D19.3 Workshop on Novel Electrode Materials

Project Information	
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Acronym	REFINE
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Document History

Version	Issue Date	Changes
[1.0]	25.02.2025	

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1 Summary and scope

The *Workshop on Novel Electrode Materials* was held on February 18-19, 2025, at the Aristotle University Research Dissemination Center (KEDEA) in Thessaloniki, Greece. The event was organized within the framework of the HORIZON (101122323) project, From Solar Energy to Fuel: A Holistic Artificial Photosynthesis Platform to produce Viable Solar Fuels (REFINE), focusing on advancements in electrode materials for electrochemical energy applications, including fuel cells, water electrolysis and batteries.

The workshop brought together experts from academia and research institutes to discuss innovative materials, fabrication techniques and performance characterization. A total of 510 participants (online) and 45 participants (in person), of which 85 had also registered online in advance, attended the event during its 2-day duration, with presentations from leading researchers across European institutions. Online participation, that has expanded its reach to a broader audience, was realized through live-streaming. Refer to part 7. Annexes for more details.

2 Workshop objectives

The primary objectives of the workshop were:

- To present state-of-the-art research on novel electrode materials and their role in energy storage and conversion.
- To foster international collaboration between academia and research institutes, enabling the translation of research into real-world applications.
- To explore key challenges in electrocatalysis, stability and material durability, with a focus on improving performance and sustainability.
- To highlight innovative approaches, such as paired electrosynthesis, galvanic replacement, co-ionic conductors, novel perovskite electrodes, printable electrochemical devices, bio-inspired and self-healing materials.

3 Organization and participants

The *Workshop on Novel Electrode Materials* took place on February 18-19, 2025, at the Aristotle University Research Dissemination Center (KEDEA) in Thessaloniki, Greece. The event was hosted in a dedicated conference hall, providing an ideal setting for scientific discussions and networking. Further details and updates about the workshop were made available on the workshop website https://sites.google.com/view/novelelectrodematerials/ and the event was live-streamed to maximize its reach, with recordings accessible at [Day 1: https://audiovisual.auth.gr/video/97416, Day 2: https://audiovisual.auth.gr/video/98011].

The workshop attracted a diverse audience, including academics, researchers and postgraduate/final year university students in electrochemistry and materials science. Speakers from leading institutions across Europe contributed to the event, sharing insights into cutting-edge advancements in electrode materials. The speakers represented prestigious organizations, including Aristotle University of Thessaloniki, University of Southampton, DIFFER (Eindhoven), National Technical University of Athens, University of Oslo, and Democritus University of Thrace. Their contributions sparked discussions on the latest developments in novel electrode synthesis, computational modeling, performance optimization and real-world applications of electrochemical materials.

4 Workshop session

The workshop featured a variety of presentations and discussions over two days. The first day began with opening remarks by Prof. Sotiris Sotiropoulos, who introduced the REFINE project and the Physical Chemistry Laboratory of the Aristotle University. This was followed by presentations on topics such as *Gas Diffusion Electrodes* by Prof. Carlos Ponce de Leon Alabarran (University of Southampton) and *Novel Electrode Synthesis for Water Electrolysis* by Dr. Michail N. Tsampas (DIFFER, Eindhoven). Additional presentations included *Printable Electrochemical Energy Devices* by Assist. Prof. Vasilios Binas (Aristotle University), *Co-Ionic Electrochemical Reactors* by Assist. Prof. Costas Athanasiou (Democritus University of Thrace), *Bio-Inspired Electrodes for Water Electrolyzers* by Assist. Prof. Panagiotis Trogadas (Aristotle University), and *Perovskite Materials for SOECs* by Assoc. Prof. Dimitrios Tsiplakides (Aristotle University).

The second day covered topics such as *Electrowetting for Advanced Electrochemical Technologies* by Assist. Prof. Athanasios Papaderakis (NTUA), *Computational & Experimental Synthesis of Solid-State Electrodes* by Sarah Geo (University of Oslo), and *Electrocatalyst Stability and Selectivity Studies* by Assoc. Prof. Ioannis Katsounaros (Aristotle University). Additional presentations focused on *Electrochemical Impedance Spectroscopy in Li-Ion Batteries* by Assist. Prof. Andronikos Balaskas (Aristotle University), *Self-Healing Electrode Materials* by Assist. Prof. Ioannis Kartsonakis (Aristotle University), and *Galvanic Deposition & Electrocatalysts on Ti/TiO_2* by Prof. Sotiris Sotiropoulos (Aristotle University). The event concluded with closing remarks and discussions on future research directions.

In addition, twelve representative poster presentations showcased emerging research from PhD students and early-career scientists from the host institution providing an excellent opportunity for young researchers to receive feedback and engage with international experts in the field.

5 Key takeaways & impact

The workshop highlighted significant advancements in electrode materials, with a focus on gas diffusion electrodes, perovskite-based materials and advancements in PGM state-of-the-art catalysts, which offer promising potential for fuel cells and electrolyzers. Another key discussion point was the growing role of computational modeling in material design, enabling more efficient prediction and optimization of electrochemical performance. Alternative preparation methods as well as the stability and long-term durability of electrocatalysts were also reviewed.

The event fostered new collaborations among European research institutions, with discussions focusing on potential joint projects and funding opportunities. Researchers also provided valuable insights, emphasizing the importance of scalable and cost-effective electrode materials for commercial applications. The integration of novel materials into existing industrial processes has been a key-point of discussions between academic and research institute participants. This was important to see, as REFINE aims at optimizing and coupling currently available systems to achieve new fuel production routes with sunlight as the main energy source.

The workshop was successfully live-streamed and recorded, increasing accessibility for those unable to attend in person. A summary of the discussions and key findings will be integrated into upcoming

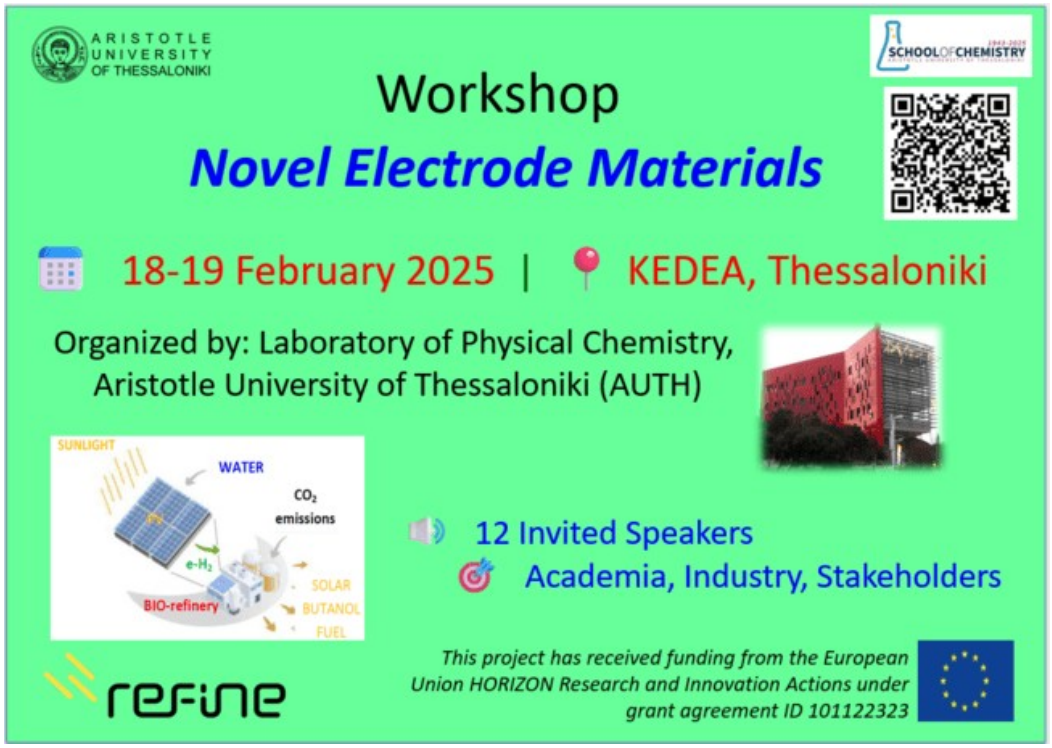
project reports, ensuring the knowledge gained from the workshop contributes to the ongoing goals of the REFINE project.

6 Conclusions

The *Workshop on Novel Electrode Materials* successfully fostered knowledge exchange and collaboration in the field of electrochemical energy materials, a key component of the REFINE project (electrochemistry being the mediator of the solar-to-chemical energy transformation proposed). Discussions emphasized the role of novel electrode materials in enhancing the efficiency, stability and scalability of fuel cells, batteries and electrolysis systems. Key takeaways included the increasing importance of computational modeling in material design and of AI in combinatorial screening experiments, as well as the traditional but still ongoing challenges related to stability, cost-effective production and scalability. The workshop highlighted the value of interdisciplinary collaboration, bringing together academics and researchers to explore real-world application prospects. Moving forward, joint research initiatives, industrial partnerships, and dissemination of findings through publications and conferences will further support the objectives of the REFINE Horizon project, contributing to the advancement of sustainable and economically viable electrochemical energy systems.

7 Annexes

- **Workshop poster**



- **Workshop program** *(Full program attached)*

Novel Electrode Materials

18-19 February 2025

Aristotle University Research Dissemination Center (*KEDEA*), Thessaloniki, Greece

workshop website: https://sites.google.com/view/novelelectrodematerials/
workshop livestreaming: https://audiovisual.auth.gr/video/97416

Day 1

8:45 - 9:15 am	**Registration – Reception**
9:15 - 9:30 am	*Opening Remarks – The REFINE project and the Physical Chemistry Laboratory of the Aristotle University* **SOTIRIS SOTIROPOULOS**, PROFESSOR, ARISTOTLE UNIVERSITY
9:30 - 10:30 am	*Applications of Gas Diffusion Electrodes* **CARLOS PONCE DE LEON ALBARRAN**, PROFESSOR, UNIVERSITY OF SOUTHAMPTON
10:30 - 11:30 am	*Unconventional electrode material synthesis pathways for water electrolysis* **MICHAIL N. TSAMPAS**, SENIOR RESEARCHER, DIFFER, EINDHOVEN
11:30 am - 12:00	Coffee break | Poster Session
12:00 - 1:00 pm	*Advanced materials for printable electrochemical energy devices* **VASILIOS BINAS**, ASSISTANT PROFESSOR, ARISTOTLE UNIVERSITY
1:00 - 2:00 pm	*Co-ionic electrochemical reactors, with electrodes of specialized catalytic activity for CO2 conversion to light olefins* **COSTAS ATHANASIOU**, ASSISTANT PROFESSOR, DEMOCRITUS UNIVERSITY OF THRACE
2:00 - 3:00 pm	Lunch break | Poster Session

3:00 - 4:00 pm	*Bio-inspired electrodes for water electrolyzers* **PANAGIOTIS TROGADAS**, ASSISTANT PROFESSOR, ARISTOTLE UNIVERSITY
4:00 - 5:00 pm	*Perovskite materials as alternative fuel electrodes for Solid Oxide Electrolysis Cells (SOECs)* **DIMITRIOS TSIPLAKIDES**, ASSOCIATE PROFESSOR, ARISTOTLE UNIVERSITY
8:00 pm	Invited Speakers' and Organizers' Dinner

Day 2

9:00 - 9:30 am	**Morning coffee – Networking**
9:30 - 10:30 am	*Electrowetting for advanced electrochemical technologies* **ATHANASIOS A.PAPADERAKIS**, ASSISTANT PROFESSOR, NATIONAL TECHNICAL UNIVERSITY OF ATHENS
10:30 - 11:30 am	*Computational and experimental methods for the synthesis of various solid-state materials for electrochemical energy conversion* **SARAH GEO**, PhD CANDIDATE, UNIVERSITY OF OSLO
11:30 am - 12:00	Coffee break | Poster Session
12:00 - 1:00 pm	*Evaluation of activity, stability and selectivity of electrocatalysts under dynamic conditions* **IOANNIS KATSOUNAROS**, ASSOCIATE PROFESSOR, ARISTOTLE UNIVERSITY
1:00 - 2:00 pm	*Electrochemical Impedance Spectroscopy for Li-ion batteries characterization* **ANDRONIKOS BALASKAS**, ASSISTANT PROFESSOR, ARISTOTLE UNIVERSITY
2:00 - 3:00 pm	Lunch break | Poster Session
3:00 - 4:00 pm	*Self-healing materials* **IOANNIS KARTSONAKIS**, ASSISTANT PROFESSOR, ARISTOTLE UNIVERSITY
4:00 - 5:00 pm	*Galvanic deposition and photodeposition of electrocatalysts on Ti and TiO_2 supports* **SOTIRIS SOTIROPOULOS**, PROFESSOR, ARISTOTLE UNIVERSITY
5:00 - 5:15 pm	*Closing Remarks*

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- **Participants** (online)

"514 watching"

- **Photos of the Workshop**

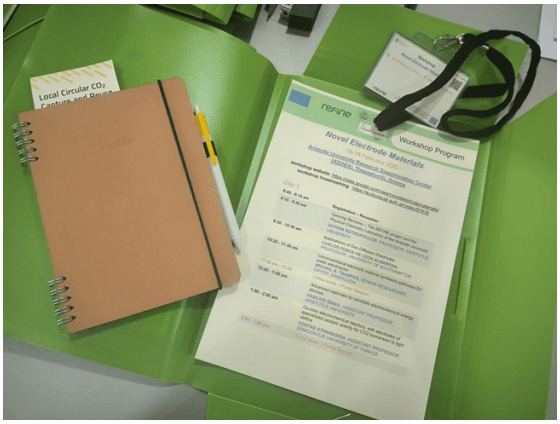

Image 1,2. Reception

Image 3. Coffee/Lunch break

Image 4. Audience

Images 5-6. Participants

Image 7. Poster Session

Image 8. Dinner

- **Certificate of attendance (some examples)**

Disclaimer

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