BOOKLET

OF

ABSTRACTS

THURSDAY APRIL 17TH

COFME

International COnference on Functional Materials and Renewable Energies

Thursday April 17th

08:30	***Welcome coffee and conference registration***	
09:00	***Keynote*** My Ali El Khakani ***Using the Pulsed Laser Deposition Approach for the Growth of 1D, 2D and Nanohybrid Materials With Tunable Optoelectronic Properties***	
	HYDROGEN	***MATERIALS AND MECHANICS FOR ENERGY***
09:45		
	Invited Conference Raphaël Ihringer ***Setup for SOFC/SOEC measurements and ceramic processing for cell fabrication***	***Invited conference*** Takashi Teranishi ***Fast Charge Transfer via Dielectric Interface for Rechargeable Batteries***
10:00		
10:15	***29*** Laince Pierre Moulebe ***Numerical analysis and presentation of the interest of implementing artificial intelligence in a green hydrogen generator set using energy efficiency techniques***	***26*** Doha Doughri ***Structural, Dielectric, and Ionic Conductivity Properties of Li_4FeSbO_6: A Promising Cathode Material for Solid-State Batteries***
10:30	***10*** Redouane Elhaloumi ***The impact of Cloud computing adoption on academic performance in higher education institutions- Case of Hassan II University of Casablanca - Morocco***	***12*** Ihsane Kinani ***Environment-friendly controlled-release customized NPK fertilizer using bio-based polyurethane derived from waste cooking oil as coating material: preparation, characterization, and agronomic study***
	Coffee Break	
11:00	***Keynote*** Ahmed Lakhssassi ***Thermal Analysis of System in Package Considering Boundary Conditions for Long-Term Reliability Studies***	
	HYDROGEN	
11:30		
	Roundtable: "Water Resources for Energy Production" Nadia Youssfi Steiner ***Participants: Amin Bennouna, Abdelilah Slaoui, Jack Legrand, Tarik Chafik, Olivier Joubert***	
11:45		
12:30 - 13:00	***Closing Ceremony***	

Keynote Lecture

Using the Pulsed Laser Deposition Approach for the Growth of 1D, 2D and Nanohybrid Materials with Tunable Optoelectronic Properties

My Ali El Khakani *

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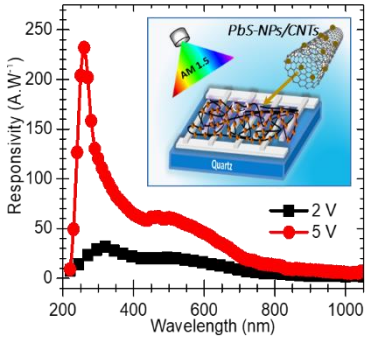
The pulsed-laser-deposition (PLD) is a versatile technique enabling the controlled synthesis of a variety of nanostructured materials, including nanoparticles (NPs), nanotubes or thin films. We will briefly introduce the physical principles of the PLD technique and its unique features. Then, we will present two different examples of the PLD based synthesized materials, namely: **(i)** PLD-based synthesis of PbS nanoparticles (NPs) and its use to nano-decorate CNTs in order to produce novel PbS-NPs/CNTs nanohybrid (NH) materials with significantly enhanced properties. By adjusting the PLD-growth conditions, it is possible to optimize the size of the PbS-NPs and their surface coverage on carbon nanotubes (CNTs). This optimization process has led to the synthesis of PbS-NPs/CNTs nanohybrids exhibiting remarkable photodetection properties (i.e.; a responsivity as high as 230 $A.W^{-1}$ (@ 5 V and fast response times of 30 µs).[1-3] Such a high responsivity, in the UV range, is due to the synergetic contributions of both multi-exciton generation (MEG) occurring in the PbS-QDs and the very efficient charge transfer from the PbS-NPs to CNTs charge carrying channels;[3,4] **(ii)** PLD synthesis of highly (002)-oriented and vertically layered "3D" MoS_2 thin films exhibiting the attractive optoelectronic properties of ultrathin 2D-MoS_2 (e.g. a direct bandgap). High-resolution-TEM imaging provided a clear-cut evidence that the PLD-MoS_2 films consist of vertically aligned MoS_2 atomic layers all across the film thickness of ~90 nm. More interestingly, Raman analyses revealed that the degree of vertical alignment of the MoS_2 layers is dependent on the deposition substrate temperature (T_d). At the optimal T_d of 500°C, the vertical alignment of the MoS_2 layers reaches its maximum, and leads to a strong photodetection performance (responsivity (R) and detectivity (D*) values as high as 125 mA/W and 9.2 x 10^9 Jones, respectively, at a biasing voltage as low as 1 V). More interestingly, the photodetection performance of the PLD-MoS_2 based PDs (i.e.; R and D*) was shown is be linearly correlated to the degree of vertical alignment of the MoS_2 layers in the "3D" films.[5] Such a relationship is fundamental for the controlled growth of PLD-MoS_2 films and the tuning of their optoelectronic properties.



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Invited Talk | Setup For SOFC/SOEC Measurements and Ceramic Processing for Cell Fabrication

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Fiaxell Sarl, EPFL Innovation Park – PSE A, 1015 Lausanne, Switzerland

Fiaxell has been active since 2008 in SOFC and provides solutions for researchers for high temperature fuel cells. The company has developed three different setups (Open Flanges™, Multi-Flanges™ (4-MF) and Large Cell Tester™ (LCT)) that allow for a wide range of cell sizes and experiment types. All three setups can test single cell of different shapes and sizes. They allow performing electrolysis experiments thanks to the integrated steamer developed by Fiaxell, which performs smooth steam injection for the cell. For long term experiment each setup has a kit with alumina tubing. With the Multi-Flanges 4 cells can be tested at the same time for thousands of hours, saving time and space. Both the Open Flanges and the LCT can be used with a short stack kit, allowing for testing several cells in realistic condition. The Open Flanges can test cells up to 80mm diameter, the 4-MF up to 50mm diameter and the LCT up to a size of 160x120mm. Fiaxell also provides accessories for cell testing such as current collectors (Gold, Platinum, Crofer M_grid™) and micro structured interconnects (Cell-Connex™)) are also available.

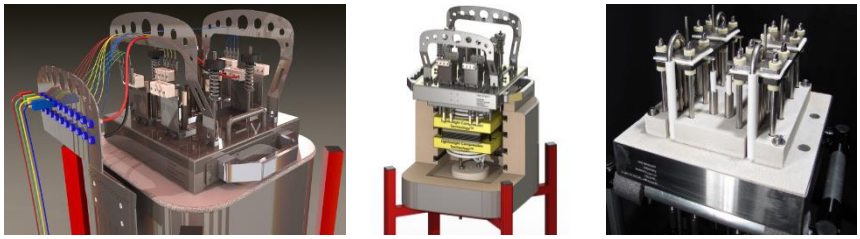

Fig. 1. Views of the Large Cell Tester™ (left and middle) and Multi-Flanges™ (right)

For researchers in ceramic processing, Fiaxell can provide a full solution from powder to cell. For raw materials a wide range is available from our supplier. Ready to use inks can also be purchased, organic or water-based solutions. These inks are both water soluble, which avoids bad smelling solvents and allows for simple cleaning of labware with water. In terms of hardware Fiaxell has also developed several devices to help researcher produce cell at lab scale: ball-mill for slurry preparation, tape caster and screen printer for cell substrate and functional layers. For the cell sintering needs, professional sintering kilns are available from our supplier. Finally, Fiaxell also proposes its own thermo gravimetric analyser (TGA), allowing for in depth study of the sintering process.

6.

Fig. 2. Ball-mill (left), TGA (middle) and screen printer (right) developed by Fiaxell

Numerical analysis and presentation of the interest of implementing artificial intelligence in a green hydrogen generator set using energy efficiency techniques

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The significant increase in the usage of renewable energy sources has sparked a movement to combine them with the generation of green hydrogen in order to address the intermittency issues that cause either a surplus or a deficit in energy production. The integration of green hydrogen in the energy sector is taking place on a large, medium, and small scale, from replacing natural gas with green hydrogen in thermal power plants to creating green hydrogen domestic batteries. The significance of incorporating AI into green hydrogen production is examined in this paper using a hydrogen power generator that has been the focus of earlier research. The function and influence of AI in the hydrogen energy generator are discussed, demonstrating how artificial neural networks (ANNs) enable the generator to forecast hydrogen production by predicting changes in solar irradiation. Additionally, it demonstrates how AI could assure the safety of the hydrogen fluidic circuit and manage the command control of various components by prioritizing storage and direct supply or supply through storage while enabling specific prevention maintenance. The numerical analysis results obtained in this study show that a generator integrating AI for a defined consumption level enables an optimized choice of components, a controlled level of safety, a longer service life, and have a lower return on investment than a hydrogen generator operating without AI. This study shows that integrating AI into energy systems using green hydrogen as an energy medium is more cost-effective from a quality, safety, and economic perspective.

The impact of Cloud computing adoption on academic performance in higher education institutions - Case of Hassan II University of Casablanca - Morocco

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Keywords: Cloud Computing, Technology Acceptance Model (TAM), Online Learning, Academic Performance.

The objective of this study is to study the impact of cloud computing adaptation on academic performance and how cloud computing technology directly and indirectly influences or facilitates students' learning environment. The research supports the TAM (Technology Acceptance Model) theory. The data were collected using an online electronic questionnaire completed by online respondents. A quantitative approach questionnaire was used to collect data from online respondents at Hassan II University of Casablanca. The research aims to show that cloud computing plays a crucial role in the field of online learning. Not only does it in-crease the efficiency of academic activities, but it also helps to work efficiently especially during difficult or crisis times such as the Covid 19 pandemic. In a very short time, students can share, store and transfer their data information through various electronic devices. This study is launched to study the effects of cloud computing on academic activities or online learning environment. The limitations of this research are the sample size, which is limited for our study. In this study, it was not possible to approach all the students of the university because the recent research was only conducted in the city of Casablanca. The survey was conducted only focusing on how cloud computing affects academic performance. However, the analysis can also be done on how cloud computing can change the public affairs sector or the business sector.

Invited Talk | Fast Charge Transfer via Dielectric Interface for Rechargeable Batteries

Takashi Teranishi*

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A substantial enhancement in the high-rate performance of lithium-ion batteries (LIBs) is essential to match the capabilities of supercapacitors, while preserving their high energy density for next-generation energy sources. One potential solution is to incorporate a dielectric nano interface, such as the well-known dielectric compound $BaTiO_3$ (BTO), into the active materials-electrolyte interface. This integration facilitates an ultra-fast charge transfer pathway through the dielectric layer. Experimental data, supported by density functional theory and molecular dynamics (DFT-MD) simulations, have confirmed the activation of this interfacial charge transfer route. For instance, during the charging process, solvated lithium ions adsorb onto the dielectric surface, where they desolvate, allowing free lithium to preferentially intercalate into the electrode material via the triple-phase interface (TPI) — the interface between the dielectric, active materials, and the electrolyte. The high-rate capability was also analysed based on the electronegativity of the doped cations in the fluorite ZrO_2 matrix used as a dielectric layer. The highest rate capability was observed when the average electronegativity of the doped cation and Zr was approximately ~1.3. This finding suggests that the balance between electrostatic attraction and repulsion influences the charge adsorption behaviour at the interface.

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Structural, Dielectric, and Ionic Conductivity Properties of Li_4FeSbO_6: A Promising Cathode Material for Solid-State Batteries

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Keywords: Structure, X-ray diffraction, Dielectric, Li_4FeSbO_6.

Abstract. The synthesis of Li_4FeSbO_6 was accomplished through a solid-state route at high temperatures, resulting in crystallization within the monoclinic system (space group C2/m) with specific cell parameters: a = 5.1711(2) Å, b = 8.9406(3) Å, c = 5.1687(2) Å. Morphological analysis revealed aggregates of varying sizes and shapes, indicating heterogeneous particle distribution.

Ultraviolet-visible spectroscopy identified three absorption bands attributed to spin-forbidden Fe3+(d5) electronic transitions in an octahedral field, with a band gap of approximately 2.01 eV. Dielectric properties were studied across frequencies from 10 Hz to 1 MHz and temperatures from 303 K to 673 K. Impedance spectroscopy confirmed the influence of both grains and grain boundaries, while complex permittivity showed dual contributions from dipolar and conductive components. The alignment of dipolar relaxation time with Maxwell-Wagner relaxation time indicated electrical inhomogeneity.

Li+ ionic conductivity was found to be influenced by bulk resistance, with Jonscher's law analysis confirming conductive pathways. The hopping frequency analysis yielded an activation energy of Ea = 0.57(3) eV, consistent with previous findings and validating the material's electrical characteristics.

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Environment-friendly controlled-release customized NPK fertilizer using bio-based polyurethane derived from waste cooking oil as coating material: preparation, characterization, and agronomic study

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Keywords: Controlled-release fertilizer, Bio-based polyurethane, Waste cooking oil, Sustainable agriculture, Transesterification, Epoxidation, Polyol synthesis, Nutrient release kinetics, Agronomic performance, Water-use efficiency, Environmental sustainability.

The growing global emphasis on sustainable agriculture has highlighted the need for innovative and eco-friendly solutions in fertilizer technology. This study presents the development, characterization, and agronomic evaluation of a novel environment-friendly controlled-release NPK fertilizer, coated with bio-based polyurethane synthesized from waste cooking oil. The polyurethane was prepared through a systematic multi-step process, including transesterification to convert waste cooking oil into methyl esters, epoxidation to introduce reactive epoxy groups, and polyol opening to create a hydroxyl-rich polyol suitable for polymerization. These processes transform an otherwise discarded material into a high-value, biodegradable polymer.

The bio-based polyurethane coating was optimized to provide controlled nutrient release while minimizing environmental impact. Key coating properties, such as elasticity, thickness, hydrophobicity, and water permeability, were extensively analyzed to ensure effective nutrient retention and gradual release. Release kinetics studies demonstrated the coating's ability to significantly reduce nutrient leaching, thereby extending the availability of nutrients in the soil. Agronomic trials conducted in controlled and field conditions revealed that the coated fertilizers improved water-use efficiency, enhanced soil nutrient retention, and significantly boosted crop productivity compared to conventional uncoated fertilizers.

This study underscores the dual benefits of using waste-derived materials for polyurethane synthesis, promoting circular economy practices while addressing critical agricultural challenges, such as nutrient loss and water scarcity. By integrating sustainability into fertilizer technology, this bio-based coating provides an innovative pathway to enhance agricultural productivity and environmental stewardship.

Keynote Lecture

Thermal Analysis of System in Package Considering Boundary Conditions for Long-Term Reliability Studies

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Ahmed Lakhssassi received the B.Eng. and M.Sc. A in electrical engineering from Université du Québec à Trois-Rivières (UQTR), Québec, Canada in 1988 and 1990 respectively. He also received the Ph.D. in Energy and Material sciences in 1995 from INRS-Énergie et Matériaux (Institut National de la Recherche Scientifique), Québec, Canada. At the same year also, he had become a professor of Electro-thermo-mechanical aspects at NSERC -Hydro-Quebec Industrial Research Chair at Electrical Engineering Department of the UQTR, where, for several years, he conducted Electro-thermal research projects. Since 1998, he has been with UQO (Université du Québec en Outaouais), where he is currently titular professor and responsible of the LIMA laboratory (Avanced Microsystem Engineering Laboratory) developing IP core and embedded algorithms for microsystems thermo-mechanical sensors. His research interest is the fields of bio-heat thermal modeling such as: heat diffusion in biological tissues, metabolic heat generation and external interactions, heat transfer mechanism in biological tissues for thermal therapeutic practices including dedicated bio-implantable puce design for cancer thermal dose control. Also, his research interest is in Design of Fully Automated tool for Porting Analog and Mixed signal circuits within Different Technology nodes. Dr. Lakhssassi is Senior member of IEEE, The Microsystem Strategic Alliance of Quebec (ReSMiQ), the OIQ (Ordre des Ingénieurs du Québec, Canada), NanoQuébec and has more than twenty-two years' experience with a large expertise with applications in the fields of Electro-Thermo-mechanical analysis for electronic and microelectronics system design. He is the author/co-author of more than 200 scientific publications and research report, and thesis advisor of 70 graduate and undergraduate students who completed their studies.