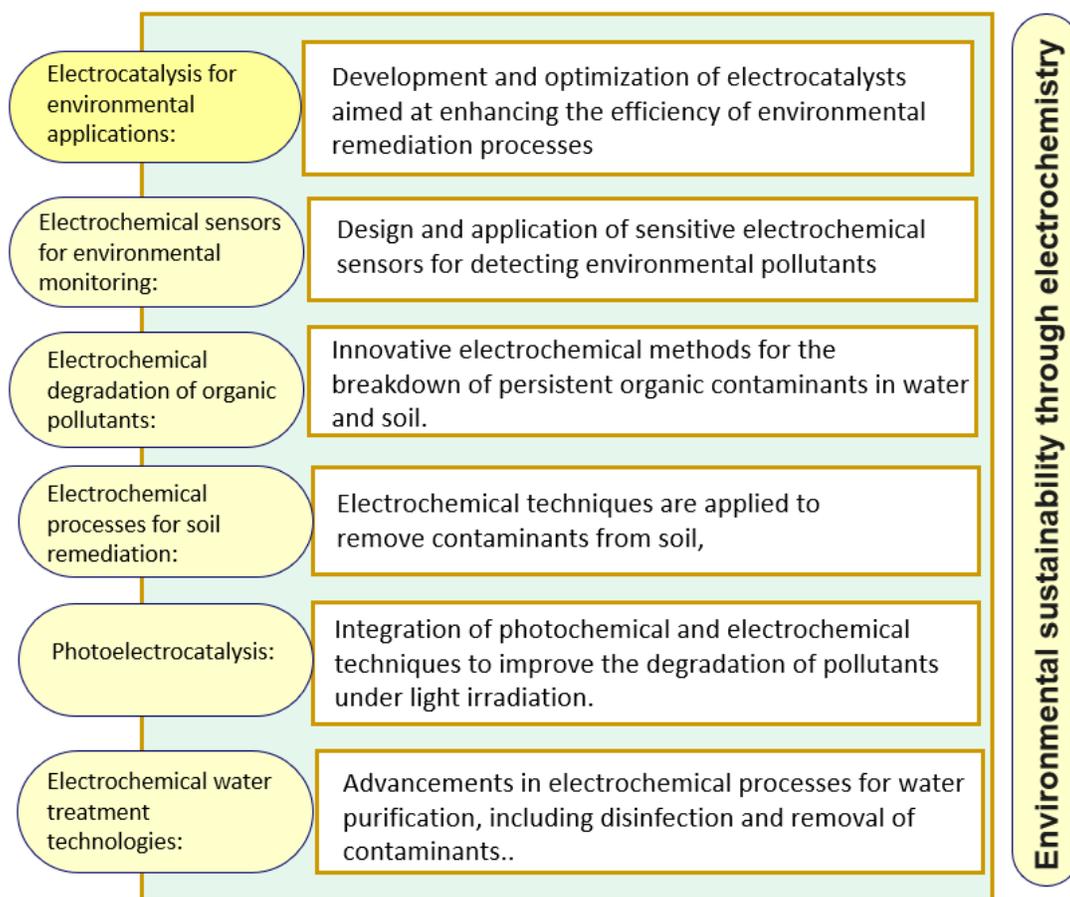
## Role of electrochemistry in sustainable Environment

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The Workshop focused on the role of electrochemistry in sustainable energy and the environment. Electrochemistry offers numerous solutions for environmental challenges, including water purification, pollution control, & energy storage. Electrochemistry is perfectly capable of addressing the environmental challenges of our epoque, ranging from pollution to climate change, by providing innovative and sustainable solutions. Indeed, electrochemistry is among the sciences that explore innovative approaches for the creation of catalysts and the production of electrodes to increase environmental sustainability. This approach aims to reduce greenhouse gas emissions, develop efficient processes for water treatment, environmental remediation, and carbon capture. Therefore, electrochemical technologies, today, appear as a promising way, offering effective, flexible, and environmentally friendly approaches.



### I - Environmental sustainability through electrochemistry

7<sup>th</sup> International Symposium on Materials, Electrochemistry and Environment – CIMEE25

## Role of electrochemistry in sustainable Energy

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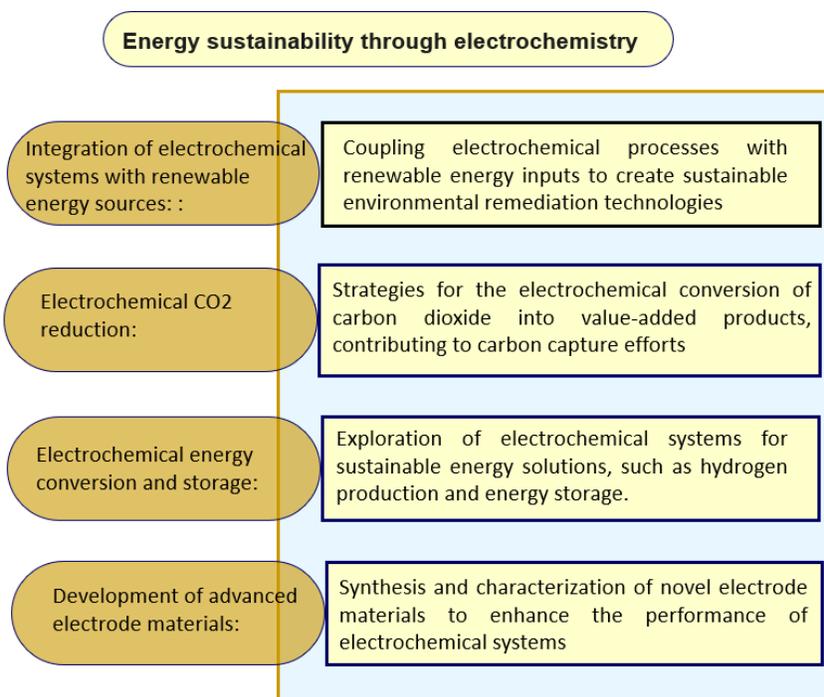
The Workshop focused on the role of electrochemistry in sustainable energy and the environment. Electrochemistry offers numerous solutions for environmental challenges, including water purification, pollution control, & energy storage.

### Role of electrochemistry in sustainable Energy

Electrochemical energy storage, such as batteries, allows for the efficient storage of electricity generated from renewables, ensuring grid stability and reliability. Diversification of battery chemistries is essential for advancing cleaner energy systems, with research focusing on stationary storage, portable electronics, and high-energy applications like electric vehicles.

A key application is the production of green hydrogen through electrochemical electrolysis, which converts electrical energy from renewable sources into hydrogen gas—a clean chemical fuel suitable for use in transportation, aviation, and the synthesis of sustainable chemicals and fertilizers.

A – The workshop focused on the role of electrochemistry in sustainable energy



II - Energy sustainability Trough Electrochemistry

## Applications in Environment

### Water & Wastewater Treatment:

Electrochemical methods like electrocoagulation & electrooxidation remove pollutants and heavy metals from contaminated water.

### Environmental Sensors:

Electrochemical sensors are used to detect and measure pollutants in air, water, and soil, aiding in environmental monitoring

### Resource Recovery & Recycling:

Electrochemistry supports the recycling of metals and other materials from waste streams

### Photoelectrocatalysis:

Integration of photochemical and electrochemical techniques to improve the degradation of pollutants under light irradiation

### Soil & Air remediation:

Electrochemical processes can treat contaminated soil and air pollutants, breaking them down into less harmful substances.

### CO<sub>2</sub> Reduction & Utilization:

Electrochemical CO<sub>2</sub> reduction & conversion technologies can transform captured carbon dioxide into valuable products, supporting carbon capture efforts.

### Electrocatalysis for environmental applications:

Development and optimization of electrocatalysts aimed at enhancing the efficiency of environmental remediation processes

## Applications in Energy

### Green Hydrogen Production:

Electrolysis, an electrochemical process, splits water into hydrogen and oxygen, providing a clean fuel source.

### Sustainable Chemical Synthesis:

Electrosynthesis allows for the precise and environmentally friendly production of various chemicals and materials

### Integration of electrochemical systems with renewable energy sources::

Coupling electrochemical processes with renewable energy inputs to create sustainable environmental remediation technologies. Also, the production of green hydrogen and ammonia.

### Energy Storage:

Batteries including novel battery technologies (e.g., lithium-ion, sodium-ion, potassium-ion batteries), solar cells, thermoelectric generators, and fuel cells, contributing to sustainable energy solutions.)

### Energy Conversion:

Fuel Cells: convert chemical energy from fuels into electricity, offering a clean power alternative.

### Development of advanced electrode materials:

Synthesis and characterization of novel electrode materials including nanostructured materials, composites, and novel electrolytes to enhance the performance of electrochemical systems

## Advances in Nanotechnology for Carbon Capture & Environmental Sustainability

<sup>1</sup>EI Moll Ahmad

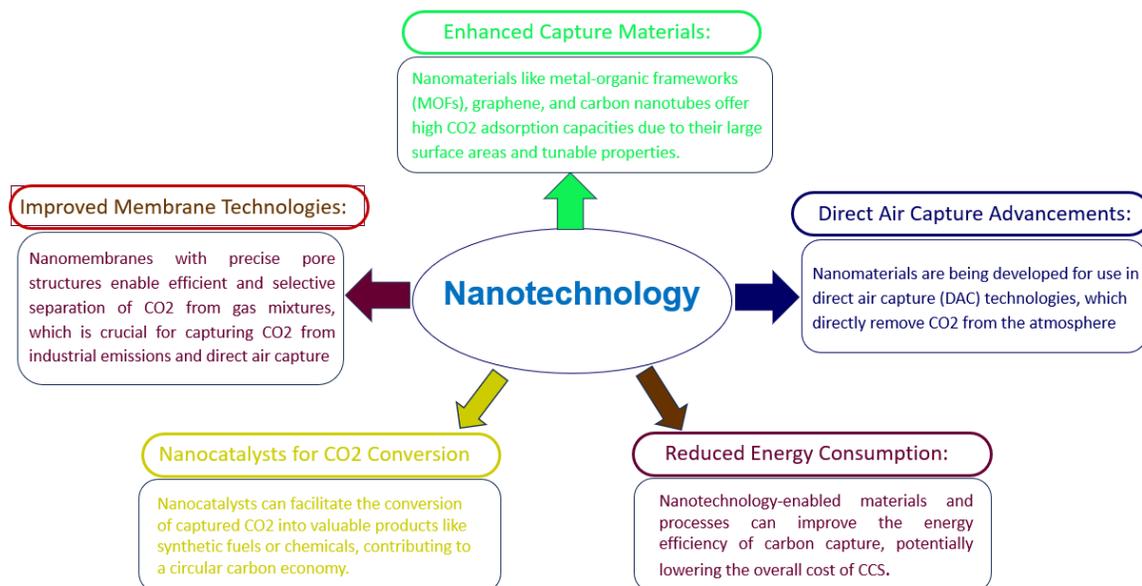
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### Abstract

Environmental nanotechnology can solve a range of environmental problems and Nanotechnology offers promising tools for achieving sustainability goals, particularly in carbon capture and storage (CCS). Furthermore, carbon capture technology has been identified as a viable solution for addressing global energy depletion and mitigating the effects of fossil fuel consumption on climate change. Recent advances in carbon capture technique based on wet scrubbing have typically focused on increasing carbon capture efficiency. Nanotechnology is playing an increasingly important role in carbon capture and environmental sustainability by offering innovative solutions for capturing, utilizing, and storing CO<sub>2</sub>. Nanomaterials like metal-organic frameworks (MOFs), carbon nanotubes, and graphene derivatives demonstrate enhanced CO<sub>2</sub> adsorption and separation capabilities. Furthermore, nanotechnology is being explored for converting captured CO<sub>2</sub> into valuable products through various processes, including electrochemical conversion, thermochemical conversion, and biochemical conversion. And for improving energy efficiency in various industrial processes. The session will focus on recent advances associated with the explored for converting captured CO<sub>2</sub> processes as well as the role of Nanotechnology for Carbon Capture & Environmental Sustainability. Finally, the recent advances of CO<sub>2</sub> capture on various nanoadsorbents (i.e., carbon-, metal (hydr)oxides-, silica-, zeolite- and polymer-bearing nanoparticles) were discussed in details.

**Keywords:** Carbon capture and utilization, Electrochemistry, CO<sub>2</sub> capture, metal-organic frameworks (MOFs), graphene-based sorbents, nanoscale zeolites, and carbon nanotube, converting captured CO<sub>2</sub> processes



## Improving water governance for long-term sustainability by integrating decentralized systems, nature-based solutions (NBS), & circular economy approaches

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### Abstract

The rapid scarcity of water resources, coupled with climate change and the need for efficient wastewater management to minimize impacts, requires us to review the way wastewater is managed in terms of energy consumption and reuse as a strategy for conserving water resources and protecting the ecosystem. Poor wastewater management leads to direct contamination of water sources, such as rivers, lakes and aquifers. Untreated or poorly treated discharges introduce harmful pollutants such as pathogens, excess nutrients and hazardous chemical compounds into aquatic ecosystems. This unfortunately harms aquatic life and deteriorates water quality and also poses a great risk to public health and the environment, especially groundwater and surface water. Moreover, water stress, exacerbated by climate change and increased demand, is forcing rural and urban areas to pursue alternative solutions for water supply. The reuse of treated wastewater, while still presenting technical and societal challenges, is becoming an increasingly viable option to relieve pressure on natural water resources. There is a real need for more efficient and sustainable wastewater treatment technologies that can reduce the environmental footprint of the process and recover valuable resources such as energy, reusable water, and nutrients. Innovation in wastewater treatment, aimed at creating sustainable solutions, will be showcased in this session, to address environmental challenges and ensure a resilient future. Advanced technologies that can improve treatment efficiency, recover valuable resources such as water and nutrients, and reduce the environmental impact of discharges. Sustainable solutions for wastewater treatment will be presented in this session such as: Advanced membrane technologies (ultrafiltration and nanofiltration). Smart sanitation systems: (The use of sensors enables real-time monitoring). By-product recovery (Biogas, phosphorus, and nitrogen recovery, creating a circular economy). Advanced biological treatment such as anaerobic digestion and activated sludge. Finally, wastewater reuse: Using treated water for various reuses, such as irrigation. Fig 1. By implementing these strategies, the wastewater sector can move towards a more sustainable and climate-friendly future, playing a vital role in mitigating the impacts of global warming.

**Keywords:** wastewater treatment technologies, Low-carbon design and operation; Renewable energy; Carbon-neutral technologies in urban sewage treatment, Circular economy

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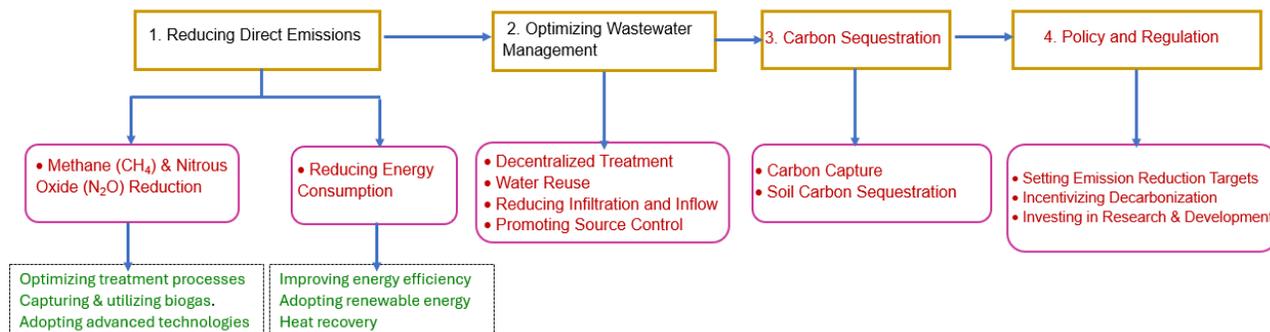
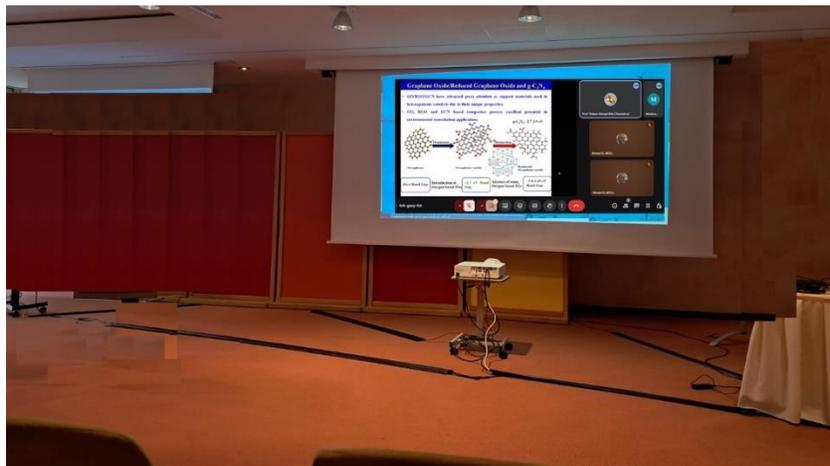


Fig 1. Sustainable wastewater treatment technologies: innovative solutions to achieving decarbonization



## Workshop B: Nanoremediation Technologies: Innovative solutions for sustainable Environment

I - Nanomaterials & Nanotechnologies for Environmental sustainability:

A - Nanoremediation technologies for climate change mitigation

B - Nanotechnology approaches to agricultural soil pollution remediation

II- Agricultural chemistry: developing innovative solutions to Achieving Sustainability in the Agro-Environment

III- Improving food security and reducing the environmental impact of agriculture: the role of Technological solutions

Chair: A. El Moll

Nanoremediation technologies represent a cutting-edge approach to sustainable environmental remediation, offering innovative solutions for the cleanup of contaminated soil, water, and air.

Workshop B: Nanomaterials & Nanotechnologies for Environmental sustainability:  
Nanoremediation Technologies: Innovative solutions for sustainable Environment

Description: Nanoremediation technologies represent a cutting-edge approach to sustainable environmental remediation, offering innovative solutions for the cleanup of contaminated soil, water, and air. Indeed, nanotechnology is driving significant advances in the environmental field, particularly through the development of nanomaterials capable of effectively treating a wide range of pollutants. Nanoparticles, for example, are being used for carbon dioxide capture, a promising application for combating climate change.

Key nanomaterials used include:

nanoscale zero-valent iron (nZVI), carbon nanotubes (CNTs), graphene oxide, metal-organic frameworks (MOFs), and covalent organic frameworks (COFs), which are effective in treating persistent organic pollutants (POPs), heavy metals, chlorinated solvents

CIMEE25 conference workshops will expose three topics:

I - Nanomaterials & Nanotechnologies for Environmental sustainability:

A - Nanoremediation technologies for climate change mitigation

B - Nanotechnology approaches to agricultural soil pollution remediation

II- Agricultural chemistry: developing innovative solutions to Achieving Sustainability in the Agro-Environment

III- Improving food security and reducing the environmental impact of agriculture: the role of Technological solutions

Today, nanotechnologies represent one of the most innovative areas of development. Through a multidimensional approach, they contribute to the fight against climate change by improving carbon sequestration, reducing greenhouse gas emissions, and enhancing the efficiency of renewable energy systems and agricultural practices.

An innovative approach provided by nanoremediation technology for the sustainable decontamination of the environment, offering solutions to persistent environmental challenges. Among the main contaminants targeted are persistent organic pollutants (POPs) such as pesticides and heavy metals.

Various nanomaterials are used in these processes, including nanoscale zero-valent iron (nZVI), carbon nanotubes (CNTs), magnetic and metallic nanoparticles, silica nanoparticles (SiO<sub>2</sub>), graphene oxide, covalent organic frameworks (COFs), and metal-organic frameworks (MOFs). These materials are used in diverse remediation strategies such as adsorption, filtration, photocatalysis, electro-nanoremediation, and nano-bioremediation.

## Nanoremediation technologies for climate change mitigation

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### Abstract

Nanoremediation technologies offer promising solutions for mitigating climate change by addressing key environmental challenges such as greenhouse gas emissions and pollution. Nanomaterials can effectively capture carbon dioxide from the atmosphere through a process of CO<sub>2</sub> capture using nanomaterials. This process helps mitigate the increase in atmospheric CO<sub>2</sub> levels, a primary driver of climate change.

The use of nanotechnology and nanomaterials holds great promise for pollution management and reduction. Thanks to the variety and versatility of nanomaterials, they can be used in atmospheric environments. This workshop focuses specifically on an overview of the application of nanomaterials to environmental remediation and analyzes the state of the art of various nanomaterials such as carbon and silica-based materials used for air purification.

Nanoremediation of polluted air and GHG emissions: Nanoremediation is considered an eco-friendly technology. As a result, it is considered a feasible choice for conventional site remediation technology. Nanoremediation may provide a cost-effective and faster solution for remediation. Various nanomaterials have been used for nanoremediation, such as carbon-based materials and Silica-Based Materials.

a) Carbon-Based Materials such as carbon nanotubes (CNTs), graphene, and graphene oxide, are highly effective due to their large specific surface area, high porosity, and tunable surface chemistry, which enhance their adsorption capacity for various pollutants. In addition, Carbon nanotube-based membranes, for instance, can separate gases like CO<sub>2</sub> at speeds 100 times faster than traditional methods, making them suitable for large-scale applications

b) Silica-Based Materials The ability of these nanomaterials for catalysis and adsorption has led to a growing interest in recent years for the remediation of polluted air and the elimination of contaminants in the gas phase. Nanofilters, which utilize materials like carbon nanotubes and electrospun nanofibers, offer superior performance compared to traditional filters. Their pore sizes, ranging from 1 to 10 nanometers, allow for the effective capture of ultrafine particles, including PM<sub>2.5</sub> and PM<sub>10</sub>

**Keywords:** environmental sustainability; nanoremediation; climate change, Air remediation;; Nanocatalysts; Silica-Based Material; Carbon-Based Materials.



## Nanotechnology approaches to agricultural soil pollution remediation

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### Abstract

Nanotechnology offers diverse and effective approaches for the remediation of agricultural soils, targeting both organic and inorganic contaminants. For organic pollutants such as polycyclic aromatic hydrocarbons (PAHs), photocatalytic photodegradation using nanomaterials like TiO<sub>2</sub> nanoparticles is a promising solution. The integration of nanotechnology into biological systems and sustainable agricultural practices opens up prospects for the development of green technologies aimed at restoring contaminated soils. Indeed, nanobioremediation represents an effective strategy for combating organic soil contamination, particularly by pesticides and herbicides. Furthermore, the use of nanophytoremediation, where nanomaterials help plants extract and detoxify pollutants, constitutes a cutting-edge and environmentally friendly approach to combating soil pollution. Moreover, green technologies for the remediation of contaminated soils are approaches that utilize natural processes and materials to detoxify, stabilize, or remove contaminants, particularly heavy metals and organic pollutants, while improving soil health and ecosystem resilience.

**Keywords:** agricultural soils, nanomaterials, Bioemediation, Green remediation, nanophytoremediation, nanobioremediation

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## Agricultural chemistry: developing innovative solutions to Achieving Sustainability in the Agro-Environment

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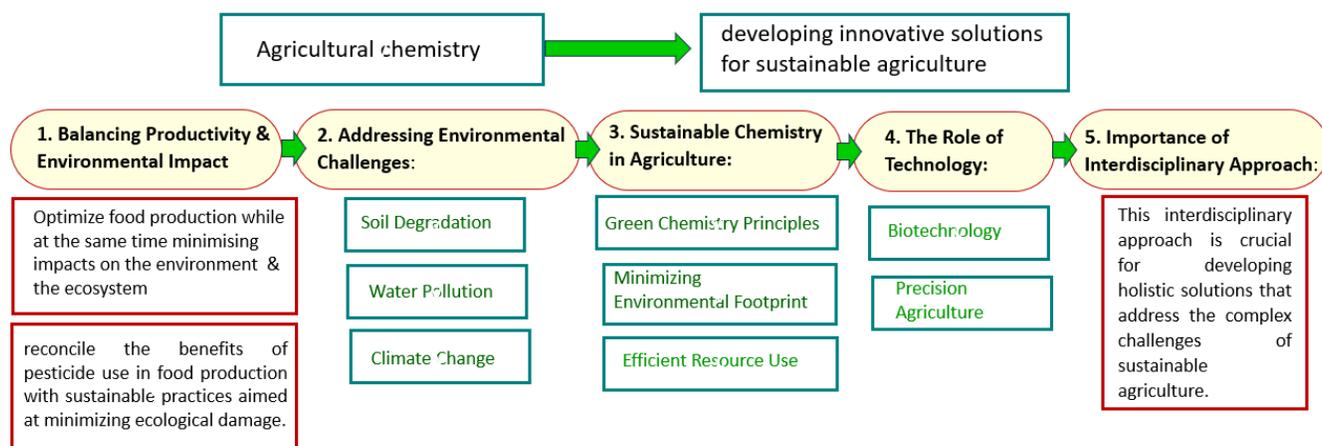
Thematic Area: Water energy nexus, & sustainable environment

### Abstract

Agrochemistry plays a crucial role in developing innovative solutions for a sustainable agricultural environment by optimizing resource use, reducing environmental impact, and improving crop productivity. This involves advances in areas such as controlled-release fertilizers, smart agrochemicals, and nanotechnology applications, thus contributing to a more sustainable and efficient agricultural system. By embracing innovative approaches such as controlled-release fertilizers, smart agrochemicals, nanotechnology, biochar, smart farming technologies, genetically modified organisms (GMOs), integrated pest management (IPM), efficient water management, and crop rotation and diversification, agricultural chemistry plays a vital role in creating a more sustainable agro-environment for the future.

The session will focus on the innovative approaches on the balancing productivity and environmental impact, addressing environmental challenges, sustainable chemistry in Agriculture, the role of technology (biotechnology, precision agriculture) and importance of Interdisciplinary Approach.

**Keywords:** biotechnology, precision agriculture, integrated pest management (IPM), efficient water management



7<sup>th</sup> International Symposium on Materials, Electrochemistry and Environment – CIMEE25

## Improving food security and reducing the environmental impact of agriculture: the role of Technological solutions

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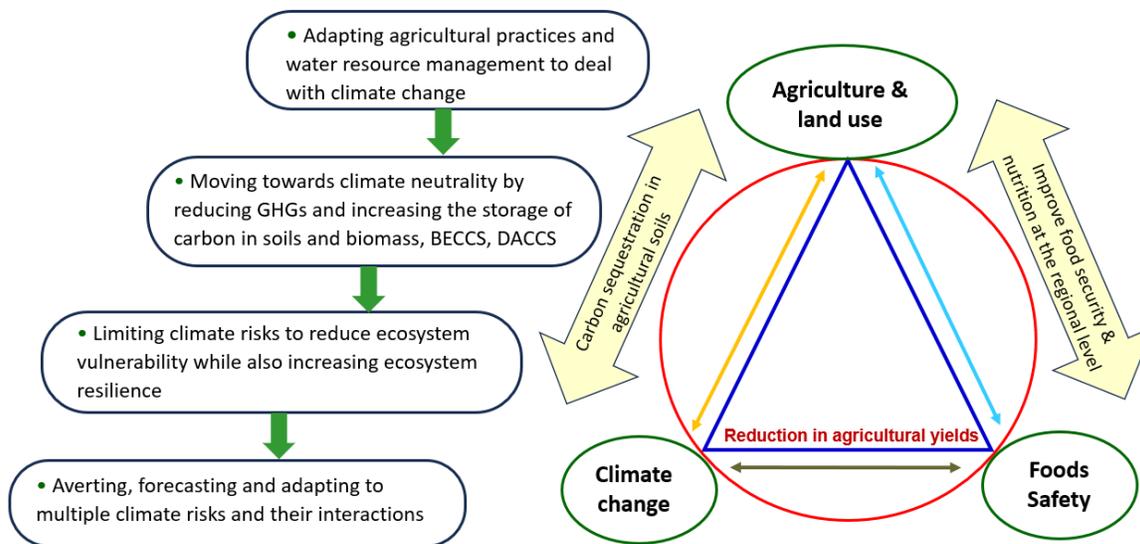
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*Thematic Area: Water energy nexus, & sustainable environment*

### Abstract

Agricultural biotechnology plays a crucial role in enhancing food security while promoting environmental sustainability. By developing crops with improved traits like pest resistance, drought tolerance, and enhanced nutritional value, biotechnology helps increase yields, reduce the need for chemical inputs, and improve food availability, especially in vulnerable regions. In agriculture, biotechnology provides creative answers to pressing issues of environmental sustainability, resource conservation, and global food security. This interdisciplinary field develops tools and methods that improve agricultural production, reduce its negative environmental impacts, and contribute to the establishment of sustainable agricultural systems through advanced technologies, genetic engineering, and biological processes. Beyond conventional breeding techniques, agricultural biotechnology improves yields, reduces chemical use, and strengthens crop resilience to environmental challenges. Finally, given agriculture's significant carbon footprint and the impacts of climate change on it, it will be important to adopt more sustainable agricultural practices. These practices, aimed at reducing greenhouse gas emissions and improving the resilience of agricultural systems. This session focused on the environmental sustainability, resource conservation and global food security, as well as targeted work to ensure new plant varieties t

**Keywords:** environmental sustainability, agricultural biotechnology, food security, carbon footprint, resource conservation.



## CLOSING REMARKS OF WORKSHOP SESSION

Dear colleagues, we appreciated the commitment and active participation that you all demonstrated during this workshop.

This workshop allowed us to proactively address the significant changes occurring in the world, such as climate change mitigation, the role of Electrochemistry in the Environmental Sustainability, as well as nanomaterials/Nanotechnologies for Environmental Sustainability. Many topics were covered: Carbon Capture, water governance with the important role of energy sustainability. In the second part of the workshop: Nanoremediation technologies for climate change mitigation through improving food security and reducing environmental impact of the agriculture, agricultural soil pollution, as well as agricultural production.

We gained a better understanding of the challenges related to the science of electrochemistry and its crucial role in sustainability, as well as nanoremediation, fertility and soil health, concluding with food security.

To conclude this workshop session, allow me to describe the current situation in the Eastern Mediterranean:

### Food and Water Security in Lebanon: Between Drought and the Scale of Losses and Damage to the Agricultural Sector Due to the War

The repercussions of the recent war in southern Lebanon, coupled with severe climate change, have plunged the agricultural sector into a deep crisis. Now, two years after the outbreak of the war, which began on October 7, 2023, the war has cost Lebanon enormous losses, in addition to the massive destruction of infrastructure and the closure of border areas to Lebanese civilians. A joint World Bank and United Nations report, published in March 2025, paints a bleak picture, revealing that the cost of the war has reached \$14 billion, divided into \$6.8 billion in direct damage and \$7.2 billion in indirect economic losses. According to the World Bank report, these losses resulted from the burning of 3,922 hectares of agricultural land and forests as a result of shelling and white phosphorus. 134 hectares of olive trees, 48 hectares of citrus trees, and 44 hectares of banana trees were also destroyed, and the productivity of the southern agricultural areas declined by more than 70%.

These losses are not limited to farmers alone; they also threaten national food security, as the South and Bekaa produce approximately 40% of Lebanon's olive oil and a quarter of its fruit.

The report, prepared by the Ministry of Agriculture in collaboration with the Food and Agriculture Organization of the United Nations (FAO), indicates that the damage is estimated at approximately \$800 million, of which \$180 million is in losses, with the remainder being losses to farmers. The Ministry, in collaboration with the FAO, has launched a three-year plan to assess the extent of the damage and work to protect the 2025/2026 agricultural season. This plan also includes the rehabilitation of severely damaged buildings, farms, irrigation networks, and wells. Furthermore, Lebanon has experienced a decline in rainfall this year, negatively impacting the agricultural sector and food security. Rainfall has decreased to less than 50% in the interior regions and the northern Bekaa, a major agricultural area. The number of rainy days has decreased to about 45, negatively impacting the agricultural sector. This represents the greatest challenge. Due to climate change, numerous efforts are currently underway to support farmers and help them adopt more water-efficient irrigation methods, including drip irrigation and the use of treated wastewater for some crops. According to recent scientific data, and in collaboration with research centers and universities, solutions to this crisis can be summarized as follows:

- Develop a new agricultural map to guide farmers toward crops more suitable for all Lebanese regions. This will reduce production costs and make agriculture more resilient to climate change, enabling increased production and contributing to food security.
- Develop training for personnel on various modern agricultural technologies and climate change mitigation strategies, enabling farmers to keep pace with agricultural developments, contributing to increased agricultural yields and the productivity of the Lebanese economy.
- Support farmers, agricultural associations, and cooperatives through agricultural extension.
- Strengthen the role of agricultural extension and increase the effectiveness of agricultural workers to support farmers, agricultural associations, and cooperatives.

I personally want to express my gratitude to all of you for participating in this workshop and for sharing your experiences and thoughts, and I hope that we will all work together to improve the worrying situation of the Mediterranean environment.

## اختتام فعاليات المؤتمر العلمي الدولي السابع CIMEE25 في لبنان

كلمة رئيس اللجنة العلمية في حفل اختتام وتوصيات المؤتمر الدولي السابع CIMEE25

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 وإفريقيا. 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.

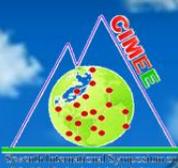
أيها المشاركون الأعزاء، اسمحوا لي أن أناقش معكم وضع القطاع الزراعي الحالي في لبنان من خلال دراسة آثار تغير المناخ والجفاف وخسائر الحرب على الزراعة

الأمن الغذائي والمائي في لبنان: بين الجفاف وحجم والخسائر والأضرار للقطاع الزراعي جراء الحرب أغرقت تداعيات الحرب الأخيرة في جنوب لبنان، بالإضافة إلى التغير المناخي الحاد، القطاع الزراعي في أزمة عميقة. الآن، وبعد عامين من اندلاع الحرب، التي بدأت في 7 أكتوبر/تشرين الأول 2023، الحرب كلفت لبنان خسائر فادحة، بالإضافة إلى الدمار الهائل الذي لحق بالبنية التحتية وإغلاق المناطق الحدودية أمام المدنيين اللبنانيين، يرسم تقرير مشترك للبنك الدولي والأمم المتحدة، نُشر في مارس/آذار 2025، صورة قاتمة، كاشفًا أن تكلفة الحرب بلغت 14 مليار دولار، مقسمة إلى 6.8 مليار دولار أضرار مباشرة و7.2 مليار دولار خسائر اقتصادية غير مباشرة. ووفقًا لتقرير البنك الدولي، نتجت هذه الخسائر عن احتراق 3922 هكتارًا من الأراضي الزراعية والغابات نتيجة القصف والفسفور الأبيض. كما دُمّرت 134 هكتارًا من أشجار الزيتون، و48 هكتارًا من أشجار الحمضيات، و44 هكتارًا من أشجار الموز، وتراجعت إنتاجية المناطق الزراعية الجنوبية بأكثر من 70%. لا تقتصر هذه الخسائر على المزارعين فحسب، بل تُهدد الأمن الغذائي الوطني أيضًا، حيث يُنتج الجنوب والبقاع حوالي 40% من زيت الزيتون في لبنان وربع ثماره.

ويُشير التقرير، الذي أعدته وزارة الزراعة بالتعاون مع منظمة الأغذية والزراعة للأمم المتحدة (الفاو)، إلى أن الأضرار تُقدر بنحو 800 مليون دولار، منها 180 مليون دولار خسائر، والباقي خسائر للمزارعين. وقد أطلقت الوزارة، بالتعاون مع منظمة الأغذية والزراعة، خطة مدتها ثلاث سنوات لتقييم حجم الأضرار والعمل على حماية الموسم الزراعي 2026/2025. وتشمل هذه الخطة أيضًا إعادة تأهيل المباني والمزارع وشبكات الري والآبار المتضررة بشدة. علاوة على ذلك، شهد لبنان انخفاضًا في هطول الأمطار هذا العام، مما أثر سلبيًا على القطاع الزراعي والأمن الغذائي. فقد انخفضت نسبة هطول الأمطار إلى أقل من 50% في المناطق الداخلية والبقاع الشمالي، وهي منطقة زراعية رئيسية. وانخفض عدد أيام المطر إلى حوالي 45 يومًا، مما أثر سلبيًا على القطاع الزراعي. ويمثل هذا التحدي الأكبر. وبسبب تغير المناخ، تَبَدَّل حاليًا جهود عديدة لدعم المزارعين ومساعدتهم على تبني أساليب ري أكثر كفاءة في استخدام المياه، بما في ذلك الري بالتنقيط واستخدام مياه الصرف الصحي المعالجة لبعض المحاصيل. وفقًا لبيانات علمية حديثة، وبالتعاون مع مراكز البحوث والجامعات، يمكن تلخيص حلول هذه الأزمة على النحو التالي:

- وضع خريطة زراعية جديدة لتوجيه المزارعين نحو محاصيل أكثر ملاءمة لجميع المناطق اللبنانية. سيؤدي ذلك إلى خفض تكاليف الإنتاج وجعل الزراعة أكثر قدرة على التكيف مع تغير المناخ، مما يتيح زيادة الإنتاج ويساهم في تحقيق الأمن الغذائي.
- تطوير تدريب الكوادر على مختلف التقنيات الزراعية الحديثة واستراتيجيات التخفيف من آثار تغير المناخ، ليتمكن المزارعون من مواكبة التطورات الزراعية، مما يساهم في زيادة الغلة الزراعية وإنتاجية الاقتصاد اللبناني.
- دعم المزارعين والجمعيات الزراعية والتعاونيات من خلال الإرشاد الزراعي. • تعزيز دور الإرشاد الزراعي وزيادة فعالية العاملين الزراعيين لدعم المزارعين والجمعيات الزراعية والتعاونيات.
- أود أن أعرب شخصيًا عن امتناني لكم جميعًا للمشاركة في هذه الورشة وتبادل تجاربكم وأفكاركم، وأمل أن نعمل جميعًا على تحسين الوضع البيئي المقلق في منطقة البحر الأبيض المتوسط.





7th International Symposium on  
**CIMEE'25**  
Materials, Electrochemistry & Environment

**International Symposium on  
Materials, Electrochemistry & Environment**

Theme: Advancing sustainability through Materials, electrochemistry & green energy

Workshop A: Electrochemistry & Environmental Sustainability

Workshop B: Nanomaterials & Nanotechnologies for Environmental sustainability:  
Nanoremediation Technologies: Innovative solutions for sustainable Environment

## CLOSING SESSIONS CIMEE25

### Speech at the Closing Sessions of the International Symposium, CIMEE25:

Dear Respected colleagues, ladies and gentlemen,

First, I would like to thank all attendees, especially the technical program committee and organizing committee as well as the speakers for their valuable contributions, and the session chairs for their excellent organization and efficient management of the sessions, adhering precisely to the conference program schedule. But most importantly, I thank all the participants. Without your active involvement, your ideas, and your discussions, this conference would not have been such a success.

When we started planning this conference, we identified our main objectives:

to foster collaboration among universities in the Mediterranean region and globally,

to exchange ideas and opinions on topics of common interest (extreme heat, water shortages and air/water pollution etc..)

to learn from each other's experiences in chemistry and environmental science, and to build strong networks among participants.

I am pleased that over the past three days; we have exceeded my positive expectations in all aspects of the conference. I hope that the relationships we have established will continue to grow; they are invaluable. We have already heard comprehensive and insightful summaries from the participants and session chairs, and I will not repeat them here.

Instead, I would like to share my personal reflections on this conference. Most of the scientific fields in which we work, from materials science and electrochemistry to renewable energy, are of paramount importance for achieving sustainability and creating a better, more dignified, and healthier environment and way of life, both in the Mediterranean region and worldwide. These efforts can therefore contribute significantly to addressing current problems in the planet, such as climate change and the significant environmental damage caused by armed conflicts in both Eastern Europe and the Eastern Mediterranean, where vast areas of agricultural land are destroyed and polluted by fires that break out during these conflicts.

Because national boundaries do not limit most climate-related factors expected to impact environment and human health, we propose that adaptation/mitigation policies must have a regional scope, and therefore require collaborative efforts among Eastern Mediterranean nations.

The policy proposals include the need to significantly reduce carbon emissions across the region, •to integrate efforts to combat land degradation and environmental pollution throughout the region,

•to promote the development and use of innovative, cost-effective technologies for water production and management,

•to develop comprehensive strategies to improve the state of the environment, and to support the establishment of regional networks for monitoring and controlling major sources of air pollution in the region.

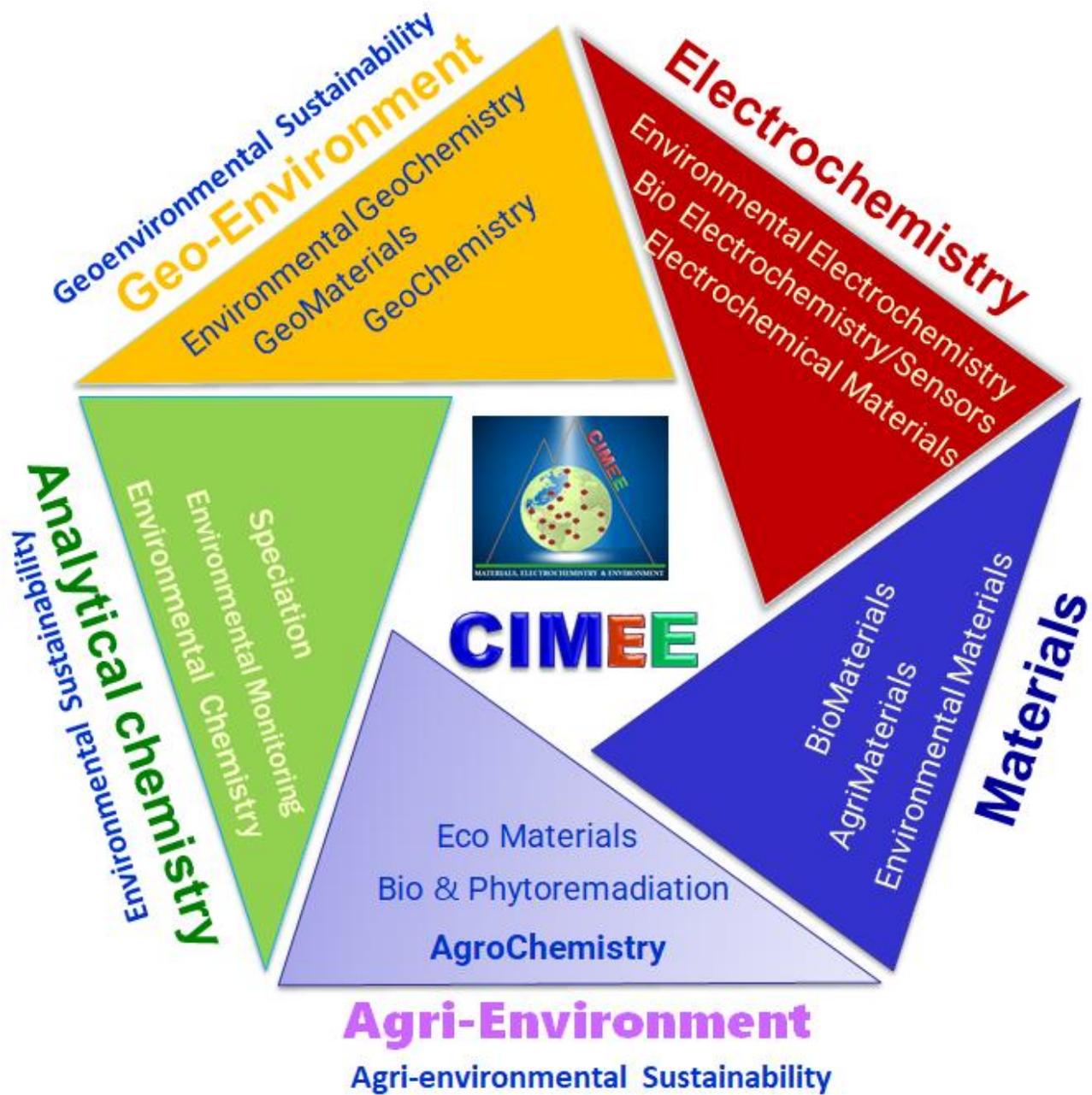
Given the negative impact of extreme high temperatures, water scarcity, and air pollution on human health in the Eastern Mediterranean region;

•This initiative aims to guide relevant scientific research to address the negative effects of rising temperatures and identify gaps in existing scientific research.

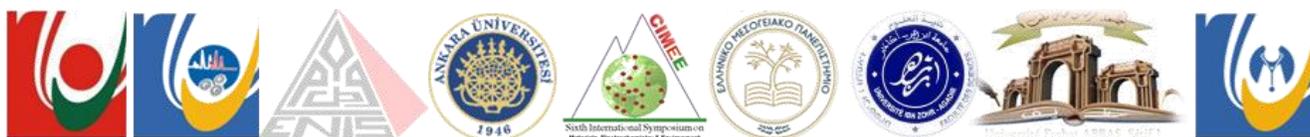
•It also aims to propose policies to mitigate and adapt to climate change, thereby enhancing the region's resilience to future environmental challenges.

In the hope to meet you in the next edition of CIMEE conference Series, CIMEE26, September 24-26 2026.

Sincerely yours



# CLOSING CEREMONY



## CLOSING CEREMONY

SEVENTH INTERNATIONAL SYMPOSIUM ON MATERIALS, ELECTROCHEMISTRY AND ENVIRONMENT

September 25 – 27, 2025 - **LEBANON**

**CLOSING SESSION & CONCLUSIONS**

**Theme: Advancing Sustainability through Materials, electrochemistry and Green Energy**

7th International Symposium on Materials, Electrochemistry and Environment (CIMEE 2025)

**Speech at the Closing Ceremony of the International Symposium, CIMEE25**

# C I M E E

INTERNATIONAL SYMPOSIUM ON MATERIALS, ELECTROCHEMISTRY & ENVIRONMENT

## CLOSING CEREMONY

SEVENTH INTERNATIONAL SYMPOSIUM ON MATERIALS, ELECTROCHEMISTRY AND ENVIRONMENT

Septième Colloque International sur les Matériaux, l'Electrochimie et l'Environnement, CIMEE25

Septembre 25 – 27, 2025, **LEBANON**

## Speech at the Closing Ceremony of the International Symposium, CIMEE25

Respected colleagues, Ladies and Gentlemen,

With international competition intensifying between some of the most powerful nations in Asia and North America, and the war in Eastern Europe escalating into a protracted conflict—all driven by the pursuit of dominance, economic gain, and control over natural resources—the ongoing conflict in the eastern Mediterranean, spanning over two years, has caused significant environmental damage and substantial loss of agricultural land, affecting an area stretching over 100 kilometers along the eastern Mediterranean coast. This has resulted in reduced productivity of vast tracts of farmland, as well as water and soil pollution from fires and combat operations. The global competition for and exploitation of natural resources, including rare minerals, water, and fossil fuels, continues to fuel tensions in many regions of the world, such as the Middle East. This situation not only increases the risk of conflict, but also hinders efforts to address global challenges, such as climate change and the need to ensure food and water security.

During July 2025, the Mediterranean Sea experienced its highest average heat wave intensity ever recorded. This increase in water temperature is extremely alarming. The water temperature reached 26.9 degrees Celsius, the highest ever recorded since measurements began, according to data from the EU's Climate Change Service (Copernicus). This poses increasingly severe threats to marine and coastal ecosystems, biodiversity and negatively impacts marine life and fisheries. In light of these numerous challenges, such as climate change, pollution, energy security, water shortages, food security, and environmental degradation, there is an urgent need to intensify international efforts to address environmental challenges and all threats to human health, safety, and the environment, particularly in the Mediterranean region.

Dear colleagues, we were very pleased to spend these three days with friends and colleagues from various countries, working together to achieve the objectives outlined in the conference program. Thanks to your participation, the conference was able to successfully complete all its sessions. On behalf of the organizing committee, I would like to express our sincere appreciation and gratitude to all participants, experts, and guests for their valuable contributions. We also extend our warmest congratulations to everyone for the tremendous success of the CIMEE25 International Conference.

During the three-day conference, we held in-depth discussions and exchanged ideas on eight main themes. We not only analyzed the overall situation and challenges of sustainable development, but also presented examples of advanced research in materials chemistry, electrochemistry, and bioenergy, and shared insights on the latest theories and practices in sustainable environmental management. Many constructive ideas and proposals were put forward to achieve more sustainable, effective, and balanced development. The discussions among all participants and experts demonstrated a keen understanding of sustainable development and how to contribute to it, thus motivating efforts to develop effective strategies and encouraging continued work in this field. Therefore, I firmly believe that the conclusion of this conference is not the end, but rather the beginning of a new phase that will foster collaborative work, bringing together researchers from around the world to conduct new and advanced research. Let us build on what we have achieved and look to the future, establishing a modern and practical platform for international cooperation, so that our ideas can contribute to sustainable development, and a green environment and a healthy life become a tangible reality for all.

Our friends, on behalf of the organizing committee, let me express our deepest gratitude to all our partners from Algeria, Greece, Morocco, Turkey, and Tunisia for their support in organizing this conference, and to all the participants. I also take this opportunity to sincerely thank all the speakers who enriched the conference with their contributions. I hope this conference will strengthen the bonds of friendship and cooperation among all experts and participants, and that we will continue to work together towards a sustainable environment. We also hope that all the participating researchers will contribute to publishing their best research in prestigious scientific journals.

We look forward to seeing you again at the next CIMEE conference, to be held from September 24 to 26, 2026.  
Thank you all!

دور مؤسسات التعليم العالي والمراكز البحثية في خدمة المجتمع وتحقيق التنمية المستدامة

ضمن أعمال المؤتمر السابع (CIMEE 2025) الذي انعقد تحت عنوان " علوم المواد والكيمياء الكهربائية والطاقة الخضراء في سبيل تعزيز الاستدامة البيئية"، اختتمت أعمال المؤتمر بمشاركة الجميع في هذا الحدث العلمي، مع التأكيد على الدور الفعّال الذي يلعبه تجمع الباحثين الدوليين (CIMEE) في دعم التنمية المستدامة وتطبيق حلول واقعية قائمة على البحث العلمي

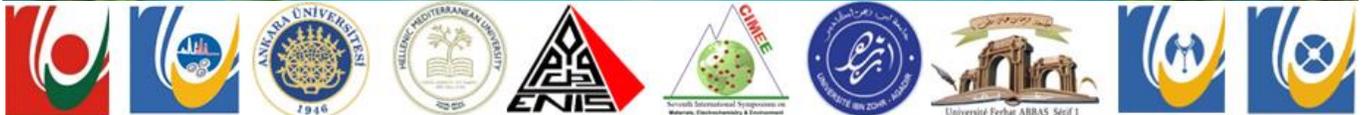
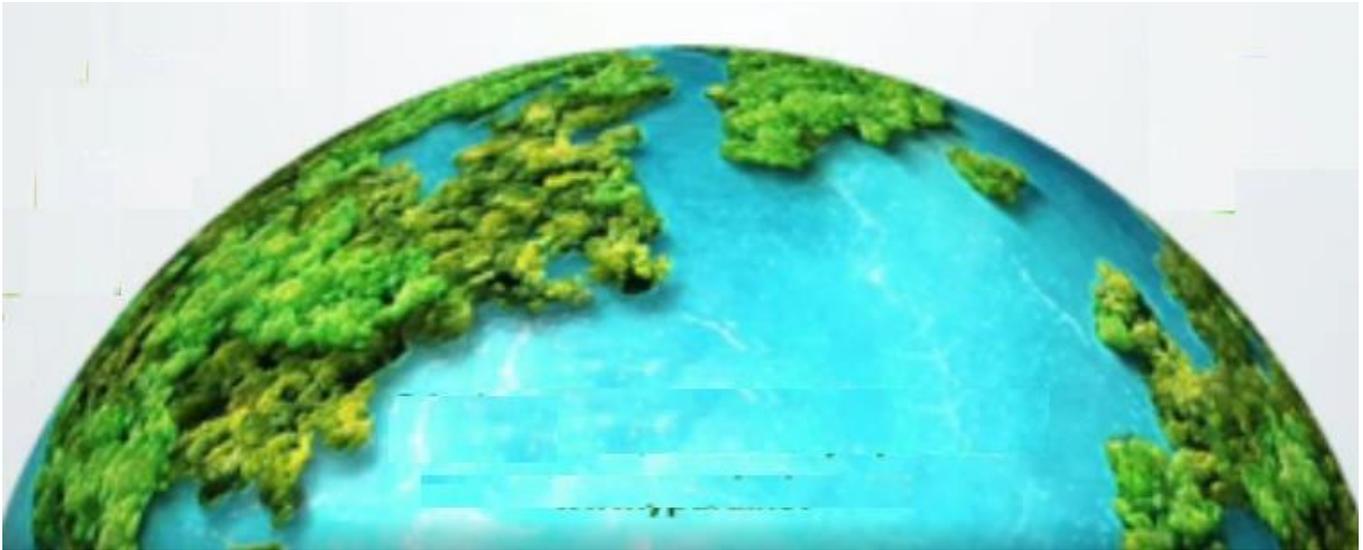
ويُعد هذا المؤتمر منصة علمية دولية رائدة تستضيف نخبة من العلماء والباحثين من مختلف أنحاء العالم، حيث يُعقد بالتعاون مع عدد من الجامعات العربية والاوروبية المرموقة، كما تم بثه أيضاً عبر الإنترنت لإتاحة المشاركة الدولية.

وقد رحب الدكتور "احمد المل" رئيس اللجنة العلمية للمؤتمر بالدور العلمي الرائد في دعم جهود الاستدامة البيئية وتبني الحلول العلمية المبتكرة. وتحرص مجموعة CIMEE على متابعة أحدث الأبحاث والتقنيات المتعلقة بمجالات الطاقة والبيئة والهندسة الكيميائية، كما تهدف المشاركة إلى تعزيز التعاون بين المؤسسات البحثية والأكاديمية وبين القطاعات التنفيذية المعنية بإدارة الموارد البيئية والمياه.

وخلال كلمته في الجلسة الختامية، أكد رئيس اللجنة العلمية على أهمية التعاون بين الجهات الأكاديمية والتنفيذية في مواجهة التحديات البيئية، خاصة في ظل التغيرات المناخية التي تؤثر على موارد المياه والبيئة والزراعة في لبنان والعالم. وقال نحن نؤمن بأن التطوير المستدام لا يتحقق إلا من خلال الاعتماد على البحث العلمي وربطه بتطبيقات عملية، ويسعدنا أن نكون جزءاً من هذا المحفل العلمي الكبير الذي يفتح آفاقاً جديدة نحو تحسين كفاءة إدارة الموارد المائية والطاقة."

وأعرب رئيس اللجنة العلمية عن تقديره لجهود الشركاء والجامعات الجامعة اللبنانية في دعم البحث العلمي وتوفير بيئة خصبة للتعاون الدولي المثمر، مؤكداً استعداد المجموعة لدعم أي مشاريع أو مبادرات ناتجة عن توصيات المؤتمر تخدم قطاع البيئة و قطاع المياه والصرف الصحي والزراعة. وأضاف إن المؤتمر يهدف إلى خلق حلقة وصل بين العلماء والباحثين من جهة، والقطاعات التنفيذية من جهة أخرى، من أجل تحقيق التنمية المستدامة ومواجهة التحديات البيئية المتزايدة، ومشاركة الجهات الدولية.

واختتمت فعاليات الجلسة الافتتاحية بتأكيد مشترك من كافة الباحثين المشاركين على ضرورة تعزيز قنوات التواصل بين البحث العلمي والقطاع التنفيذي، والعمل على تحويل مخرجات البحوث إلى حلول عملية تسهم في تحسين جودة الحياة والحفاظ على البيئة، كما تم توجيه الدعوة للمزيد من الشراكات بين الجامعة والشركات الوطنية المعنية بشؤون البيئة والمناخ والمياه.



## Thank-You Letter CIMEE 2025

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, Italy, 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'26 on September 24-26, 2026.

Many thanks to all of you!

Best regards



## MATERIALS, ELECTROCHEMISTRY & ENVIRONMENT



## Book of Abstracts & Program

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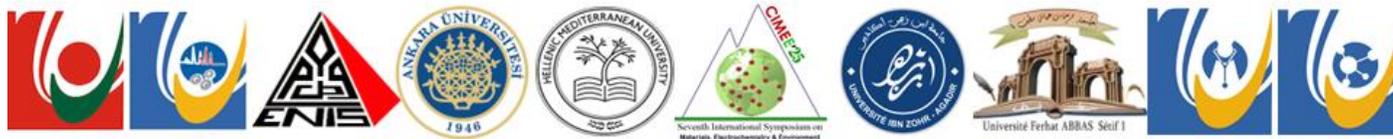
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**Theme of the meeting:**

**Advancing Sustainability through Materials, Electrochemistry and Green Energy**  
**SYMPOSIUM PARTNERS**



This book composes the abstracts of the plenary, keynote, oral and poster presentations as well as the special session and workshop of the 7th International Symposium on Materials, Electrochemistry and Environment, CIMEE25, held in Lebanon, from 25 - 27 September 2025. The abstracts are reproduced as accepted by the Scientific Committee of the meeting.

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