




# ABSTRACT BOOK

## 1<sup>st</sup> International Conference on Sciences and Techniques for Renewable Energy and the Environment STR2E 2025

**MAY 06-08, 2025**

Faculty of Sciences and Techniques  
Al Hoceima, Morocco



 Scopus Preview

**Solar Energy  
And Sustainable Development**

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WEBSITE: <https://str2e.com/>  
str2e.conference@gmail.com

# Preface

We are pleased to present the proceedings of the **1st International Conference on Sciences and Techniques for Renewable Energy and the Environment (STR2E 2025)**, held from **May 6 to 8, 2025**, at the **Faculty of Sciences and Techniques of Al Hoceima**, Morocco.

STR2E 2025 was jointly organized by the **Chemistry, Computer Science and Artificial Intelligence Research Team (ERCIA)** of **Abdelmalek Essaadi University**, Tetouan, Morocco, and the **Moroccan Association of Sciences and Techniques for Sustainable Development (MASTSD)**, based in Beni Mellal, Morocco), in collaboration with **Higher School of Technology, Beni Mellal, Morocco**, the Journal of “*Solar Energy and Sustainable Development*”, and the **Libyan Center for Research and Studies in Solar Energy**

This first edition of STR2E brought together researchers, academics, and industry professionals from around the world to discuss recent scientific and technological advances in the fields of **renewable energy and environmental sustainability**. The event provided a multidisciplinary platform for exchanging ideas, showcasing cutting-edge research, and fostering collaborations aimed at developing innovative and sustainable solutions to today’s pressing energy and environmental challenges.

The conference featured a rich program of **keynote lectures, oral and poster presentations, and thematic sessions**, offering attendees a comprehensive overview of current research trends and future directions in the field.

We extend our deepest gratitude to all the **researchers and contributors** for their high-quality submissions and active participation. We also sincerely thank the **scientific reviewers, session chairs, and organizing committees** for their dedication and efforts in ensuring the academic excellence and smooth execution of the event. Our thanks also go to our **partners and sponsors**, whose support played a key role in the success of STR2E 2025.

Selected papers from the conference have been accepted for publication in **indexed journals and conference proceedings** (Journal of “*Solar Energy and Sustainable Development*”), ensuring the visibility and impact of the presented research within the scientific community.

A special acknowledgment goes to the **conference chair, Professor Charaf Laghlimi**, whose leadership, vision, and unwavering dedication were instrumental in the successful organization of this inaugural edition.

We hope that **STR2E 2025** will pave the way for future editions that will further promote scientific innovation, knowledge sharing, and interdisciplinary collaboration in the service of a more sustainable future.

We hope that this first edition of **STR2E** will inspire continued collaboration and serve as a catalyst for new research initiatives in support of a more sustainable future.

## **Guests of Honor**

**Pr. Bouchta El Mounni:** *President of Abdelmalek Essaadi University-Morocco*

**Pr. Mohammed Bakkali:** *Dean of Faculty of Sciences and Techniques, Al-Hoceima- Morocco*

**Pr. Hassan Amhamdi:** *Vice-Dean in charge of Pedagogical Affairs, Faculty of Sciences and Techniques, Al-Hoceima- Morocco*

**Pr. Mohammed Hassani Zerrouk:** *Vice-Dean in charge of Scientific Research and Cooperation, Faculty of Sciences and Techniques, Al-Hoceima- Morocco*

**Pr. Kebir CHAJI:** *Acting Director of the Higher School of Technology, Beni Mellal, Morocco*

## **Conference Chairman**

**Pr. Charaf Laghlimi**

*Abdelmalek Essaadi University, Tetouan –Morocco*

*Faculty of Sciences and Techniques, Al Hoceima*

## **Conference Co-Chairs**

**Pr. Isaad Jalal** *Abdelmalek Essaadi University, Tetouan –Morocco, Faculty of Sciences and Techniques, Al Hoceima*

**Pr. Soufi Adil** *Abdelmalek Essaadi University, Tetouan –Morocco, Faculty of Sciences and Technique, Al Hoceima*

**Pr. Abderrahim Zanno** *Abdelmalek Essaadi University, Tetouan –Morocco, Faculty of Sciences and Techniques, Al Hoceima*

**Pr. Aziz Srai** *Abdelmalek Essaadi University, Tetouan –Morocco, Faculty of Sciences and Techniques, Al Hoceima*

**Pr. Younes Ziat** *Sultan Moulay Slimane University-Morocco, Higher School of Technology, Beni Mellal*

**Pr. Younes Abou El Hanoune** *Abdelmalek Essaadi University, Tetouan, Morocco, National School of Applied Sciences Al Hoceima*

**Pr. Ahmed Toukmati** *Abdelmalek Essaadi University, Tetouan –Morocco, Faculty of Sciences and Techniques, Al Hoceima*

## **Guest Editors**

**Pr. Charaf Laghlimi:** *Abdelmalek Essaadi University, Tetouan –Morocco Faculty of Sciences and Techniques, Al Hoceima*

**Pr. Younes Ziat:** *Sultan Moulay Slimane University-Morocco, Higher School of Technology, Beni Mellal, Morocco*

**Pr. Zakaryaa Zarhri:** *Autonomous University of the State of Morelos, Cuernavaca, Mexico*

**Pr. Nouredine Lakouari:** *National Council for the Humanities, Sciences and Technology, Mexico*

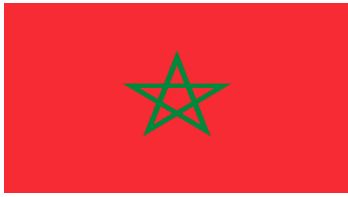


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# Plenary Speakers





## Pr. YASSINE LAKHAL

Higher School of Technology of Beni Mellal, Sultan Moulay Slimane University, Morocco



*“Is a professor and researcher in Mechatronics at the Higher School of Technology of Beni Mellal, Sultan Moulay Slimane University (Morocco). His research focuses on intelligent control, modeling, and optimization of wind energy systems. He is also the coordinator of the Mechatronics program and director of the university's FabLab, where he promotes innovation and digital manufacturing.”*

### Plenary 1: Next Generation of Wind Turbines: Smart Design, Intelligent Blades, and Advanced Control

- **Abstract of the Speech:**

The new generation of wind turbines stands out with a modern design, reimagined to optimize aerodynamic performance, structural lightness, and seamless integration into complex environments. These advanced designs incorporate, from the modeling phase, considerations related to adaptability, fiability and efficiency.

At the heart of this evolution are intelligent blades, capable of dynamically responding to wind variations thanks to embedded sensors, actuators, and morphable materials. Combined with advanced control strategies—particularly those based on artificial intelligence and adaptive approaches—these technologies enable optimal turbine operation, enhancing energy efficiency, system stability, and integration into smart energy networks. This talk offers a comprehensive vision of the innovations shaping the wind turbines of the future.



## Pr. RABAH BOUKHERROUB

Institute of Electronics, Microelectronics and Nanotechnology (IEMN), CNRS & University of Lille, France

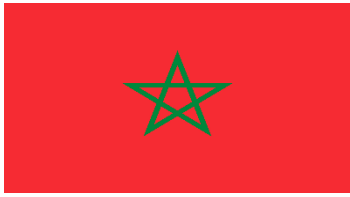
“Dr. Rabah Boukherroub received a PhD in chemistry from the University Paul Sabatier in Toulouse, France. He is currently a CNRS research director at the Institute of Electronics, Microelectronics and Nanotechnology (IEMN), CNRS & University of Lille, France. His research interests are in the area of functional materials, surface chemistry, and photophysics of semiconductor/metal nanostructures with emphasis on biosensors, nanomedicine, photocatalysis and electrocatalysis. He has published many research publications, wrote 43 book chapters and co-editor of 10 books in subjects related to nanotechnology, materials chemistry, and biosensors. He has 15 patents or patents pending.”

### Plenary 2: Advanced Electrocatalytic Materials for Sustainable Production of Fuels and Chemicals Fossil fuels represent a vital part of the energy infrastructure and chemical industry. However, long-term

- **Abstract of the Speech:**

Neglecting excessive CO<sub>2</sub> emission and carbon reduction have become a significant destabilizing factor for the natural carbon cycle and the biggest cause of climate change. The Paris Climate Accord commits signatories the goal of achieving “a balance between anthropogenic emissions by source and removals by sinks of greenhouse gas in the second half of this century”, and countries can formulate specific plans to achieve this goal according to their national conditions. In this line, there is a paradigm shift towards sustainable energy production.

Electrochemical processes hold a central role in this area. This presentation will focus on efforts devoted to sustainable approaches for producing fuels and chemicals based on renewable sources. In this regard, hydrogen (H<sub>2</sub>) production from water electrolysis, CO<sub>2</sub> conversion into added-value chemicals and carbon-based fuels, and ammonia production from nitrogen (N<sub>2</sub>) are some relevant examples. In this talk, the fundamental design and preparation of high-performance catalyst systems able to conduct the desired chemical



## Pr. YOUSSEF AIT EL KADI

Higher School of Technology of Beni Mellal, Sultan Moulay Slimane University, Morocco



“Dr. Youssef Ait El Kadi obtained his Agrégation degree in Electrical Engineering and Power Electronics in 2000, followed by a postgraduate diploma in Energetics in 2004. He completed a Ph.D. in Instrumentation, Measurements, Control, Characterization, and Modeling in 2016. He is currently an associate professor and teacher-researcher at Sultan Moulay Slimane University, with over 27 years of teaching experience. His research focuses on the modeling and control of electrical machines and power electronics converters, the optimization of renewable energy conversion and grid-integration systems, microgrids, smart grids, and power quality improvement. He was a member of the Microelectronics, Embedded Systems, and Telecommunication research team and is currently a permanent member of the Engineering and Applied Physics research team. Dr. Ait El Kadi has held several administrative positions. He is the author of several articles

published in peer-reviewed indexed journals, including numerous contributions to the optimization of photovoltaic energy conversion and power quality. He is actively involved in several international research and cooperation projects and serves as an expert in a consultancy initiative to establish a Master’s program in Renewable Energies in an African country. He serves on the scientific committees of international conferences and has reviewed over 100 manuscripts for indexed journals.”

### Plenary 3: Optimization of Renewable Energy Implementation: A Review of the Current State and Emerging Trends in the Context of Artificial Intelligence Solutions

- **Abstract of the Speech:**

In a global context increasingly dominated by awareness of environmental and energy-related challenges, renewable energies are emerging as an essential solution to address future energy challenges. Although plentiful and environmentally sustainable, These energy sources remain associated with numerous challenges, particularly regarding intermittency, storage, and integration into existing conventional power grids. Scientific research aims to address these challenges by exploring new technological avenues and optimizing existing systems. Simultaneously, artificial intelligence (AI) is undergoing significant advancements and presents robust tools to revolutionize the energy domain.

This presentation will highlight expectations from scientific research regarding the integration of renewable energies. It will explore the current state of research in this field, recent breakthroughs, ongoing challenges, and future perspectives in the era of AI-based solutions. Potential and concrete applications will also be discussed; including production and consumption



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prediction, power distribution based on demand, system control optimization, faults monitoring, and smart grid stability; within the scope of a comprehensive approach to system optimization and energy quality improvement.

Finally, the presentation will explore future perspectives, highlighting the interdisciplinary nature of research in renewable energies and underscoring the importance of collaboration among researchers to develop innovative, sustainable, and needs-driven solutions for the future.



## Pr. JAFFREZIC-RENAULT NICOLE

Director of Research at CNRS, French



“Dr Nicole Jaffrezic-Renault received her engineering degree from Chimie ParisTech, Paris, in 1971 and the Doctorat d’Etat és Sciences Physiques from the University of Paris-Saclay in 1976. She is Emeritus Director of Research at CNRS, past president of the chemical micro sensor club (CMC2), president of the Analytical Division of the French Chemical Society. She was decorated as Knight of the National Order of Legion of Honor and Officer of the National Order of Merit. Her research activities in the Institute ISA University of Lyon and now at the Institute UTINAM University of Franche-Comte, include conception and design of (bio)chemical sensors and their integration in microsystems. She coordinates several European and national projects for the development of microsystems for biomedical and environmental monitoring and for food safety. She published more than 655 papers with more than 15300 citations (H index: 65).”

### Plenary 4: A Sensitive Micro Conductometric Ethanol Sensor Based on an Alcohol Dehydrogenase-Gold Nanoparticle Chitosan Composite

- **Abstract of the Speech:**

Volatile organic compounds (VOCs) are chemicals with a relatively high vapor pressure at room temperature and atmospheric pressure so they vaporize readily. In the environment, Sources of VOC emission are widespread and can be of natural origin or through human activities. VOC can be used in breath to indicate health conditions and in packaging for controlling food quality. The techniques for quantifying VOC are GC-MS, PTR-MS, etc; these devices are bulky, expensive, and time-consuming. Semiconducting metal oxide-based gas sensors are cheap, miniaturized, and very sensitive; their main drawbacks are their high working temperature and rather bad specificity. Taking advantage of the enzyme selectivity, enzyme-based sensors were used as “bio-sniffer” for detecting different types of VOC.

#### Detection of ethanol in food

Analysing the headspace above the liquid sample, instead of the liquid sample itself, offers the advantage that possible non-volatile interfering substances in the liquid sample (e.g. ascorbic acid) cannot impair the measurement. The relation between the gas phase concentration at room temperature and the liquid concentration was calculated from Henry’s law constants ( $k_H$ ) compiled by Sanders [1].

A simple conductometric microsensor, based on interdigitated electrodes and alcohol dehydrogenase immobilized in a chitosan film on top of the sensor, will be presented, for the detection of ethanol in the headspace of commercial wine [2].



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### Detection of ethanol in breath

An acetaldehyde “biosniffer”, based on the reverse reaction of alcohol dehydrogenase, was composed of an UV-LED as an excitation light source, a photomultiplier tube as a fluorescence detector and an optical fiber. This biosniffer shows a response time of less than 2 min and a dynamic range of 0.02 – 10 ppm, and was applied to measure the concentration of acetaldehyde in exhaled breath from healthy subjects after ingestion of alcohol [3].

A conductometric sensor functionalized by alcohol dehydrogenase immobilized and fold nanoparticles in a chitosan film was used for the detection of ethanol in breath, after mouth washing with an antiseptic [4].

### References

- [1] R. Sander, Compilation of Henry’s law constants for inorganic and organic species of potential importance in environmental chemistry, version 3, 1999. [www.henrys-law.org](http://www.henrys-law.org). Accessed 09 Mar 2021.
- [2] A. Madaci, N. Jaffrezic-Renault et al. J Mater Sci: Mater Electron 2021, 32, 17752–17763
- [3] K. Iitani, P.J. Chien, T. Suzuki, K. Toma, T. Arakawa, Y. Iwasaki, K. Mitsubayshi. ACS Sensors 2018, 3, 425-431
- [4] A. Madaci, N. Jaffrezic-Renault et al. Chemosensors 2023, 13, 2316



## Pr. SEID HUSSEN MUHIE

Horticulture at Wollo, University, Ethiopia



*“Dr. Seid Hussen Muhie is an Associate Professor of Horticulture at Wollo University. He earned his PhD in Horticulture from Ankara University, Turkey, in 2019, specializing in Horticulture (Stress Physiology, and Sustainable Agriculture). His academic journey also includes a Master’s degree in Horticulture from Haramaya University, Ethiopia, and a Bachelor’s degree in Plant Sciences from the same institution.*

*Seid has held several leadership roles, including his current position as Head of the Research and Technology Transfer Vice President Office at Wollo University. His professional expertise spans teaching, research, and project management, with notable contributions to horticultural science and community development initiatives.*

*He is an active member of several professional societies, such as the Ethiopian Horticultural Science Society and the Ethiopian Society of Postharvest Management. Seid has published extensively on horticultural crop management, organic farming, and sustainable agricultural practices. His work continues to focus on enhancing food security and promoting sustainable agriculture in Ethiopia and beyond.”*

## Plenary 5: Fostering Innovation: Advancing Sustainable Agricultural Practices for a Resilient Planet

- **Abstract of the Speech:**

This presentation underscores the critical importance of advancing sustainable agricultural systems through innovation and collaboration in response to global challenges such as climate change, biodiversity loss, and growing food insecurity. As the global population is expected to reach nearly 10 billion by 2050, agricultural systems will need to produce 70% more food. This projection necessitates a profound rethinking of current agricultural practices to ensure they are both productive and environmentally sustainable.

The presentation explores the transformative role of technology in shaping the future of agriculture, focusing on four key areas: precision agriculture, biotechnology, agroecology, and renewable energy solutions. Precision agriculture leverages data analytics, satellite imagery, and IoT technology to optimize yields while reducing water and resource consumption. Biotechnology, including CRISPR and genetic modification, enhances crop resilience to climate extremes and pests, contributing directly to Sustainable Development Goal (SDG) 2: Zero Hunger. Agroecological practices, such as agroforestry and crop rotation, restore soil health, increase biodiversity, and align with the principles of a Green Economy. Renewable energy solutions, particularly solar-powered irrigation systems, further reduce reliance on fossil fuels, supporting SDG 7: Affordable and Clean Energy.



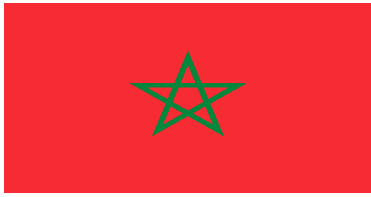
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Effective collaboration is identified as crucial for maximizing the impact of these innovations. Key strategies include knowledge sharing through farmer training programs, fostering public-private partnerships to drive investment in sustainable technologies, and empowering local communities with the tools and knowledge to adopt these practices. These efforts align with SDG 17: Partnerships for the Goals, fostering global cooperation to achieve long-term food security.

In conclusion, by integrating technological innovations with collaborative approaches, sustainable agricultural systems can be developed to meet future food demands while protecting the environment and ensuring resilience against emerging global challenges.





## Pr. FATIMA ZAHRA BAGHLI

Higher School of Technology of Beni Mellal, Sultan Moulay Slimane University, Morocco



“Dr. Fatima Zahra BAGHLI is currently a professor in the Department of Mechatronics at the Higher School of Technology, Sultan Moulay Slimane University, Beni Mellal Morocco, where she has been since 2017. She received her PhD in Mechatronics / Robotics from Abdelmalek Essaadi University. She received her Master’s Degree in Mechatronics Engineering from the Faculty of Sciences, Tetuan, Morocco. Her research includes mechatronic and robotic system modeling and control.”

### Plenary 6: Modeling and Simulation of Complex Energy Systems: Insights from Mechatronics and Bond Graph Theory

- **Abstract of the Speech:**

The increasing global demand for energy efficiency and sustainability has accelerated the integration of advanced technologies into energy systems. Among these technologies, mechatronic tools and intelligent control strategies are playing a critical role in transforming how energy infrastructures are designed, managed, and maintained. Mechatronics, an interdisciplinary field combining mechanics, electronics, computer science, and intelligent control, enables the development of sophisticated robotic systems capable of operating in complex and dynamic energy environments.



## Pr. NOUREDDINE LAKOUARI

National Council for the Humanities, Sciences and Technology, Mexico

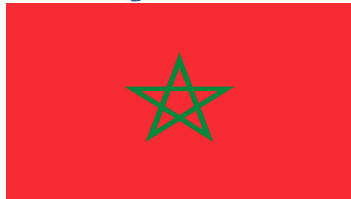


*“He completed his studies in Physical Sciences at Mohammed V University in Rabat, Morocco, in 2011. He pursued a Master’s degree in Computational Physics at the same institution. In 2015, he completed his Ph.D. at the Laboratory of Condensed Matter and Interdisciplinary Sciences at Mohammed V University in Rabat, Morocco. From 2016 to 2017, he was a Researcher at the Laboratory of Condensed Matter and Interdisciplinary Sciences at the same institution. In 2017, he joined UAEM (Autonomous University of the State of Morelos) for postdoctoral research in the field of simulation and modeling of complex systems, such as traffic flow. In 2018, he joined INAOE (National Institute of Astrophysics, Optics, and Electronics in Puebla) as a faculty member, where he began research in distributed computing, artificial intelligence, data science, and the modeling and simulation of mass phenomena in urban areas. He completed a Diploma in Data Science with Python at the Science Research Center, Autonomous University of the State of Morelos (UAEM), an IBM Data Science Professional Certificate in 2024, and a Diploma in Artificial Intelligence at Anáhuac University, Puebla, Mexico, 2024.”*

### Plenary 7: Artificial Intelligence for Renewable Energy: Concepts and Applications

- **Abstract of the Speech:**

This presentation will investigate some state-of-the-art Artificial Intelligence (AI) techniques- machines learning, artificial neural networks, fuzzy logic, genetic algorithms, and hybrid methods- that seek to optimize the performance of renewable energy systems. Through an in-depth study of system modeling, performance prediction, and process optimization driven by AI, this presentation presents a broad view of how artificial intelligence is transforming power generation, grid infrastructure, and energy use practices toward a sustainable future.



## Pr. JALAL ISAAD

Faculty of Sciences and Techniques, Al-Hoceima- Morocco



“Dr. Jalal ISAAD was born in Mohammedia - Morocco, on October 27, 1979. In 2004, he obtained his M.Sc. degree in fine organic chemistry at the University Claude Bernard Lyon 1 - France. In September 2005, he joined the group of Prof. Roberto Bianchini as a Ph.D. student at the University of Florence - Italy, where he obtained his Ph.D. in Chemical Sciences in February 2009. From 2009 to 2014, he was an associate research lecturer in chemistry and then a researcher at the École Nationale Supérieure des Arts et Industries Textiles - France, and since April 2015, he has been an associate professor of organic chemistry at the Faculty of Science and Technology Al Hoceima- Morocco and a head of the research team "Chemistry, informatics, and artificial intelligence in the same Faculty His research interests revolve around the design and synthesis of new bio-derived materials (polymers, nanoparticles, and macromolecules) and their application in the removal and chemical detection of toxic anions, heavy metals and VOCs for wastewater treatment”

### Plenary 8: The dye-carbohydrate combination: a new approach to eco-design of environmentally-friendly materials for wastewater treatment

- **Abstract of the Speech:**

Water is one of the major tools for sustainable development, which aims to reduce poverty, promote social development, foster economic activities and protect the environment. Recently, the demand for water is becoming increasingly great, while its natural reserves and pluvial precipitations are decreasing considerably. Therefore, it is of great interest to develop physical-chemical processes for the treatment of wastewater for possible reuse. Wastewater treatment has two major components, the detection of toxic pollutants and their removal. In this sense, our interest is focused on the use of natural substances such as carbohydrates to develop water-soluble organic dyes. These new dyes, called glycoconjugates, were first used as coloring agents for different textile fibers; and as detecting agents for toxic chemical agents such as cyanides and heavy metals in water. The glyco-conjugation of organic dyes offers a high-water solubility of the obtained glyco-conjugated dyes, which allows the detection of different toxic chemical elements by colorimetric or fluorescence way in the water, and on the other hand, to perform the dyeing of different natural and synthetic fibers in water and without any other chemicals, which considerably reduces the number of chemicals usually released in the water after the dyeing process.



## Pr. MOHAMED MOHAMEDI

Institut National de la Recherche Scientifique (INRS), Canada

*“Dr. Mohamed Mohamedi graduated from the Institut National Polytechnique de Grenoble (INPG), France. He actually works as a research-professor at Institut National de la Recherche Scientifique (INRS), Canada, where he leads the Electrochemistry and Micro Energy Sources Laboratory. His research is focused on the science, engineering and technology of electrochemical devices, in particular energy conversion (fuel cells) and storage devices (metal-air batteries and supercapacitors), implantable biological fuel cells power sources and bioelectrochemical sensors for medical applications. Dr. Mohamedi has published in international scientific journals, over 180 articles and participated in more than 160 conferences including several as invited and keynote speaker. He is the recipient of the Tajima Prize from the International Society of Electrochemistry (ISE), the Electrochemistry Communications Award, the Research fellow of the Japan Society for the*

*Promotion of Science (JSPS), Grant-in-Aids award for Encouragement of Young Scientists (Ministry of Science & Technology Japan), the Research Fellow of the 21st Center of Excellence at the Center for Practical Nano-Chemistry of Waseda University (Japan), the Research Fellow of the New Industry Creation Hatchery Center of Tohoku University (Japan), the Research Fellow of the New Energy and Industrial Technology Development Organization (NEDO) Japan and Leaders Opportunity Fund from Canada Foundation for Innovation.”*

## Plenary 9: Unlocking Affordable Green Energy: The Breakthrough Potential of Rechargeable Zinc-Air Batteries and Green Hydrogen Production

### • Abstract of the Speech:

Electrochemical devices, particularly batteries, are essential for modern society, powering portable electronics, remote sensing technologies, IoT devices, and electric vehicles. The demand for efficient energy storage continues to surge, primarily driven by lithium-ion batteries (LIBs), which dominate the market. However, the growing demand for lithium, coupled with its limited availability and uneven distribution, necessitates the exploration of alternative battery technologies. Metal-air batteries, especially zinc-air batteries (ZABs), have emerged as promising candidates. ZABs generate energy through the oxidation of zinc at the anode and the reduction of atmospheric oxygen at the cathode, functioning similarly to air-breathing fuel cells. They boast a theoretical energy density of 1350 Wh/kg (excluding oxygen) and a potential operating voltage of 1.65 V, alongside lower production costs.

This presentation will explore the challenges, advancements, and future prospects of ZAB technology, highlighting recent proof-of-concept experiments with both single and stacked ZABs for powering portable electronic devices. Additionally, we will discuss electrolysis, a technology utilizing modular systems to produce environmentally friendly hydrogen. However, its efficiency



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is limited by the oxygen evolution reaction (OER) at the anode. To ensure sustainable hydrogen production, the electricity used in this process must be decarbonized.

Studies indicate that ZABs can be produced with low environmental impacts, making them suitable for greener hydrogen production. We will present preliminary results demonstrating the potential of combining low-carbon ZABs with water electrolysis to address long-term energy and environmental challenges, emphasizing their role in the transition to sustainable energy solutions.





## Pr. LJILJANA TRAJKOVIC

School of Engineering Science, Simon Fraser University, Burnaby, British Columbia, Canada

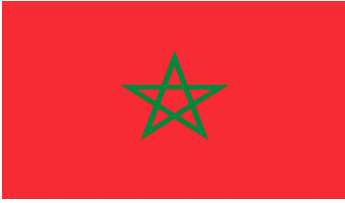


*“Ljiljana Trajkovic received the Dipl. Ing. degree from University of Pristina, Yugoslavia, the M.Sc. degrees in electrical engineering and computer engineering from Syracuse University, Syracuse, NY, and the Ph.D. degree in electrical engineering from University of California at Los Angeles. She is currently a professor in the School of Engineering Science, Simon Fraser University, Burnaby, British Columbia, Canada. Her research interests include communication networks and dynamical systems. Dr. Trajkovic served as IEEE Division X Delegate/Director, President of the IEEE Systems, Man, and Cybernetics Society, and President of the IEEE Circuits and Systems Society. She serves as Editor-in-Chief of the IEEE Transactions on Human-Machine Systems. She is a Distinguished Lecturer of the IEEE Systems, Man, and Cybernetics Society and was a Distinguished Lecturer of the IEEE Circuits and System Society. She is a Fellow of the IEEE.”*

## Plenary 10: Data Mining and Machine Learning for Analysis of Network Traffic

### • Abstract of the Speech:

Collection and analysis of data from deployed networks is essential for understanding communication networks. Hence, data mining and statistical analysis of network data have been employed to determine traffic loads, analyze patterns of users' behavior, predict future network traffic, and detect traffic anomalies. The Internet has historically been prone to failures and attacks that significantly degrade its performance, affect the Internet connectivity, and cause routing disconnections. Frequent cases of various cyber threats have been encountered over the years and, hence, detection of anomalous behavior is a topic of great interest in cybersecurity. In described case studies, traffic traces collected by various collection sites are used to classify network anomalies. Various anomaly and intrusion detection approaches based on machine learning have been employed to analyze collected data. Deep learning, broad learning, gradient boosted decision trees, and reservoir computing algorithms were used to develop models based on collected datasets that contain Internet worms, viruses, power outages, ransomware events, router misconfigurations, Internet Protocol hijacks, and infrastructure failures in times of conflict. The reported results indicate that while performance of machine learning models greatly depends on the used datasets, they are viable tools for detecting the Internet anomalies.



## Pr. YOUNES ZIAT

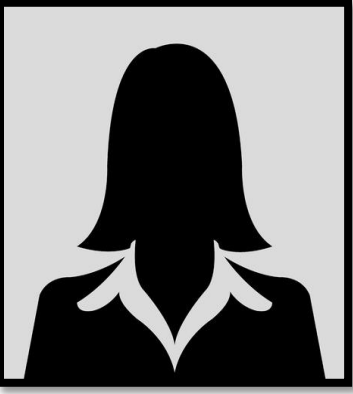
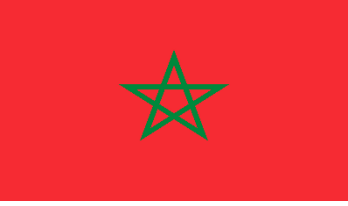
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*“Younes Ziat is a Moroccan physicist and academic affiliated with Sultan Moulay Slimane University in Beni Mellal. He serves as a professor at the Higher School of Technology, where he is involved in both teaching and research activities. His research interests encompass areas such as thin films, spintronics, magnetic materials, and density functional theory. Dr. Ziat has contributed to various scientific publications and has been involved in organizing international conferences related to materials science and sustainable energy. Dr. Ziat is active in academic circles, participating in conferences and contributing to the advancement of materials science in Morocco. His dedication to both education and research underscores his commitment to the scientific community.”*

### Plenary 11: Prediction the effect of (S, Se, Te) doped MgTiO<sub>3</sub> on optoelectronic, catalytic, and pH conduct as promised candidate photovoltaic device: ab initio framework

- **Abstract of the Speech:**

This study employed the density functional theory (DFT) with the generalized gradient and modified Becke-Jones approximation (GGA-mBJ) to predict the structure, electronic, optical, and photocatalytic properties of Y-doped MgTiO<sub>3</sub> perovskite materials, where Y = S, Se, and Te, is being incorporated at oxygen sites in different amounts ( $x = 8.33, 16, \text{ and } 25\%$ ). The results reveal that Y-doped MgTiO<sub>3</sub> (Y= S, Se, and Te) significantly decreases the band gap energy ( $E_g$ ) compared to pure MgTiO<sub>3</sub>, which has a band gap of 2.933 eV. For S, Se, and Te-doped MgTiO<sub>3</sub> alloys, at  $x = 8.33\%$ , the gap is 1.936, 1.891 and 1.110 eV for S, Se, and Te, respectively. These values decrease when the dopant increases, at  $x = 16\%$ , it is around 1.789, 1.7574, and 0.821 eV, for S, Se, and Te, respectively, and at  $x = 25\%$ , the band gap is 1.270, 1.038, and 0.511 eV for S, Se, and Te, respectively. The shift of the Fermi level towards the valence band in the doped compounds indicates a p-type semiconductor. Furthermore, doping enhances absorption in the visible spectrum, thereby increasing the photocatalytic activity of the doped materials for hydrogen production. This research addresses a gap by demonstrating that MgTiO<sub>3</sub> doped with S, Se, and Te can provide superior photocatalytic performance in visible light, paving the way for more efficient applications in hydrogen production systems. Concerning the effect on the photocatalytic activity connected to the redox zone ( $H^+/H_2$  and  $O_2/H_2O$  at  $pH = 7$ ), Se-doped MgTiO<sub>3</sub> at  $x = 8.33$  and  $16\%$  may be used to prepare active materials for photocatalytic applications. However, compounds doped with Se at  $x = 25\%$  and Te-doped MgTiO<sub>3</sub> at  $x = 8.33$ , and  $25\%$  are outside the redox zone.



## Pr. RACHIDA OUAABOU

Faculty of Sciences and Techniques, Al-Hoceima- Morocco

*“Pr. Rachida Ouaabou leads a research program focused on sustainable food processing through three key areas: (1) developing eco-friendly drying technologies including solar-assisted and conductive systems, (2) advancing preservation methods using gamma irradiation and thermal processing, and (3) creating innovative food products like functional biscuits, syrups, yoghurts, jam... Our team specializes in applying sorption isotherm modeling to optimize drying processes and predict shelf-life stability, combining fundamental research with practical applications.”*

### Plenary 12: Solar Drying of Fresh Produce: Current Advances, Drying Kinetics, and Quality of Products

- **Abstract of the Speech:**

Global demand for high-quality fresh produce continues to rise, yet the perishability of these products, primarily due to their high moisture content, poses significant challenges. To address this issue, solar dryers have emerged as effective preservation tools. This work explores the impact of solar drying on the drying kinetics and quality of fresh produce. Key quality factors, such as color, aroma, appearance, and rehydration capacity, must always be considered when evaluating dried products. Hybrid solar drying systems have been shown to achieve higher drying rates and improved product quality compared to conventional solar dryers. However, energy efficiency and product quality assessments remain crucial, as highlighted by several studies. Additionally, pre-treatment of fresh produce is essential prior to solar drying to ensure optimal final product quality. Future research should focus on developing innovative pre-treatment techniques that facilitate necessary chemical and physical changes, thereby enhancing mass and heat transfer during the drying process. Finally, there is a need for further investigation into how solar drying affects nutrient retention, functionalities, and sensory characteristics of the final products, particularly in comparison to non-solar drying technologies.

**Keywords:** Solar drying; Fresh products; Drying kinetics; Bioactive compounds.



## Pr. ZORAN MANDIĆ

University of Zagreb Faculty of Chemical Engineering and Technology, Croatia



*“Zoran Mandić is a professor at the University of Zagreb Faculty of Chemical Engineering and Technology. He has a background in electrochemistry and electrochemical engineering fields. In the last ten years, his work has focused on the development of advanced electrode materials for energy storage applications, particularly batteries and supercapacitors. The development of electrochemical methods in performance testing and predicting cycle life and SoH is also of increasing interest in his research. He has led several international and national projects, published more than 50 papers in international journals, 3 patents and had many invited lectures at international conferences and events.”*

### Plenary 13: Can battery development keep pace with ever increasing demands of electric vehicles and mobile applications.

- **Abstract of the Speech:**

The development of electric vehicles and consumer electronics places increasing demands on battery systems in terms of energy and power density, cycle life and operating temperature range. The properties and performance of single battery cells depend on the chemical composition of the cell, the rate of electrochemical reactions that occur during discharge/charge and the design of the cell. In the development of battery cells, it is necessary to combine knowledge of chemical and material engineering, electrochemical and electrical engineering. This lecture will discuss the current state of the composition and functioning of single cells, their chemistry and new trends in their development.



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# Impact of Static and Dynamic Bottlenecks on Traffic Flow and Accident Risks in a Two-Lane Cellular Automaton Framework

Noureddine Lakouari<sup>1</sup>, Younes Ziat<sup>2, 3</sup>, Hamza Belkhanchi<sup>2, 3</sup>

<sup>1</sup>National Institute of Astrophysics, Optics and Electronics (INAOE), Puebla, Mexico. Secretariat  
of Science, Humanities, Technology and Innovation (Secihti), Mexico

<sup>2</sup>Laboratory of Engineering and Applied Physics Team (EAPT), Sultan Moulay Slimane  
University, Beni Mellal, Morocco.

<sup>3</sup>The Moroccan Association of Sciences and Techniques for Sustainable Development  
(MASTSD), Beni Mellal, Morocco

**Abstract.** Bottlenecks remain a primary source of congestion and safety issues in road traffic. This study employs a two-lane cellular automaton model to analyze how fixed (e.g., lane closures) and moving (e.g., slow-moving vehicles) bottlenecks influence traffic flow and collision probability. The simulation results show that at low vehicle densities, traffic self-organizes: slow vehicles occupy a single lane, while faster ones overtake and then return. However, at high densities, static bottlenecks cause complete flow interruption, regardless of their length. From a safety perspective, longer static bottlenecks reduce the risk of rear-end collisions due to decreased lane-change frequency and increased vehicle standstill. Notably, at full saturation, the system enters a state of gridlock, virtually eliminating collision chances. These insights emphasize the role of intelligent bottleneck design and control in improving both traffic fluidity and safety outcomes.

**Keywords:** Bottlenecks; road traffic; safety issues; two-lane cellular automaton model





## Embedded System In Energy

Abhay Dhasmana<sup>1</sup>, Aditya Singh Rana<sup>1</sup>, Sachin Srivastava<sup>1</sup>, Yashwant Singh Bisht<sup>\*2</sup>

<sup>1</sup>Department of Aerospace Engineering, Uttaranchal Institute of Technology, Uttaranchal University, Dehradun-248007, Uttarakhand, India

<sup>2</sup>Department of Mechanical Engineering, Uttaranchal Institute of Technology, Uttaranchal University, Dehradun-248007, Uttarakhand, India

**Abstract.** As the use of renewable sources of energy, smart grids, and efficient energy management systems takes over the global energy industry, this shift is taking place. The shift depends enormously on the use of an embedded system—a compact power unit for computation. They can be applied to real-time monitoring, control, and optimization of energy generation, distribution, and consumption. However, their incorporation into energy applications is equally characterized by some critical challenges, such as energy efficiency, scalability, reliability, cybersecurity, and cost-effectiveness. Energy efficiency does not disappear since many of the embedded systems have to act as low-power devices but deliver the maximum possible performance, renewable energy installations, battery management systems, etc. Scalability and integration are equally important because of this diversity of devices and of communication protocols in modern energy systems. Reliability under harsh environmental conditions and protection against potential cybersecurity threats add complexity for the deployment of embedded systems. The cost and complexity involved can also limit the overall wide-scale adoption of complex advanced solutions, especially in relatively poorer regions. This research introduces the architecture, the current applications, and all possible challenges of embedded systems into energy systems, using such critical roles in smart grids for the management of renewable energy as in energy storage systems in electric vehicle infrastructure. Critical Appraisal of Emerging Solution Opportunities: AI-driven algorithms as Edge Computing and Advanced Communication protocols over existing challenges. The paper highlights successful implementations through case studies and, therefore, documents the effects of embedded systems in enhancing energy efficiency and reliability. The paper identifies future trends and innovations: advancements in hardware; application of machine learning for predictive energy management; and IoT, for creating intelligent energy ecosystems.

**Keywords:** Energy, Edge Computing, Scalability, IoT



# Electronic and Optoelectronic Modulation of LiMgN Half-Heusler Alloy via Be and P Doping: A DFT-Based Insight

Zakaryaa Zarhri<sup>1</sup>, Younes Ziat<sup>2, 3</sup>, Hamza Belkhanchi<sup>2, 3</sup>

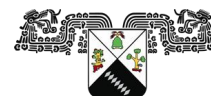
<sup>1</sup>CONACYT-Faculty of Chemical Sciences and Engineering, The Autonomous University of the  
State of Morelos (UAEM), Av. Universidad 1001, Col. Chamilpa, C.P. 62209, Cuernavaca,  
Morelos, Mexico

<sup>2</sup>Laboratory of Engineering and Applied Physics Team (EAPT), Sultan Moulay Slimane  
University, Beni Mellal, Morocco.

<sup>3</sup>The Moroccan Association of Sciences and Techniques for Sustainable Development  
(MASTSD), Beni Mellal, Morocco

**Abstract.** Using density functional theory within the TB-mBJ approximation, this work explores the influence of beryllium (Be) and phosphorus (P) doping (at 6.25% concentration) on the electronic and optoelectronic properties of the half-Heusler compound LiMgN, crystallizing in the cubic F-43m (No. 216) space group. Substitution of Be at Li (X-site) or Mg (Y-site), and P at N (Z-site), leads to notable modifications in the material's behavior. Be doping at the Li site induces a Burstein–Moss (BM) effect, shifting the Fermi level into the conduction band and increasing the apparent band gap due to the filling of low-energy conduction states. This phenomenon causes a blue shift of the absorption edge and enables tuning of the material's optical response. Optical transparency remains high, with transmittance reaching 76% for Be at the Y-site and 73% for P doping. These results demonstrate that controlled Be and P doping in LiMgN is a promising route to tailor its electronic structure and optical performance for optoelectronic device applications.

**Keywords:** Half-Heusler compound, LiMgN; electronic properties; Burstein-Moss effect





# Effect of Electronegativity-Based Doping on the Electronic and Optoelectronic Properties of LiMgP: A DFT Study

Zakaryaa Zarhri<sup>1</sup>, Younes Ziat<sup>2, 3</sup>, Hamza Belkhanchi<sup>2, 3</sup>

<sup>1</sup>CONACYT-Faculty of Chemical Sciences and Engineering, The Autonomous University of the  
State of Morelos (UAEM), Av. Universidad 1001, Col. Chamilpa, C.P. 62209, Cuernavaca,  
Morelos, Mexico

<sup>2</sup>Laboratory of Engineering and Applied Physics Team (EAPT), Sultan Moulay Slimane  
University, Beni Mellal, Morocco.

<sup>3</sup>The Moroccan Association of Sciences and Techniques for Sustainable Development  
(MASTSD), Beni Mellal, Morocco

**Abstract.** This study investigates the effect of doping LiMgP with elements of varying electronegativity, specifically sulfur (S), oxygen (O), fluorine (F), and chlorine (Cl), at a concentration of 6.25%. The study focuses on understanding how these dopants influence the electronic structure and optoelectronic properties of the material, using density functional theory (DFT) with the Wien2k package and the TB-mBJ approach. The results show that doping induces a Burstein–Moss shift, leading to n-type behavior with the Fermi level shifting into the conduction band. This behavior allows for the modulation of the band gap and the optical properties of LiMgP. Among the dopants, halogens (F, Cl) exhibit a stronger impact on the electronic properties compared to chalcogens (S, O). The doping also leads to a shift in the absorption edge to lower energies, with distinct peaks corresponding to each dopant element. These findings highlight the potential of using electronegativity to fine-tune the electronic and optoelectronic properties of LiMgP for various technological applications.

**Keywords:** Electronegativity; density functional theory (DFT); Wien2k; TB-mBJ



# Study of photoelectric properties of solar cells and sensors based on the semiconductor heterostructure p-CdTe – n-CdS AND p-CdTe – n-CdSe

S.M. Otajonov<sup>1</sup>, R.N. Ergashev<sup>1\*</sup>, T.Y. Bakirov<sup>1</sup>

<sup>1</sup>150100 Fergana, Fergana State University, Uzbekistan

**Abstract.** The paper examines the effect of temperature on the surface recombination rates of solar cells and sensors created on the basis of p-CdTe – n-CdS and p-CdTe – n-CdSe film heterostructures. It has been established that the surface recombination rates  $S$  at the heterointerface at  $N_S \rightarrow \infty$  tend not to infinity, but to a finite drift velocity in the boundary electric field. It is shown that the carriers are separated not at the interface of CdS and CdTe, but in the depth of the CdTe layer, which is equal to several micrometers from the surface, which is associated with the formation of a layer as a result of the diffusion of a free cadmium atom in p-CdTe. In this work, the practical application of heterostructures as optical sensors for determining environmental pollution is also investigated. Our research demonstrates that optical sensors fabricated using heterostructures are well-suited for integration into microcontrollers operating in the near-infrared spectral region. This is attributed to cadmium telluride's deep impurity levels with an activation energy of  $E_c-1.17$  eV. Furthermore, as the temperature increases, the sensitivity uniformity of the optical sensors improves, significantly reducing the impact of background signals.

**Keywords:** heterostructures, solar cells, p-CdTe – n-CdS, photosensitivity, polycrystalline film, recombination centers, spectral sensitivity, ventilation, sensor, LED, photodetector.





# DFT Study of Magnetic and Electronic Properties in LiMgP Half-Heusler Alloys Doped with Ti, V, Fe, and Ni

Noureddine Lakouari<sup>1</sup>, Younes Ziat<sup>2, 3</sup>, Hamza Belkhanchi<sup>2, 3</sup>

<sup>1</sup>National Institute of Astrophysics, Optics and Electronics (INAOE), Puebla, Mexico. Secretariat  
of Science, Humanities, Technology and Innovation (Seciht), Mexico

<sup>2</sup>Laboratory of Engineering and Applied Physics Team (EAPT), Sultan Moulay Slimane  
University, Beni Mellal, Morocco.

<sup>3</sup>The Moroccan Association of Sciences and Techniques for Sustainable Development  
(MASTSD), Beni Mellal, Morocco

**Abstract.** We performed a DFT analysis on LiMgP half-Heusler compounds doped with transition metals (Ti, V, Fe, Ni), focusing on ferromagnetism and half-metallicity. All doped structures exhibit full spin polarization at the Fermi level, confirming their half-metallic character. Magnetic behavior arises from specific orbital occupancies: Ti<sup>2+</sup> and V<sup>2+</sup> dominate near E<sub>F</sub>, Fe induces hybridized states with P, and Ni's minority-spin states lie just below E<sub>F</sub>. The magnetic moments and crystal field splittings are correlated, following the trends M<sub>Ni</sub> < M<sub>Ti</sub> < M<sub>V</sub> < M<sub>Fe</sub> and Δ<sub>Ni</sub> < Δ<sub>Ti</sub> < Δ<sub>V</sub> < Δ<sub>Fe</sub>, respectively. These doped systems are promising candidates for spintronic applications due to their robust magnetic stability and electronic tunability.

**Keywords:** half-metallicity; spin polarization; Fermi level; magnetic behavior





# Photovoltaic phenomena of solar cells based on p-CdTe- nCdS AND pCdTe-nCdSe heterostructures with deep impurity levels.

S.M. Otajonov <sup>\*1</sup>, R.N. Ergashev <sup>\*2</sup>, J.M. Boqirov <sup>\*3</sup>, Sh.A. Ibragimova <sup>\*4</sup>

<sup>1</sup>Doctor of Physics of Mathematical Sciences, Professor, 150100 Fergana, Murabbilar Street - 19, Uzbekistan.

<sup>2</sup>PhD of Physics of Mathematical Sciences, 150100 Fergana, Murabbilar Street - 19, Uzbekistan.

<sup>3</sup>Master's student of Fergana State University, 150100 Fergana, Murabbilar Street - 19, Uzbekistan.

<sup>4</sup>Master's student of Fergana State University, 150100 Fergana, Murabbilar Street - 19, Uzbekistan.

**Abstract.** In this paper, photovoltaic processes in solar cells based on pCdTe - nCdS and pCdTe - nCdSe heterostructures with deep-lying impurities are considered. It is found that the developed heterostructures exhibit a growth of photoactive carriers due to the presence of deep levels in the forbidden zone of CdTe, whose activation energies are  $E_C - 1.15$  eV. It is revealed that the pressure increase leads to a decrease in electrical resistance in the structures pCdTe-nCdS and pCdTe-nCdSe, while the temperature increase causes an increase in the linear expansion coefficient, which makes it possible to use such structures to convert solar energy into electricity.

**Keywords:** Heterostructure, Surface state densities, Photosensitivity, Solar cells.





## Internet of things, artificial intelligence (IOT & AI) and robotics in energy

Abhay Dhasmana<sup>1</sup>, Aditya Singh Rana<sup>1</sup>, Sachin Srivastava<sup>1</sup>, Yashwant Singh Bisht<sup>\*2</sup>

<sup>1</sup>Department of Aerospace Engineering, Uttaranchal Institute of Technology, Uttaranchal University, Dehradun-248007, Uttarakhand, India

<sup>2</sup>Department of Mechanical Engineering, Uttaranchal Institute of Technology, Uttaranchal University, Dehradun-248007, Uttarakhand, India

**Abstract.** The global energy sector faces mounting pressure to meet rising demand while remaining efficient, sustainable, and reliable. Inefficiencies in monitoring, forecasting, and maintenance often characterize traditional energy management systems, resulting in wasteful energy consumption, high operating costs, and reduced system reliability. Another issue that comes with transitioning to renewable sources is variability in power generation, grid stability, and integration issues. Emerging technologies like IoT, AI, and Robotics have tremendous transformative power but their application in the energy domain is fragmented and mostly underutilized. This paper discusses the integration of IoT, AI, and robotics to revolutionize energy systems through performance enhancement, sustainability, and adaptability. The smart grids and real-time monitoring systems enabled by IoT make it possible to have proper management of energy, decrease losses, and increase the efficiency of the grid. Predictive analytics and optimization algorithms can be used with AI-based solutions to predict energy demand, improve the usage of renewable energy, and improve decision-making processes. Robotics can play a critical role in inspection and maintenance in hazardous or remote environments, increasing safety and reducing downtime. A few real-world case studies illustrate the potential benefits: increased system reliability, reduced environmental impact, and efficiency gains. Hazards of cyberattacks, setup costs, and technological bottlenecks are accompanied by some possible solutions. This leaves scope for further improvements on robotic autonomy, matured machine learning, and smooth integration of IoT and AI. This paper shows the revolutionary possibility of IoT, AI, and robots in changing the future energy landscape in the search for more intelligent, sustainable energy solutions and progress towards a robust and efficient future.

**Keywords:** Energy, Edge Computing, Scalability, IoT



# Comprehensive Environmental Assessment and 3D Geostatistical Modeling of Copper Tailings: Toward Sustainable Management and Resource Recovery

Koucham M'hamed <sup>\*1</sup>, Khalil Abdessamade <sup>1,2</sup>, Ait khouia Yassine <sup>2</sup>, Soulaïmani Saâd <sup>1,2</sup>, Mouhagir Lahcen <sup>3</sup>, Zouhri Lahcen <sup>4</sup>, and EL Adnani Mariam <sup>1</sup>

<sup>1</sup>*Resources Valorization, Environment and Sustainable Development Research Team (RVESD), Department of Mines, Mines School of Rabat, Ave Hadj Ahmed Cherkaoui, BP 753, Agdal, Rabat 10090, Morocco;*

<sup>2</sup>*Geology and Sustainable Mining Institute, Mohammed VI Polytechnic University, Lot 660, Hay Moulay Rachid, Ben Guerir 43150, Morocco;*

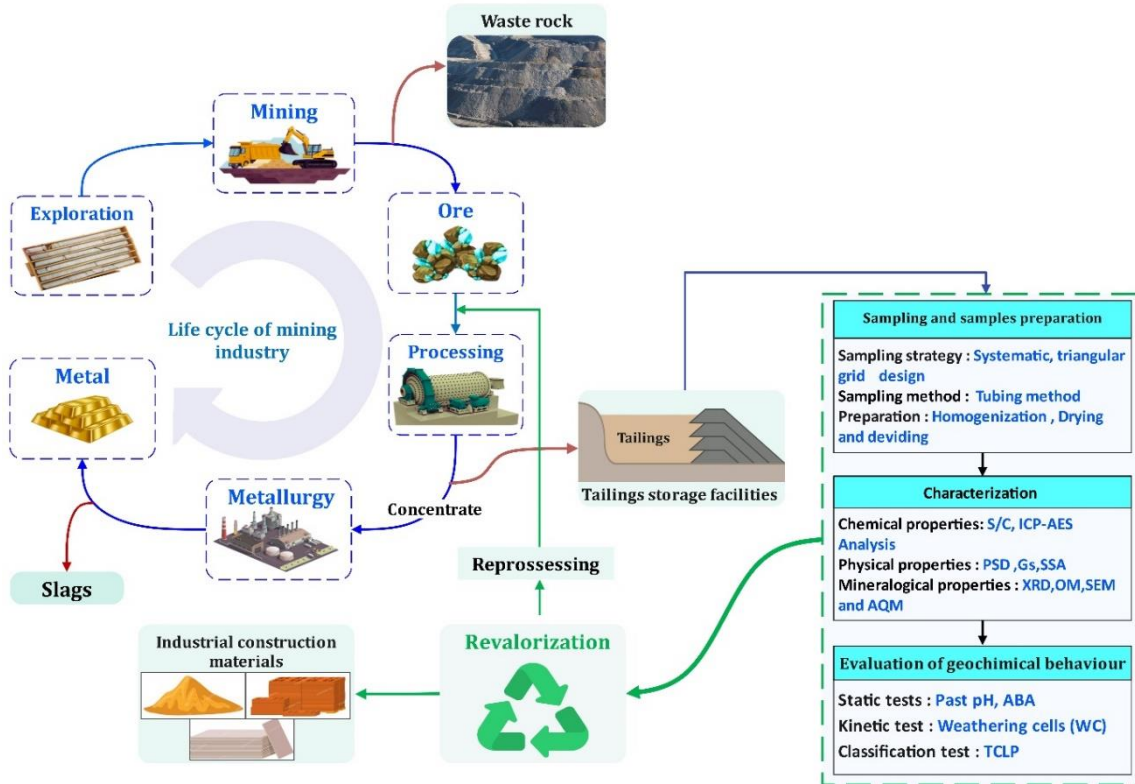
<sup>3</sup>*Managem Group, Twin Center, Boulevard Zerktouni, Casablanca 20000, Morocco ;*

<sup>4</sup>*Aghyle, Institut Polytechnique UniLaSalle Beauvais, SFR Condorcet FR CNRS 3417, 19 Rue Pierre Waguët, 60026 Beauvais, France.*

**Abstract.** The sustainable management of mine tailings remains a pressing global challenge due to their potential environmental risks and substantial volumes. This study focuses on the copper tailings, assessing their environmental behavior and residual resource potential through a combination of advanced environmental testing and geostatistical modeling. Environmental characterization was conducted using static tests, weathering cell experiments, and the Toxicity Characteristic Leaching Procedure (TCLP). The results demonstrated that the tailings are non-acid generating, with a pH range of 6.5 to 7.8, low sulfide oxidation rates, and minimal metal leachability. Key neutralizing minerals such as dolomite (27.4 wt.%) and calcite (2.4 wt.%) contribute to geochemical stability by buffering acidity and promoting the sequestration of metals in secondary mineral forms. The TCLP test confirmed the classification of the tailings as non-hazardous, indicating low risks of heavy metal mobilization under natural conditions. In parallel, geostatistical modeling using ordinary kriging provided a detailed estimation of residual copper resources within the tailings. Systematic sampling and analysis revealed an average copper grade of ~0.3%, with an estimated resource of 2,760 tonnes distributed across 3.73 million cubic meters (4.85 million tonnes) of tailings. The metallic content is predominantly associated with sulfide and carbonate minerals, exhibiting a low degree of liberation. This integrated approach underscores the dual potential of tailings for sustainable management and resource recovery. By combining rigorous environmental assessments with 3D geostatistical modeling, the study provides valuable insights for the re-mining and recycling of tailings as secondary raw materials, offering a pathway to reduce environmental risks while contributing to the circular economy in the mining sector.



**Keywords:** sustainable mine waste management, copper resource assessment, static and kinetic tests, Environmental and geochemical behavior assessment.



**Title:** Comprehensive Environmental Assessment and 3D Geostatistical Modeling of Copper Tailings: Toward Sustainable Management and Resource Recovery



# Selection of Gasification technology to maximize hydrogen-rich syngas from biomass using Multi-Criteria Decision-Making Methods

Housna Idrissi <sup>1</sup>; Najoua Labjar <sup>1</sup>; Souad El Hajjaji <sup>2</sup>; Toufik Boushaki <sup>3</sup>

<sup>1</sup>LS3MN2E, ENSAM, Mohammed V University in Rabat

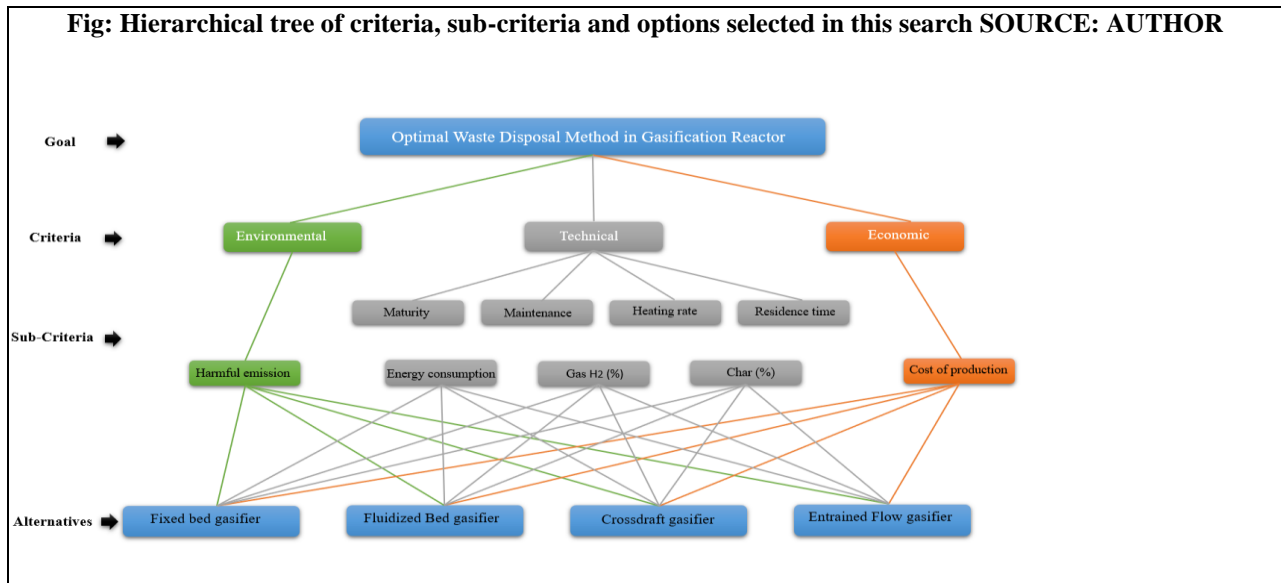
<sup>2</sup>LS3MN2E, Faculty of Sciences, Mohammed V University in Rabat

<sup>3</sup>ICARE-CNRS, University of Orleans, France

**Abstract.** Gasification of solid waste is an efficient and renewable energy recovery method, offering a promising alternative to traditional waste disposal. This process converts biomass and organic waste into syngas, which can be used for electricity and heat production. However, choosing the most suitable gasification technology requires balancing energy efficiency, syngas quality, cost, and environmental impact. This study aims to identify the most suitable gasifier by evaluating four types of gasifiers: fixed bed, fluidized bed, entrained flow, and thermal plasma. Using the Fuzzy TOPSIS (FTOPSIS) method, the technologies are compared according to multiple technical, economic, and environmental criteria. Data from the scientific literature are analyzed, and the importance of each criterion is assessed using two objective weighting methods: ENTROPY and CRITIC. These methods provide consistent results, confirming the robustness of the evaluation. Among the four technologies, the fluidized bed gasifier emerges as the most efficient solution. It offers the best energy efficiency, better management of different fuel compositions, and optimal syngas conversion. A sensitivity analysis confirms its reliability for large-scale applications. This makes the fluidized bed gasifier the recommended choice for maximizing hydrogen yield and ensuring efficient use of resources in waste to energy systems.

**Keywords:** Gasification technology; Hydrogen production; MCDM method; Syngas





**Title:** Selection of Gasification technology to maximize hydrogen-rich syngas from biomass using Multi-Criteria Decision-Making Methods



# Valorization of Rosemary Residues through Pyrolysis for Sustainable Biofuel Production

Fatima-Zahrae ED-DARRAZ <sup>\*1,2</sup>, Saida TAYIBI <sup>2</sup>, Abdellatif BARAKAT <sup>2,3</sup>, Elkhadir GHARIBI <sup>\*1</sup>

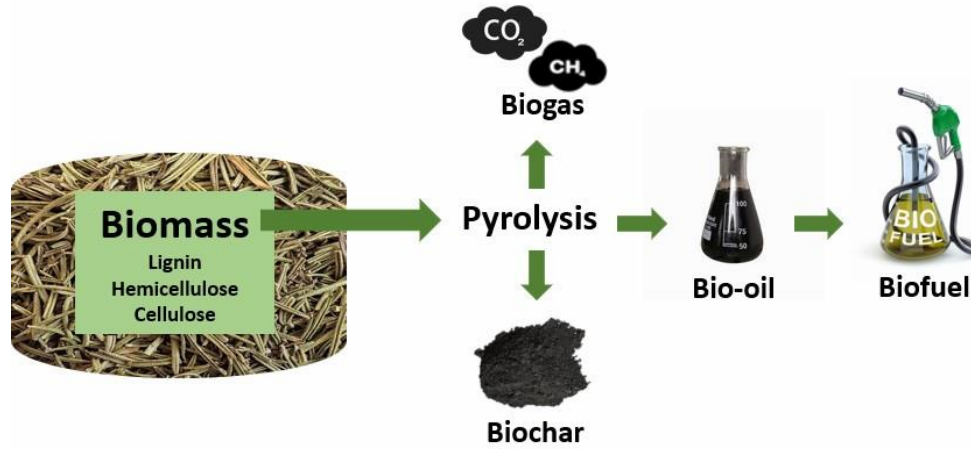
<sup>1</sup> *Laboratory of Applied Chemistry and Environment, Faculty of Sciences, Mohammed First University, 60000, Oujda, Morocco.*

<sup>2</sup> *Mohammed VI Polytechnic University (UM6P), 43150, Ben Guerir, Morocco.*

<sup>3</sup> *IATE, University of Montpellier, INRAE, Agro Institut of Montpellier, Montpellier, France.*

**Abstract.** Fossil fuels, such as oil, gas and coal, are finite, non-renewable energy sources and are the type of fuel most consumed by humans in various industries. However, they are considered a major cause of atmospheric pollution. Biomass is considered a renewable energy source, with great potential for ensuring energy security and the transition to green, non-fossil energy. Among new technologies, biomass pyrolysis appears to be a promising avenue to produce energy and chemical raw materials. *Rosmarinus officinalis L.*, abundant in the eastern and northern regions of Morocco, is widely exploited to produce essential oils and extracts. This exploitation generates large amounts of solid biomass residues. These residues, rich in aromatic compounds, cellulose, and lignin, offer opportunities for valorization in the production of biofuels and pyrolytic acid through catalytic pyrolysis. In bio-oil production, the chemical composition varies according to the nature of the residues (leaves and stems) and the pyrolysis temperature (500, 700 and 900°C). The physico-chemical characteristics of bio-oils were analyzed using GC/MS, elemental analysis (CHNS) and calorific value. The produced bio-oils were also characterized using FTIR and NMR. The biofuel characteristics obtained were assessed against the biofuel standard (EN 14214). The pyrolysis of rosemary residues enables the production of bio-oils with promising potential for refined biofuel manufacturing and pyrolytic acid rich in antioxidants.

**Keywords:** *Rosmarinus officinalis L.*; pyrolysis; bio-oil; biofuel.



**Title:** Valorization of Rosemary Residues through Pyrolysis for Sustainable Biofuel Production.

# Assessment of the electrical and energetic properties of rosemary residue bio-chars

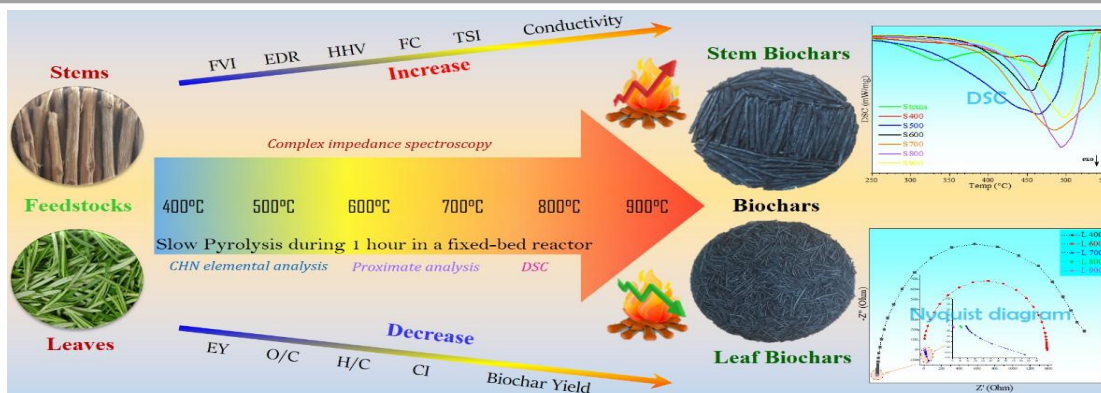
Abdelouassia Dira<sup>\*1</sup>, Abdelhakim Elmouwahidi<sup>2</sup>, Francisco Carrasco-Marin<sup>2</sup>, Elkhadir Gharibi<sup>\*1</sup>

<sup>1</sup>Faculty of Sciences, Mohammed First University, Oujda, BP 717, Oujda 60000, Morocco.

<sup>2</sup>Facultad de Ciencias, Universidad de Granada (UEQ-UGR), Granada ES18071, Spain.

**Abstract.** Renewable energies are clean, sustainable, and eco-friendly alternatives. Producing biochar from biomass through thermochemical processes offers an efficient method for energy conversion. In this study, biochars were produced by fixed-bed slow pyrolysis, at temperatures ranging from 400 to 900°C, using two types of biomass, rosemary leaf and stem residues. The resulting biochars were analyzed using various techniques, including complex impedance spectroscopy, CHN elemental analysis, DSC, and proximate analysis, to determine their electrical and energetic properties. Additionally, key energy parameters such as higher and lower heating values (HHV and LHV), energy density ratio (EDR), energy yield (EY), fuel value index (FVI), thermostability index (TSI), combustibility index (CI), and volatile ignitability (VI) were calculated. Proximate analysis revealed that the fixed carbon content increased with pyrolysis temperature, reaching its maximum in stem biochar produced at 900°C (91.31%), which also exhibited the highest HHV (32.18 MJ/kg). Notably, rosemary stem biochars demonstrated superior FVI (4402.25 MJ/m<sup>3</sup> at 900°C), indicating their potential as a renewable energy source to replace fossil fuels locally. Furthermore, complex impedance spectroscopy highlighted the suitability of these biochars for use as electrodes in batteries and supercapacitors, due to its high conductivity and energy storage capacity.

**Keywords:** Biochar; Complex impedance; Renewable energy; Rosemary.



**Title:** Electrical and energetic properties of rosemary residue bio-chars

# Hydrothermal liquefaction of brachychiton populneus: the role of different catalyst

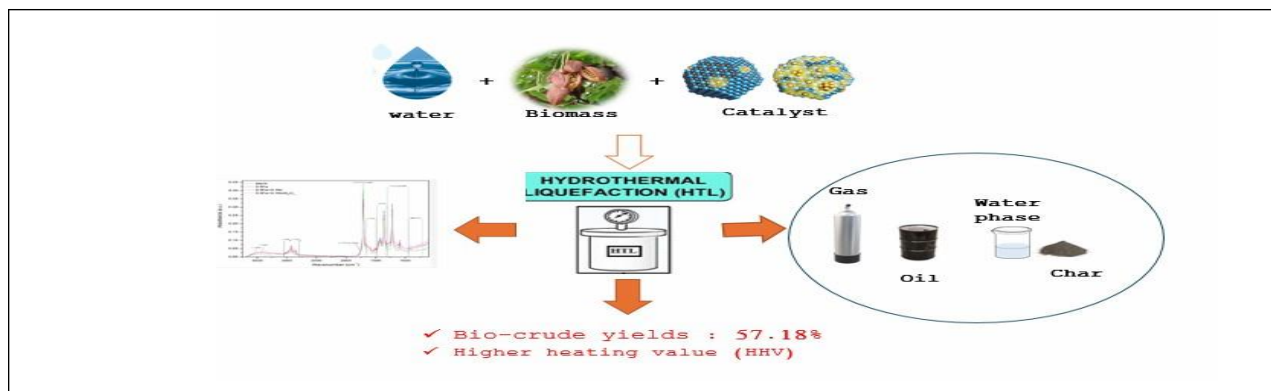
Ikram Eladnani <sup>\*1</sup>, Maria Paola Bracciale <sup>2</sup>, Martina Damizia <sup>2</sup>, Seyedmohammad Mousavi <sup>2</sup>, Paolo De Filippis<sup>2</sup>, Rajae Lakhmiri <sup>\*1</sup>, Benedetta de Caprariis <sup>2</sup>

<sup>1</sup> Laboratory of Chemical Engineering and Valorization of the Resources, Faculty of Sciences and Techniques of Tangier, Abdelmalek Essaâdi University, Km 10 Road of Ziaten, P.O. Box 416, Tangier 93000, Morocco

<sup>2</sup> Department of Chemical Engineering Materials Environment, SAPIENZA University of Rome, Via Eudossiana 18,00184 Rome, Italy

**Abstract.** The aim of this research is to improve both the quantity and quality of bio-crud derived from a lignocellulosic biomass *Brachychiton populneus* using Ni metal and of Ni/Al<sub>2</sub>O<sub>3</sub> as a catalyst. In our previous study, we establish the best operating process conditions, the influence of variation of temperature and reaction time on the product yields was also examined. The HTL tests were performed in a stainless-steel tubular reactor. The highest bio-crude yields of 57.18% and 48.23% for BS and BM.

**Keywords:** hydrothermal liquefaction; Brachychiton populneus; catalytic HTL; energy recovery



**Title:** Study of optimum process conditions: temperature and reaction time



## Advanced design of chemically modified electrodes for the electrochemical analysis of uric acid and xanthine

Abdelaziz Moutcine <sup>a, f</sup>, Charaf Laghlimi <sup>b, f</sup>, Younes Ziat <sup>c, f</sup>, Soumia El Bahraoui <sup>d, f</sup>, Hamza Belkhanchi <sup>c, f</sup>, Ahmed Jouaiti <sup>e</sup>

<sup>a</sup> Faculty of Science and Technology, Sultan Moulay Slimane University, Beni Mellal, Morocco

<sup>b</sup> ERCI2A, FSTH, Abdelmalek Essaadi University, Tetouan, Morocco

<sup>c</sup> Engineering and Applied Physics Team (EAPT), Superior School of Technology, Sultan Moulay Slimane University, Beni Mellal, Morocco

<sup>d</sup> Université du Québec à Chicoutimi, Canada

<sup>e</sup> Laboratory of Sustainable Development, Faculty of Sciences and Technologies, Sultan Moulay Slimane University, Beni Mellal, Morocco

<sup>f</sup> The Moroccan Association of Sciences and Techniques for Sustainable Development (MASTSD), Beni Mellal, Morocco

**Abstract.** This study reviews advances in chemical detection methods applied to the metabolic products known as uric acid (UA) and xanthine (XA), which are residues of purine metabolism, with XA being an important intermediate preceding UA. UA and XA play crucial roles in maintaining physiological homeostasis in organisms. Chemical modification of electrodes is a widely used method to address the issues of poor sensitivity and selectivity encountered with bare electrodes. This article reviews various materials commonly used to modify electrode surfaces for the detection of uric acid and xanthine, focusing on properties that enhance electrocatalytic activity. We highlight recent trends in detecting these compounds using electrochemical methods with microfabricated devices and explore cutting-edge modification techniques involving novel nanomaterials, carbon derivatives, metallic nanoparticles, and polymers. The review includes a comparative analysis of these materials, addressing their strengths, limitations, and recent advancements, such as in carbon-based materials and metal-organic frameworks (MOFs). Finally, we critically examine the challenges and future prospects of electrochemical detection of UA and XA in real samples, offering strategies to address these issues. The challenges associated with determination of UA and XA in real samples are also discussed.

**Keywords :** Detection methods, Uric acid, Xanthine, Chemical modification, Electrode, Electroanalytical activity



## Adsorption Kinetics, Isotherm Models, and Thermodynamics: A Brief Review

Imane Yazidi<sup>\*1</sup>, Khadija Ziat<sup>\*1</sup>, Naoual El Bardiji<sup>\*1</sup>, Youssef El Boundati<sup>\*1</sup>, Ahmed Naji<sup>\*2</sup>, Jamal El Haskouri Bennagi<sup>\*3</sup>, Mohamed Saidi<sup>\*1</sup>.

<sup>1</sup>Laboratoire Physico-Chimie des Matériaux, Substances Naturelles et Environnement, Faculty of Sciences and Techniques, Abdelmalek Essaâdi University, Tangier, Morocco

<sup>2</sup>Laboratoire de mathématiques appliquées, Substances Naturelles et Environnement, Faculty of Sciences and Techniques, Abdelmalek Essaâdi University, Tangier, Morocco

<sup>3</sup>Instituto de Ciencia de los Materiales de la Universidad de Valencia, Calle catedrático José Beltran, Paterna, Valencia, Spain.

**Abstract.** The study of adsorption kinetics, isotherms and thermodynamics provides crucial insights into adsorption mechanisms, rates and energy dynamics. Adsorption kinetics elucidate the rate and duration of adsorbate interactions at the solid-liquid interface, while isotherms reveal the interaction dynamics and maximum adsorption capacities. Thermodynamic analyses evaluate the feasibility, spontaneity and energy changes of the adsorption process. This article reviews the main models of adsorption kinetics, isotherms and thermodynamics, as well as their optimisation and validation. Kinetic models discussed include pseudo-first order, pseudo-second order, Elovich and intra-particle diffusion models, which assume heterogeneous reactions and allow the calculation of parameters such as adsorption capacity and rate constants using graphical interpretations. Statistical metrics such as coefficient of determination ( $R^2$ ) and root mean square error (RMSE) ensure model reliability. Isothermal models such as Langmuir, Freundlich, Temkin and Dubinin-Radushkevich are evaluated for their ability to characterise adsorption processes including physisorption or chemisorption and single or multi-layer adsorption. Thermodynamic parameters such as Gibbs free energy ( $\Delta G^\circ$ ), enthalpy ( $\Delta H^\circ$ ) and entropy ( $\Delta S^\circ$ ) are examined to assess the spontaneity, feasibility and energy profiles of adsorption. This review provides a comprehensive understanding of adsorption processes, enabling model optimisation and application in various fields.

**Keywords:** Adsorption, kinetics, isotherms, thermodynamics, optimization, validation, pseudo-first order, Langmuir



# Theoretical study of the optical, structural and electronic properties of germanium dioxide (GeO<sub>2</sub> Rutile) doped with Ti and Nb by DFT approach

Younes Ziat<sup>1,2</sup>, Hamza Belkhanchi<sup>1,2</sup>, Zakaryaa Zarhri<sup>3</sup>, Charaf Laghlimi<sup>2,4</sup>

<sup>1</sup> Engineering and Applied Physics Team (EAPT), Superior School of Technology, Sultan Moulay Slimane University, Beni Mellal, Morocco

<sup>2</sup> The Moroccan Association of Sciences and Techniques for Sustainable Development (MASTSD), Beni Mellal, Morocco

<sup>3</sup> CONACYT- Faculty of Chemical Sciences and Engineering, The Autonomous University of Morelos State, Cuernavaca, Morelos, Mexico

<sup>4</sup> ERCI2A, FSTH, Abdelmalek Essaadi University, Tetouan, Morocco

**Abstract.** This study investigates the effects of doping GeO<sub>2</sub> with 6.25% Ti and Nb using density functional theory (DFT) with the GGA-mbj approximation, focusing on structural, electronic, and optical properties. The density of states (DOS) analysis shows that the Ti-3d and Nb-2p orbitals are dominant in Ge<sub>0.9375</sub>Ti<sub>0.0625</sub>O<sub>2</sub> and Ge<sub>0.9375</sub>Nb<sub>0.0625</sub>O<sub>2</sub>, respectively. The bandgap energy decreases from 4.09 eV in pure GeO<sub>2</sub> to 3.4 eV in Ge<sub>0.9375</sub>Ti<sub>0.0625</sub>O<sub>2</sub> and 3.11 eV in Ge<sub>0.9375</sub>Nb<sub>0.0625</sub>O<sub>2</sub>. The study also examines dielectric permittivity, conductivity, refractive index, absorption function, and energy-loss spectrum up to a photon energy of 13 eV, revealing anisotropic behavior along the zz (001) and xx (100) axes. Optical properties indicate that doping increases the refractive index, leads to significant ultraviolet absorption, and results in high optical conductivity between 3.61 and 13 eV. The negative values of the real part of the dielectric function,  $\epsilon_1(\omega)$ , at 12 eV suggest metallic behavior, with the doped materials exhibiting higher plasmonic frequencies, especially in Ge<sub>0.9375</sub>Ti<sub>0.0625</sub>O<sub>2</sub>. These results suggest that Ti and Nb doping improves the suitability of GeO<sub>2</sub> for optoelectronic devices and transparent conductors.

# CoAl/MgAl/MgFe-Layered Double Hydroxides: Synthesis, physicochemical properties and adsorption of methyl blue from aqueous solution

Zineb Tchorbo<sup>1\*</sup>, Mustapha Dib<sup>1</sup>, Kacem Mariem<sup>1</sup>, Essaddek Abderrahim<sup>1</sup>, Mounsef Neffa<sup>2</sup>, J. M. Doña Rodriguez<sup>3</sup>

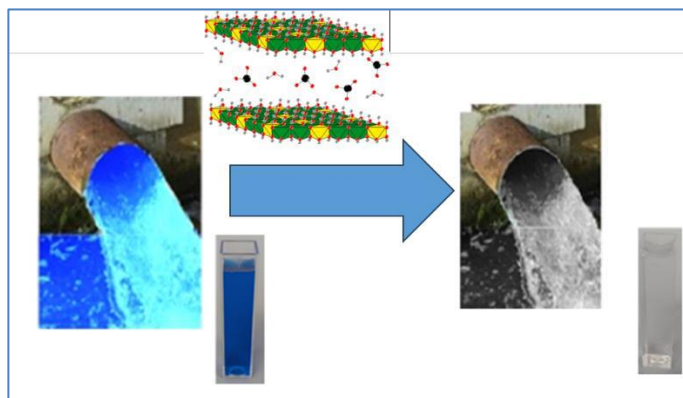
<sup>1</sup>LCAE, Mineral Solid Chemistry Team, Faculty of Sciences, Mohammed First University, B.P. 717, 60 000, Oujda, Morocco

<sup>2</sup>Laboratory of Bioresources, Biotechnology, Ethnopharmacology and Health, Faculty of Sciences, Mohammed First University, B, P, 717, Oujda 60000, Morocco

<sup>3</sup>FEAM, Institute of Environmental Studies and Natural Resources (i-UNAT), Universidad de Las Palmas de Gran Canaria, Campus Universitario de Tafira, Las Palmas, 35017, Spain

**Abstract.** In this study, the CoAl/MgAl/MgFe-LDH mesoporous materials were successfully prepared by coprecipitation method. The prepared LDH materials with different bimetallic and trimetallic cations were investigated by numerous techniques for physicochemical characterization including XRD, FT-IR, SEM-EDS and N<sub>2</sub> adsorption-desorption. The removal effect of the different LDH samples on methylene blue (MB) dye from aqueous solutions was studied. As result, highlights the potential of CoAl, MgAl, and MgFe LDH as environmentally friendly adsorbents for polluted water treatment.

**Keywords:** Layered Double Hydroxides (LDHs), synthesis, properties, potential applications, adsorption of methylene blue.



**Title:** Synthesis and applications of CoAl/MgAl/MgFe-LDH materials as adsorbent for water treatment.



# Solar Drying of Fresh Produce: Current Advances, Drying Kinetics, and Quality of Products.

Rachida OUAABOU <sup>\*1</sup>, Abdessamad LAHRACH <sup>2</sup>, Lahcen HSSAINI<sup>3</sup>, Jalal ISAAD <sup>1</sup>, Said ENNAHLI <sup>4</sup>

<sup>1</sup>*Environmental Technologies, Biotechnology and Valorization of Bio-Resources Team, Faculty of Sciences and Techniques Al Hoceima, Abdelmalek Essaadi University, Morocco*

<sup>2</sup>*Water Biodiversity and Climate Change Laboratory, Faculty of Sciences – Semlalia, Cadi Ayyad University, 40090 Marrakech, Morocco*

<sup>3</sup>*National Institute of Agricultural Research, Avenue Ennasr, BP 415 Rabat Principale, 10090, Rabat, Morocco*

<sup>4</sup>*Deaprtment Arboriculture, Vituculture, oleiculture, Ecole Nationale d'Agriculture de Meknès, Meknes 50001, Morocco*

**Abstract.** Global demand for high-quality fresh produce continues to rise, yet the perishability of these products, primarily due to their high moisture content, poses significant challenges. To address this issue, solar dryers have emerged as effective preservation tools. This work explores the impact of solar drying on the drying kinetics and quality of fresh produce. Key quality factors, such as color, aroma, appearance, and rehydration capacity, must always be considered when evaluating dried products. Hybrid solar drying systems have been shown to achieve higher drying rates and improved product quality compared to conventional solar dryers. However, energy efficiency and product quality assessments remain crucial, as highlighted by several studies. Additionally, pre-treatment of fresh produce is essential prior to solar drying to ensure optimal final product quality. Future research should focus on developing innovative pre-treatment techniques that facilitate necessary chemical and physical changes, thereby enhancing mass and heat transfer during the drying process. Finally, there is a need for further investigation into how solar drying affects nutrient retention, functionalities, and sensory characteristics of the final products, particularly in comparison to non-solar drying technologies.

**Keywords:** Solar drying; Fresh products; Drying kinetics; Bioactive compounds.

# The Catalytic Influence on Stereoselective Cycloaddition Reactions: A Theoretical Investigation of the Reactions Catalyzed by TiCl<sub>4</sub> between Cyclopenta-1,3-Diene and Benzyl Acrylate/Benzyl 2-Fluoroacrylate

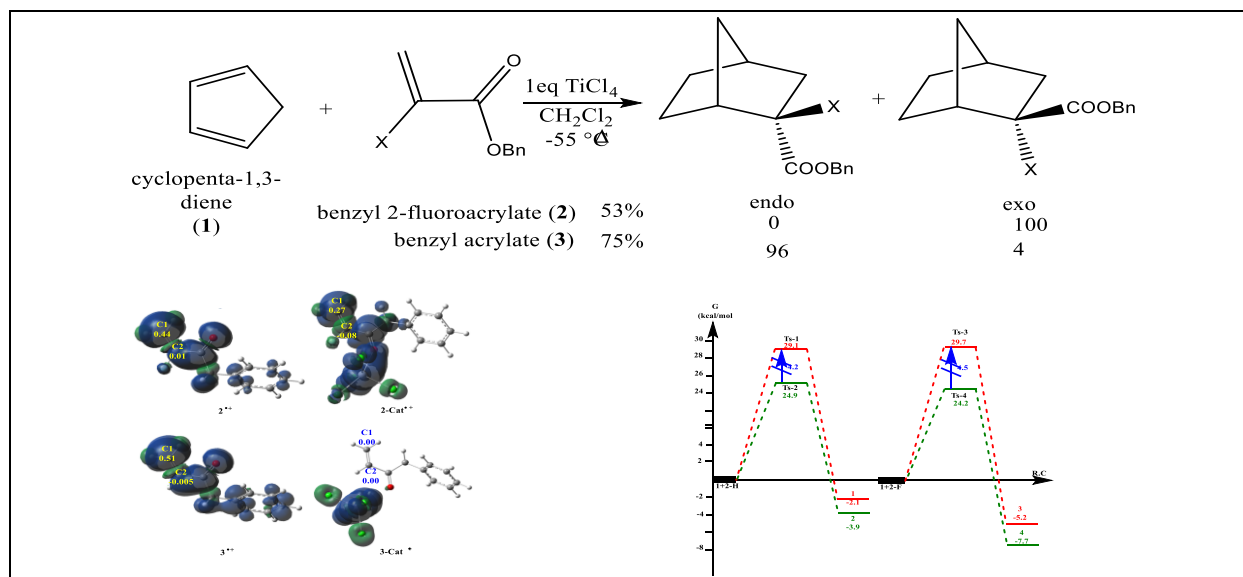
Khadija EL IDRISSEI <sup>\*1,2</sup>, Abdellah Zeroual <sup>\*1</sup>, Hocine Garmes <sup>\*2</sup>

<sup>1</sup> Molecular Modelling and Spectroscopy Research Team, Faculty of Science, Chouaib Doukkali University, P.O. Box 20, 24000 El Jadida, Morocco

<sup>2</sup> Analytical Chemistry and Environmental Sciences Team, Department of chemistry, Faculty of Science, University Chouaib Doukkali, El Jadida

**Abstract.** Molecular Electron Density Theory (MEDT) at the DFT/B3LYP/SDD calculation level is being used to investigate cycloaddition reactions between cyclopenta-1,3-diene and benzyl acrylate, as well as benzyl 2-fluoroacrylate, with and without the TiCl<sub>4</sub> catalyst. This approach allows for a full examination of reaction energy profiles, providing insights into mechanism and stereochemical selectivity. The results show stereoselectivity, favoring certain stereoisomers, with the TiCl<sub>4</sub> catalyst increasing reaction selectivity, consistent with experimental observations.

**Keywords:** Cyclopenta-1,3-diene, MEDT, benzyl acrylate, benzyl 2-fluoroacrylate, TiCl<sub>4</sub>, selectivity.



**Title:** TiCl<sub>4</sub> catalyzed DA reaction of Cyclopenta-1,3-diene with Benzyl 2-Fluoroacrylate and Benzyl Acrylate.



# Effect of Drying Processes on the Total Phenolic Content in Methanolic Extracts of *Ulva rigida* and *Gracilaria* sp

Zainab Srhiri <sup>\*1</sup>, Ramdani Mohammed <sup>1</sup>

<sup>1</sup> Department of Chemistry, Laboratory of Applied Chemistry and Environment (LCAE), Mohammed First University, Faculty of Sciences, 60000 Oujda, Morocco

**Abstract.** Total phenolic compounds (TPC) are widely recognized for their antioxidant properties and their potential role in enhancing the value of marine algae as a source of bioactive agents. This study aims to evaluate the influence of different drying conditions on the TPC content in methanolic extracts of two algae species, *Ulva rigida* and *Gracilaria* sp. Four drying methods were applied: freeze-drying, air drying at 25 °C, and oven drying at 40 °C and 60 °C. The TPC content was determined using the Folin-Ciocalteu method. The results reveal that air drying at 25 °C leads to the highest TPC concentration for *U. rigida* ( $1.24 \pm 0.31$  mg GAE/g of extract) and *Gracilaria* sp. ( $1.46 \pm 0.42$  mg GAE/g of extract). In contrast, drying at 60 °C significantly reduces TPC levels in both species. These findings highlight the importance of selecting appropriate drying conditions to preserve the phenolic compounds in algae, thus promoting the optimal valorization of marine biomolecules. This study aligns with a green chemistry approach aimed at developing eco-friendly processes for the sustainable exploitation of marine resources, while minimizing energy consumption and optimizing yields of bioactive compounds.

**Keywords:** Algae valorization; Bioactive compounds; Drying; Methanolic extracts.

# CFD Simulation of the Influence of Blade Installation on the performance of Single-Slope Solar Still

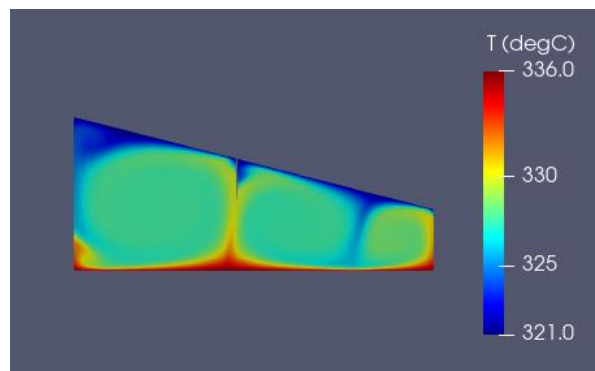
Reda Aftiss <sup>\*1</sup>, Monssif Najim <sup>\*1,2</sup>

<sup>1</sup> Laboratory of engineering Sciences and Biosciences (LSIB), Faculty of science and technology Hassan II University, Casablanca, Morocco

<sup>2</sup> GEMS Laboratory, ENSA Ibn Zohr University, Agadir, Morocco

**Abstract.** In the last years the water scarcity become one of the major problem that many countries suffer from it. Thus, solar desalination provide a valuable solution providing fresh water with low cost and environmentally friendly. The present study present a numerical a study of solar desalination integrated with blade. The CFD model consist of comparing two types of solar still: conventional solar still (CSS), solar still with blade (SSP). The present simulation of solar still is developed and modeled based on OpenFoam software. To ensure the validity of the present simulation, the present findings is validated with experimental and numerical data available in the literature review. The results showed that the integration of blade within solar still still enhanced the Nusselt number by about 8%. furthermore, the effect of the blade position along the length of solar still is investigated.

**Keywords:** Solar Still; CFD; Optimization



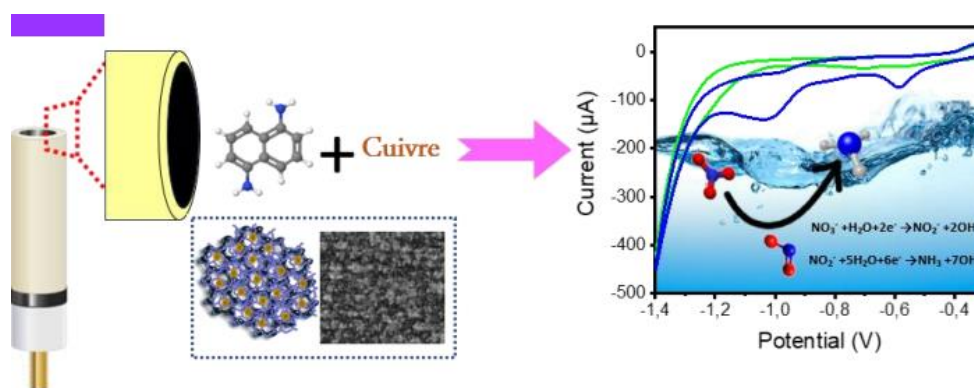
# Enhanced Electroreduction of Nitrate Ions Using a Copper-Modified Carbon Paste Electrode Supported by Poly(1,5-Diaminonaphthalene)

I. ELAZHARY<sup>1</sup>, S. BENHAIBA<sup>1</sup>, A. Ezzahi<sup>1\*</sup>, M. EL Rhazi\*

<sup>1</sup>Put au Laboratoire des Matériaux Membranes et Environnement (L2ME), Faculté des Sciences et Techniques de Mohammedia, Université Hassan II de Casablanca, Maroc

**Abstract.** Nitrate, is the major nitrogen-containing compounds responsible for water pollution. They have significant risks on freshwater and aquatic ecosystems. Regular monitoring of these ions is essential to reduce their harmful impacts. Nitrate, being widely used and persistent in the environment, is one of the major ions in most industrial and agricultural areas. Herein, a simple, low-cost electrochemical sensor was prepared for nitrate ions determination in water samples based on the modification of a carbon paste electrode with copper nanoparticles and conducting polymer: poly(1,5-diaminonaphthalene), poly(1,5-DAN). The performance of the designed sensor under optimum conditions by using square wave voltammetry and cyclic voltammetry exhibits an excellent performance. It reached an extensive detection range of 1–100  $\mu\text{M}$  and an impressively low detection limit of 0.26  $\mu\text{M}$  at the applied potential of -1.05 V versus Ag/AgCl (saturated KCl). The response was also very selective to nitrate detection in un-treated water samples and stable in the long term. These results demonstrate that this is potentially an important tool for the monitoring of nitrate contamination and facilitating denitrification in real-life applications.

**Keywords:** nitrate detection, conducting polymer, poly(1,5-diaminonaphthalene), electrochemical sensor, copper nanoparticles.



**Title:** Detection of nitrate



# High performance of perovskite chalcogenide BaHfS<sub>3</sub> in solar cells

N. El Hidaoui<sup>a,\*</sup>, F. Goumrhar<sup>a,b,c</sup>, L. B. Drissi<sup>a,c,d</sup>, R. Ahl Laamara<sup>a,c</sup>

<sup>a</sup> LPHE- Modeling & Simulation, Faculty of Sciences, Mohammed V University in Rabat, Av. Ibn Batouta, B. P. 1014 Rabat, Morocco

<sup>b</sup> Higher School of Education and Training (ESEF), Chouaib Doukkali University, El Jadida, Morocco

<sup>c</sup> Centre of Physics and Mathematics (CPM), Faculty of Science, Mohammed V University in Rabat, Morocco

<sup>d</sup> Hassan II Academy of Sciences and Technology, Rabat, Morocco

**Abstract:** Chalcogen perovskites have become one of the most competitive materials in environmentally friendly energy production due to their stability and non-toxicity. Using the DFT method, we studied stability, structural, and optoelectronic properties. We also addressed the calculation of photovoltaic parameters via the Scaps-1D simulation software. The orthorhombic structure of the semiconductor has been studied. Our results demonstrated the energetic and mechanical stability of this material. has a direct band gap, it was evaluated using GGA, and the value found is 1.28eV. High absorption ( $\alpha$ ), and low reflectivity (<40%). These properties motivate us to calculate photovoltaic parameters by varying the absorber layer thickness in the solar cell architect ( $J_{sc}$ ) after carefully selecting the other layer materials, we find significant values for the main characteristics: 35.02 (mA/cm<sup>2</sup>) of  $J_{sc}$ , 1.08 mV of  $V_{oc}$ , 80.24% of FF and 30.56% for PCE.

**Keywords:** DFT; Scaps-1D; Perovskite ; Solar cell; Photovoltaics; Optoelectronic.





# Solar drying kinetics and physicochemical study of snail meat

Abdessamad LAHRACH <sup>\*1</sup>, Majdouline BELAQZIZ <sup>\*2</sup>, Rachida OUAABOU <sup>\*3</sup>,  
Noamane TAARJI <sup>\*4</sup>, Naaila OUAZZANI <sup>\*5</sup>

<sup>1</sup>Water Biodiversity and Climate Change Laboratory, Faculty of Sciences – Semlalia, Cadi Ayyad University, 40090 Marrakech, Morocco

<sup>2</sup>Water Biodiversity and Climate Change Laboratory, Faculty of Sciences – Semlalia, Cadi Ayyad University, 40090 Marrakech, Morocco

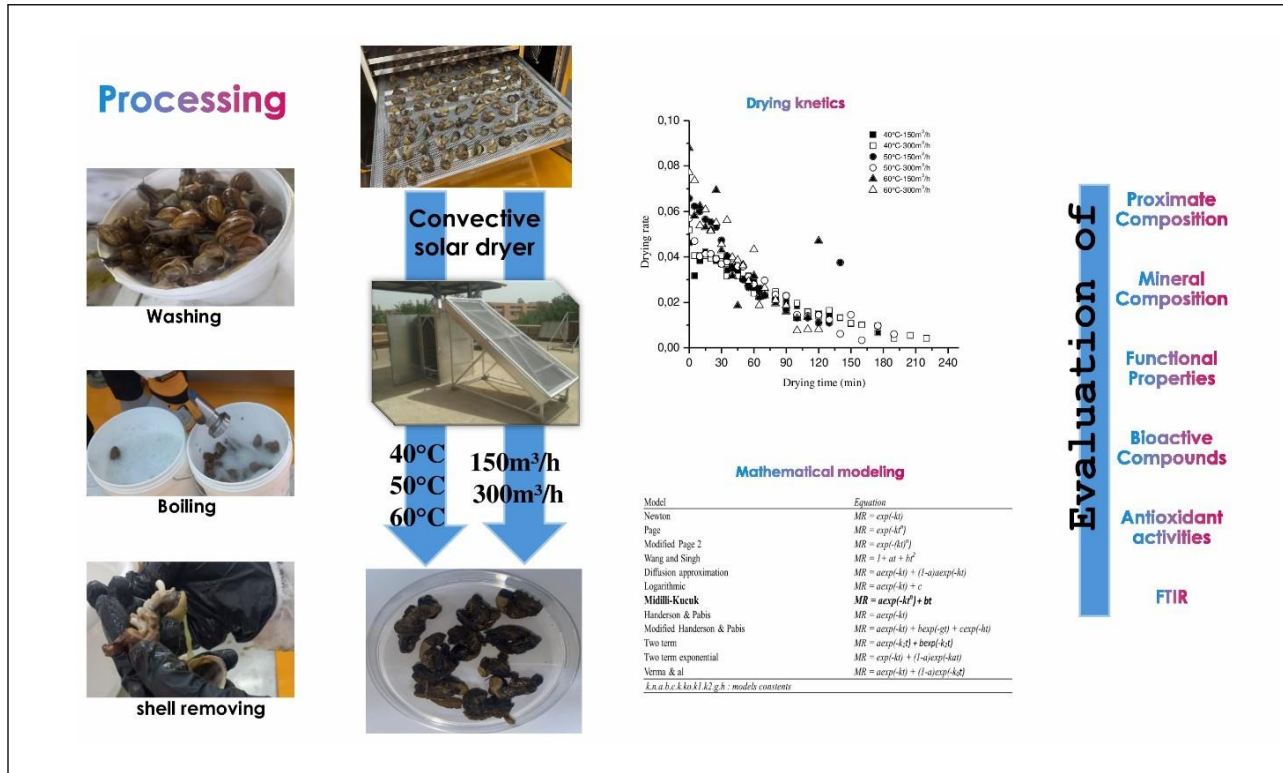
<sup>3</sup>Environmental Technologies, Biotechnology and Valorization of Bio-Resources Team, Faculty of Sciences and Techniques Al Hoceima, Abdelmalek Essaadi University, Morocco

<sup>4</sup>College of agriculture and environmental sciences, AgroBioSciences department, Mohammed VI Polytechnic University, Ben Guerir, 43150, Morocco

<sup>5</sup>Water Biodiversity and Climate Change Laboratory, Faculty of Sciences – Semlalia, Cadi Ayyad University, 40090 Marrakech, Morocco

**Abstract.** Meat is an important source of nutrients for human well-being and health; however, recently a decline in preference for meat as a source of nutrients has been suggested due to some associated health problems. Snail meat could be one of the alternatives due to its high protein, mineral and vitamin content. The aim of this work was to study the drying kinetics of snail meat and the influence of drying temperature on different parameters (moisture, protein, carbohydrates, lipids, fiber and ash), mineral content (Ca, Na, K, Mg, P and Fe) and functional properties of snail meat. The snail meat drying process was carried out in a solar convection dryer at three drying air temperatures (40, 50 and 60°C) and two drying air flow rates (300 m<sup>3</sup>/h and 150 m<sup>3</sup>/h) in January 2024, with an ambient air temperature range of 17 to 28°C and 2 to 39% relative humidity. The variation of moisture content and drying rate as a function of drying time at different drying temperatures is presented graphically. Several empirical and semi-empirical models were used to model and describe the drying kinetics. In addition, the effective moisture diffusivity, activation energy and electrical energy consumption were determined for each drying condition, providing essential information on the energy efficiency and optimisation of the snail meat drying process.

**Keywords:** Bioactive compounds; Snail meat; Solar drying; Drying kinetics.



**Title:** Solar drying kinetics and physicochemical study of snail meat.



# A New Generation of Porous Polymer Materials from Polystyrene Waste: Synthesis and Adsorption of Nitrate Anions in Aqueous Media

Mohamed Anannaz<sup>1</sup>, Jalal Isaad<sup>\*1</sup>

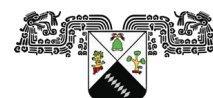
<sup>1</sup>ERC12A, FSTH, Abdelmalek Essaadi University, Tetouan 93000, Morocco

**Abstract.** Industrial production developed by human activities releases various chemical pollutants into the environment. The majority of the chemical pollutants are characterized by high toxicity, even at low concentrations. The presence of these pollutants in natural waters and in the environment, in general, can cause serious effects on human health, animals, and ecological systems. In fact, the wastewater generated by wastewater treatment stations, daily human activities and agricultural areas contains nitrate contaminants in particular, which have the potential to accumulate in living organisms and cause a variety of health problems. The removal of these chemical pollutants are of major importance, hence the interest in developing knowledge and understanding of the mechanisms of elimination of these pollutants. Among the different wastewater treatment techniques, adsorption is considered one of the most effective and efficient methods due to its low cost, universal nature, and ease of use. In recent years, many researchers have been interested in finding new organic, inorganic, and hybrid adsorbents based on less expensive materials. In this regard, polystyrene waste, recognized for its advantageous physicochemical properties, is not considered hazardous or toxic. However, the chemical modification of polystyrene waste to develop adsorbents offers a potentially promising approach [1]. In this presentation, we will examine the ability of polystyrene-based adsorbents to adsorb nitrate anions from water and the parameters influencing adsorption efficiency.

**Keywords:** Adsorption; Nitrate; Polystyrene waste; Wastewater

## References:

- [1] M Anannaz, F Tafraout, C Laghlimi, R Ouabou, J Isaad, *Organics* **2024**, 5(4), 561-574





## Purification of used marine oils using moroccan natural clay: process of acid treatment

Jamila Bouchgl<sup>1, 2\*</sup>, Mustapha Lamine<sup>3</sup>, Khadija Ouaisa<sup>1, 4</sup>, Abderahim bouftou<sup>5</sup>,  
S. Majid<sup>5</sup>, Abdelilah Hachim<sup>6</sup>

<sup>1</sup> Higher institute of maritime Fisheries, Agadir, Morocco

<sup>2</sup> Laboratory of energy Engineering, Materials and Systems, ENSA, University Ibn Zohr, Agadir,  
Morocco

<sup>3</sup> Laboratory of Mechanics, Department of Physics, Faculty of Sciences Ain-Chock, University  
Hassan II, Casablanca, BP 5366, Morocco

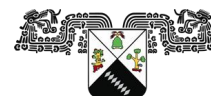
<sup>4</sup> Environmental, Ecological and Agro-Industrial Engineering Laboratory. Department of  
Biology, Faculty of sciences and Techniques. University Sultan Moulay Slimane. Beni-Mellal,  
Morocco.

<sup>5</sup> Laboratory of Materials Engineering for the Environment and Valorization (GeMEV), Faculty  
of Sciences Ain Chock, Hassan II University of Casablanca, 5366, Casablanca, Morocco.

<sup>6</sup> Higher institute of maritime studies, Casablanca, Morocco

**Abstract.** Marine engine lubricants, especially engine oil, are the lifeblood of a ship's machinery, reducing friction, preventing corrosion, extending the lifespan of equipment and ensuring the smooth operation of engines. The lubricating oils are composed of base oils of petroleum or synthetic origins and additives. These give the lubricating oils good properties. However, these characteristics can be lost after use, this used oil is unloaded in the emptying stations which cause environmental pollution. In this investigation, we study the purification of the used marine oils by a natural Moroccan Clay. This recuperation is a necessity to protect the environment and can drive to substancial gains. This work concerns the physico- chemical study of new oil and worn oil samples and the test of regeneration worn oil samples by treatment through sulfuric acid. Tests are made on the treated oil such as: the viscosity, the flash point, the flow point.

**Keywords:** Environment; lubricating marine oil; used oils; Regeneration; Power engineering





# Harnessing the power of streptomyces in sustainable agriculture: integrating advanced technologies for climate-resilient and crop management

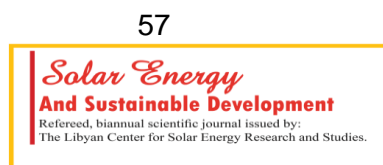
Hajar Mhammedi <sup>\*1,2</sup>, Youssef El Hilali Alaoui <sup>1,2</sup>, Said Bouda <sup>1</sup>, Adil Essarioui <sup>2</sup>

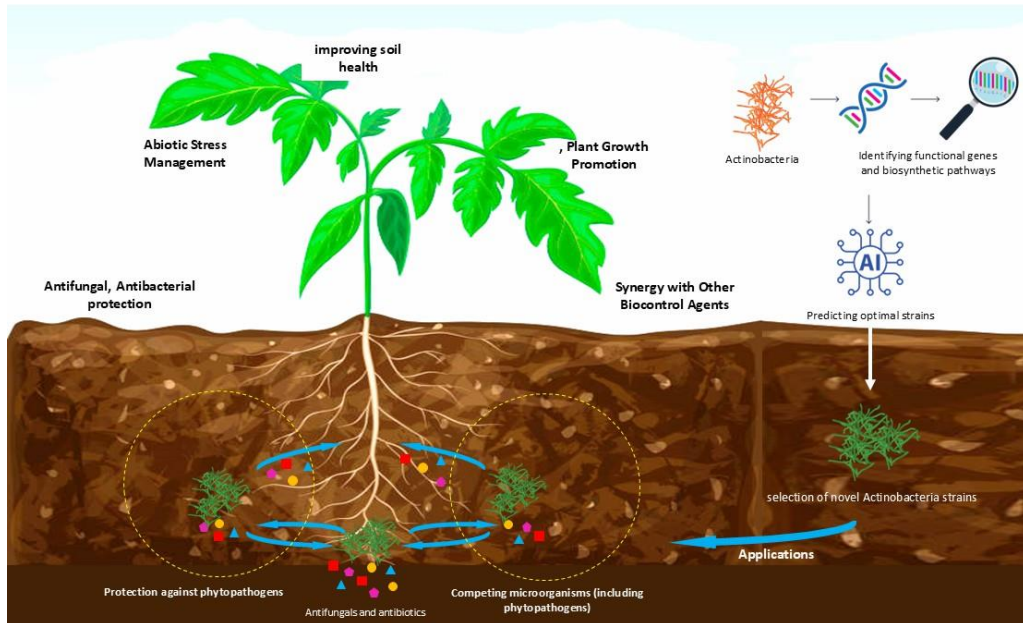
<sup>1</sup>Laboratory of Agro-Industrial and Medical Biotechnology, Faculty of Sciences and Technics, Sultan Moulay Slimane University, B.P. 523, Beni Mellal, Morocco

<sup>2</sup> Oasis System Research Unit, Regional Center of Agricultural Research of Errachidia, National Institute of Agricultural Research, PO. Box 415, Rabat 10090, Morocco

**Abstract.** Actinobacteria, a diverse group of Gram-positive bacteria, are ecologically significant due to their ability to produce bioactive secondary metabolites that support soil health and promote sustainable agricultural practices. These microorganisms play a key role in nutrient cycling, pathogen suppression, and enhancing agricultural sustainability. Within this group, the genus *Streptomyces* stands out for its exceptional metabolic potential, producing antifungal, antibacterial, and plant growth-promoting compounds. These characteristics make *Streptomyces* a valuable tool for combating soilborne pathogens and enhancing crop resilience. Additionally, *Streptomyces* demonstrates remarkable adaptability to extreme environments, such as arid and semi-arid regions, making it particularly useful in addressing challenges like drought stress and soil degradation, exacerbated by climate change. To fully harness the potential of *Streptomyces*, integrating advanced technologies such as genomics, bioinformatics, and artificial intelligence (AI) is essential. Genomics allows for the identification of functional genes and biosynthetic pathways, bioinformatics provides insights into the genetic structure of *Streptomyces*, and AI aids in optimizing strain selection and predicting environmental interactions. This review examines the ecological and agricultural importance of Actinobacteria, particularly *Streptomyces*, and highlights the role of these advanced technologies in enhancing their application in sustainable agriculture.

**Keywords:** Actinobacteria; Biocontrol; Streptomyces; Abiotic stress





**Title:** Leveraging genomics, bioinformatics, and AI for enhanced biocontrol and climate resilience using Actinobacteria.



# Enhanced Methylene Blue Adsorption in Wastewater Treatment through Chemical and Mechanical Modification of Sugarcane Bagasse-Derived Biochar

OUAHOUAH Zineb <sup>\*1</sup>, MIFTAH Amine<sup>\*1</sup>, BASAOUD Soumaya<sup>\*1</sup>, Mounir El Achaby<sup>\*2</sup>, KASSAB Zineb<sup>\*2</sup>, EL HARFI Khalifa<sup>\*1</sup>, ABOULKAS Adil<sup>\*1</sup>.

<sup>1</sup>*Equipe des Procédés Chimique et Matériaux Appliqués (EPCMA, Faculté Polydisciplinaire de Béni- Mellal, Université Sultan Moulay Slimane, BP 592, 23000 Béni-Mellal, Morocco*

<sup>2</sup>*Materials Science, Energy, and Nano-Engineering (MSN) Department, Mohamed VI Polytechnic University (UM6P), Lot 660 – Hay Moulay Rachid, Benguerir, 43150, Morocco*

**Abstract.** With the growing need for effective and sustainable solutions to remove organic pollutants, such as dyes, from wastewater, biochar is emerging as a promising material thanks to its remarkable adsorption properties [1]. In this study, a biochar derived from sugarcane bagasse was modified using an environmentally friendly approach. A less toxic oxidant, hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>), was used at low concentration to introduce functional groups onto the biochar surface, thereby improving its chemical properties. Subsequently, a mechanical method was applied to increase the specific surface area and optimize the textural characteristics of the material. Various characterization techniques were used to highlight the structural and chemical transformations resulting from these modifications. The adsorption performance of the modified biochar was evaluated for the removal of methylene blue (MB) from aqueous solutions. A maximum adsorption capacity of 390 mg/g was achieved, with an efficiency of 99.93% at an initial MB concentration of 100 ppm. These results are attributed to the introduction of new reactive sites and an increase in the surface area. Key parameters such as pH, adsorbent dose, contact time, and dye concentration were optimized. Isothermal and kinetic models confirmed improved adsorption mechanisms, underlining the treated biochar's superiority. This strategy offers a sustainable pathway to developing high- performance adsorbents for wastewater treatment.

**Keywords:** Biochar; Adsorption; Methylene blue; Wastewater treatment.



# The synthesis and electrochemical applications of Schiff bases containing an imidazopyridine core.

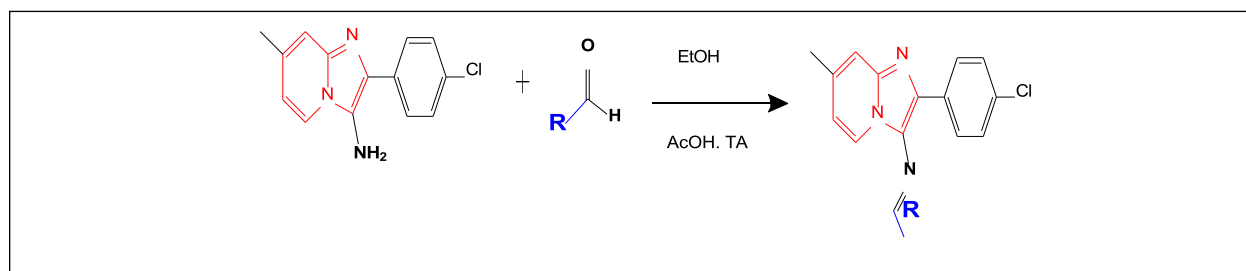
Abdeljalil Hamdi<sup>\*1</sup>, M'hamed Ahari<sup>1\*</sup>, Abdelmalik El aatiaoui<sup>\*3</sup>

<sup>1</sup>Applied Chemistry Research Unit, FSTH, Abdelmalek Essaâdi University, AL Hoceima, Tetouan, Morocco

<sup>2</sup>Laboratory of Molecular Chemistry, Materials and Environment (LCM2E), Departement of Chemistry, Multidisciplinary Faculty of Nador, University Mohamed I, 60700 Nador, Morocco

**Abstract.** In this study, we designed novel heterocyclic ligands, specifically Schiff base imines featuring an imidazopyridine motif. The synthesis began with the creation of the imidazopyridine core, achieved by condensing 2-aminopyridine with various  $\alpha$ -haloacetones using the Paudler method. This was followed by C-3 amination via a nitroso intermediate, which was then reduced to yield the desired amines. These amines were subsequently reacted with a range of substituted aldehydes in the presence of acetic acid as a catalyst at room temperature, resulting in the formation of pure Schiff bases with excellent yields. The process is notable for its simplicity, cost-effectiveness, safety, and efficiency. The structures of the synthesized products were confirmed through modern spectroscopic techniques, including <sup>1</sup>H and <sup>13</sup>C NMR, IR, and LC-MS. Additionally, the resulting compounds displayed promising electrochemical properties. A strong correlation was observed between the experimental spectroscopic data and the parameters computed using density functional theory (DFT).

**Keywords:** Synthesis; Density functional theory; electrochemical



**Title:** Synthesis of the new Schiff bases

# Evolution and Sensitivity of Groundwater in the Ghiss-Nekor Plain

Yahya Mfedal<sup>\*1, 3</sup>, Mourabit Fouad<sup>\*1</sup>, Amina Labhar<sup>\*1</sup>, Nihade Bensitel<sup>\*2</sup>, Azzouz Abdelmonaim<sup>\*3</sup>

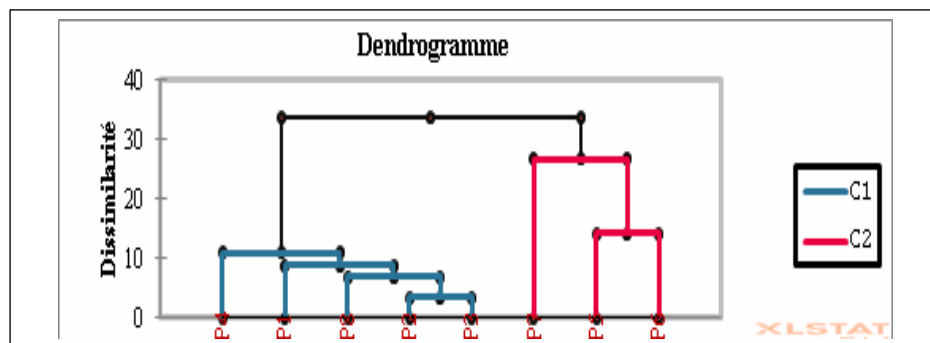
<sup>1</sup>Applied Chemistry Team, FSTH, Abdelmalek Essaâdi University, Al Hoceima, Morocco. B.P 34 Ajdir Al Hoceima 32 003, Ctre Ait Youssef Ou Ali. Morocco

<sup>2</sup>Laboratory of National Office of Water and Electricity – Water Branch, Al Hociema, Morocco

<sup>3</sup>Departement of chemistry, faculty of science, Abdelmalik Essaâdi university, B.P.2121. M'Hannech II, 93002 Tetouan, Morocco

**Abstract:** The study aims to analyze the evolution and sensitivity of groundwater in the Ghiss-Nekor plain in Morocco, focusing on geological, hydrochemical, and water quality aspects. The aquifer is located in a region characterized by limestone, marl, and alluvial rocks, which significantly influence groundwater recharge and circulation. To achieve its objectives, the study conducts a detailed chemical analysis of groundwater, examining the main cations (Ca<sup>2</sup>, Mg<sup>2</sup>, Na, K) and anions (HCO<sub>3</sub><sup>-</sup>, SO<sub>4</sub><sup>2-</sup>, Cl<sup>-</sup>, NO<sub>3</sub><sup>-</sup>). These analyses help identify the origin of the water and apply various statistical tests, such as Piper diagrams and principal component analysis (PCA). The results reveal high concentrations of certain ions, notably SO<sub>4</sub><sup>2-</sup> and Cl<sup>-</sup>, as well as pollutants like NO<sub>3</sub><sup>-</sup>, suggesting contamination from seawater intrusion and intensive agricultural activities. The identified pollution sources include excessive use of fertilizers and pesticides, industrial and domestic emissions, and the infiltration of untreated wastewater. To protect the aquifer, several solutions are proposed, such as adopting sustainable agricultural practices and implementing regular water quality monitoring.

**Keywords:** Geology; Hydrochemistry; Groundwater quality; Pollution



**Titel:** HCA dendrogram of groundwater at survey points

# Green Hydrogen: Morocco's Gateway to Global Energy Leadership

Abdellah El-Maaroufi <sup>\*1</sup>, Mohammed Daoudi <sup>2</sup>, Rachid Ahl Laamara <sup>1</sup>

<sup>1</sup>High Energy Physics Laboratory - Modeling and Simulation, Department of Physics, Faculty of Sciences, University Mohammed V in Rabat, Morocco

<sup>2</sup>Solar Energy and Environment Group, Faculty of Sciences University Mohammed V in Rabat, Morocco.

**Abstract.** The global push to reduce greenhouse gas emissions and achieve carbon neutrality by 2050 is transforming the energy landscape. Measures like Europe’s carbon tax are pressuring fossil fuel-dependent industries, accelerating the shift toward cleaner alternatives. Green hydrogen has emerged as a key solution, addressing renewable energy limitations in sectors such as transportation and heavy industry. Its production via clean energy eliminates emissions and avoids carbon taxation, offering economic and environmental benefits. Morocco, with its abundant solar and wind resources, is uniquely positioned to capitalize on this shift. Falling renewable electricity costs—89% for solar and 69% for wind since 2010—further enhance its competitive edge. By leveraging these advantages, Morocco can become a global leader in green hydrogen production and a catalyst for sustainable energy innovation.

**Keywords:** Green hydrogen; Morocco; Renewable energy; Sustainability



**Title:** Green hydrogen and renewable energy sustainability



# Recent research landscape on chitosan-mineral-based composites for wastewater treatment: A 2013–2023 bibliometric analysis

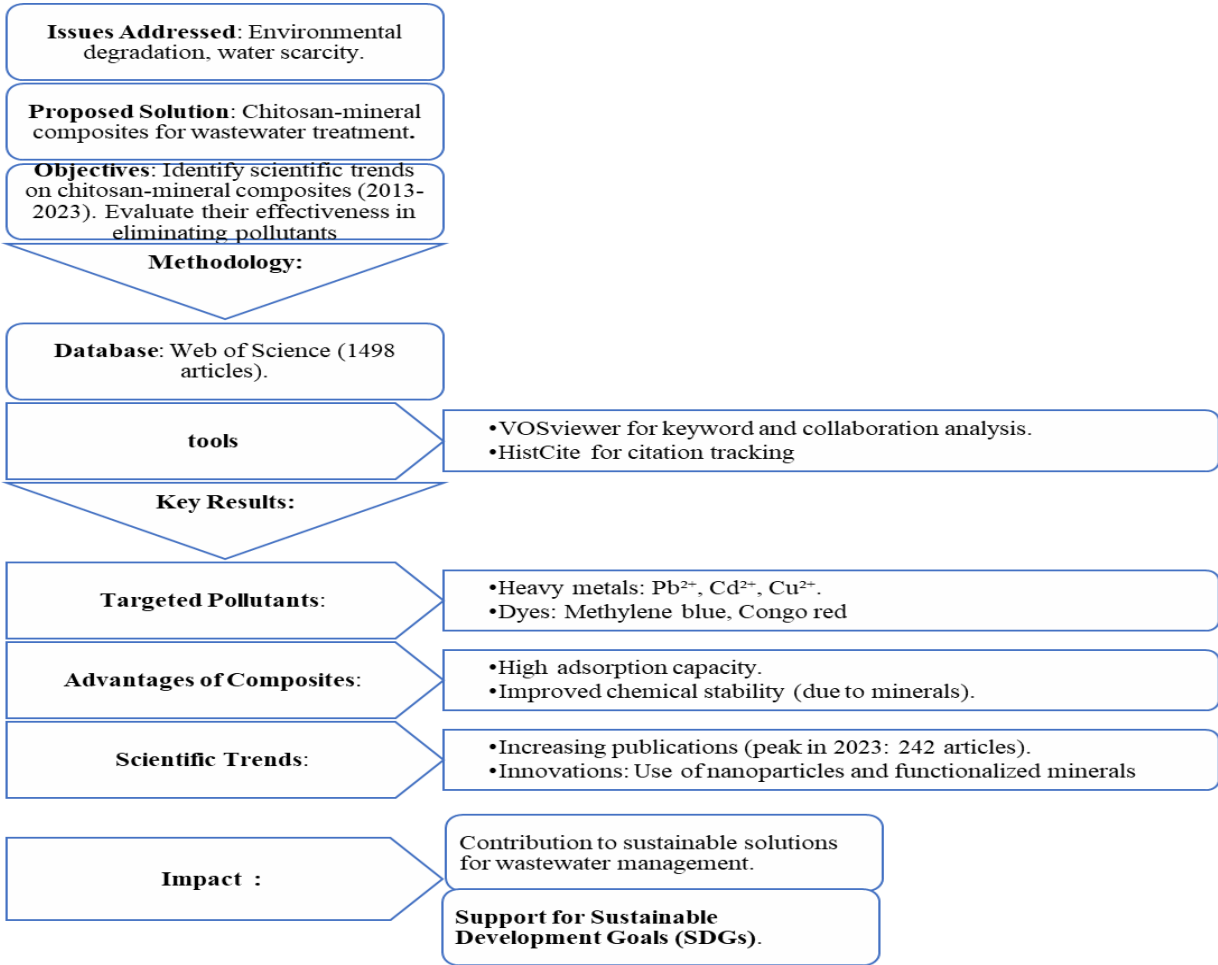
Tafraout Fatiha<sup>a\*</sup>, Isaad Jalal<sup>a</sup>

<sup>a</sup> ERCI2A, FSTH, Abdelmalek Essaadi University, Tetouan 93000, Morocco

**Abstract.** In response to escalating environmental deterioration and the critical issue of water scarcity, the quest for innovative and ecologically sustainable methods to treat wastewater is more urgent than ever. Chitosan is known for its natural biodegradability and superior capacity to adsorb a wide array of contaminants and has been effectively augmented with various minerals to increase its water treatment performance. This paper presents a thorough bibliometric investigation of chitosan–mineral composite materials and explores their contributions to wastewater treatment from 2013-2024. A total of 1498 documents from the Web of Science database were analyzed via advanced visualization tools such as HistCite and VOSviewer, revealing 5997 authors, 438 journals, and 62101 cited references. The analysis indicates a peak of 242 publications in 2023 and a high of 5365 citations in 2019 from 152 documents. The keyword network and innovations for wastewater treatment highlight China and India as leading countries with numerous collaborations.

**Keywords:** Chitosan; Minerals; Composites; Water treatment; HistCite; VOSviewer.





**Title:** Schematic Summary of the study



## Etude electrochimique de l'effet du peroxyde d'hydrogène (H<sub>2</sub>O<sub>2</sub>) sur les réactions rédox à l'aide d'electrodes CPE

Maria ENASRAOUY \*<sup>1</sup>, Mustapha OUKBAB \*<sup>2</sup>, Younes TAHIRI \*<sup>3</sup>, Hassan HADDOUCHY\*<sup>4</sup> Abdelkrim AIT MANSOUR\*<sup>5</sup>, Abdelilah CHTAINI

<sup>1</sup>Molecular Electrochemistry and Inorganic Materials Team, Sultan Moulay Slimane University, Beni Mellal Faculty of Science and Technology, Mghila, Beni Mellal 23000, Morocco

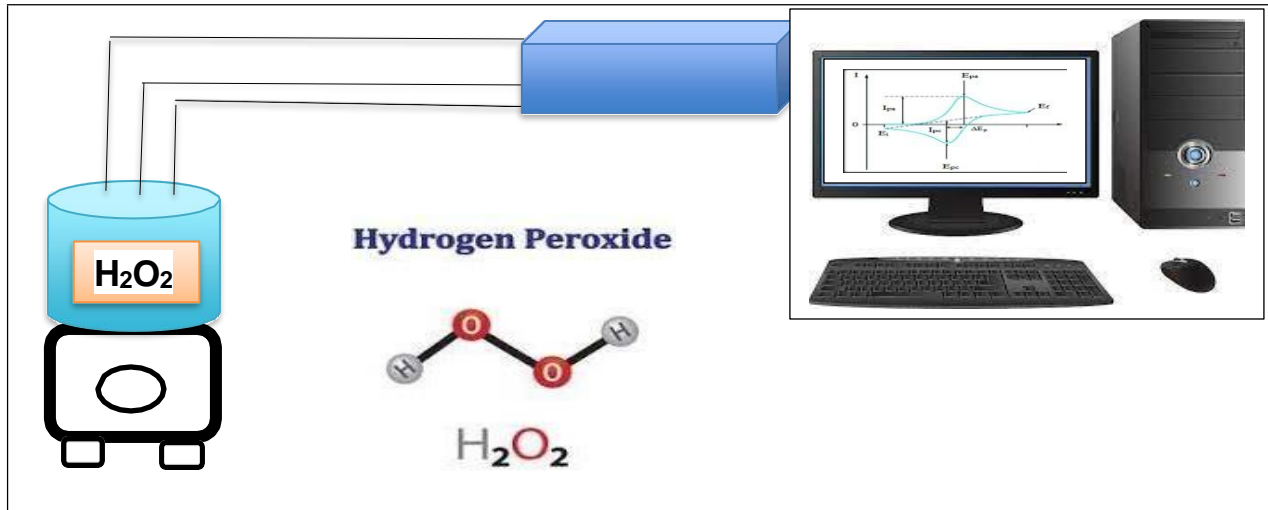
<sup>2</sup> Molecular Electrochemistry and Inorganic Materials Team, Sultan Moulay Slimane University, Beni Mellal Faculty of Science and Technology, Mghila, Beni Mellal 23000, Morocco

<sup>3</sup> Molecular Electrochemistry and Inorganic Materials Team, Sultan Moulay Slimane University, Beni Mellal Faculty of Science and Technology, Mghila, Beni Mellal 23000, Morocco

**Abstract.** Hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>) is commonly used as an oxidizing agent in electrolytic solutions due to its chemical reactivity and environmentally friendly properties. In an electrolytic solution containing a graphite carbon paste electrode, the oxidizing effect of H<sub>2</sub>O<sub>2</sub> plays a key role in electrochemical processes. It promotes redox reactions at the electrode-solution interface, enabling the oxidation of various organic and inorganic compounds. The study focuses on characterizing the interaction between H<sub>2</sub>O<sub>2</sub> and the graphite carbon electrode by analyzing the reaction kinetics, oxidation efficiency, and structural modifications of the electrode. Techniques such as cyclic voltammetry, electrochemical impedance spectroscopy, and surface analysis were employed. The results show that the graphite carbon electrode, owing to its high conductivity and active surface area, enhances the catalytic decomposition of H<sub>2</sub>O<sub>2</sub>, thereby amplifying its oxidizing effect. This approach holds promise for applications such as water treatment, pollutant degradation, and electrochemical synthesis reactions.

**Keywords:** Environmentally Friendly Oxidizing Agent; Electrochemical Synthesis; Cyclic Voltammetry; Electrochemical Impedance Spectroscopy; Square Wave Voltammetry





**Title:** Electrochemical Setup for Voltammetry: Study of H<sub>2</sub>O<sub>2</sub> with Electrodes Connected to a Voltmeter

# Copper Ferrite/Hydroxyapatite-based Magnetic composites: Synthesis, properties and Applications

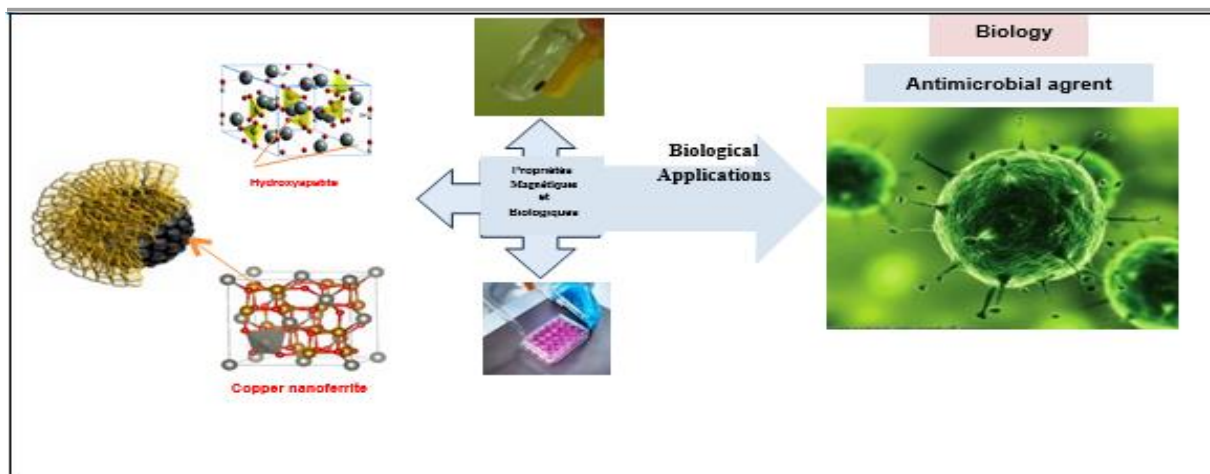
Merieme Magroud<sup>1,\*</sup>, Zineb Tchorbo<sup>1</sup>, Idrissi Yahyaoui Meryem<sup>2</sup>, Kacem Marieme<sup>1</sup>  
Mustapha Dib<sup>1</sup>, Jamil Mohamed<sup>1</sup>, Essaddek Abderrahim<sup>1</sup>, AsehrouAbdeslam<sup>2</sup>

<sup>1</sup>Laboratory of Applied Chemistry and Environment, Mineral Solid Chemistry Team, Faculty of Sciences, Mohammed First University, B.P. 717, 60 000, Oujda, Morocco;

<sup>2</sup> Laboratory of Bioresources, Biotechnology, Ethnopharmacology and Health, Department of Biology, Faculty of Sciences, Mohammed First University, Oujda, Morocco

**Abstract.** Magnetic nanocomposites have potential applications in a variety of fields due to their extraordinary properties. This study focused on the synthesis of magnetic nanocomposites based on copper ferrite and hydroxyapatite (CuF@HAp). Copper ferrite nanoparticles was synthesized using the co-precipitation method, while hydroxyapatite was obtained through double decomposition pathway. More than, the CuF@HAp composites were prepared by combining the two materials via chemical precipitation processes and hydrothermal treatment. The as-synthesized nanocomposites were investigated by various analytical techniques, including Fourier-transform infrared spectroscopy (FTIR), X-ray diffraction (XRD), scanning electron microscopy (SEM), and energy-dispersive X-ray analysis (EDX). In addition, the present study investigated the antimicrobial effect of the deferent composites against gram-positive and gram-negative bacteria. As result, antimicrobial tests revealed significant antibacterial and antifungal activity against several pathogenic strains, highlighting their potential for biomedical applications.

**Keywords:** Magnetic nanocomposites, Copper ferrite, Hydroxyapatite, physicochemical investigation, antimicrobial activities.



**Title:** Copper Ferrite/Hydroxyapatite Composite for Biological Applications.



# Evaluation of Nador Bentonite's Efficiency in Organic Dye Removal: A Modeling and DFT Investigation

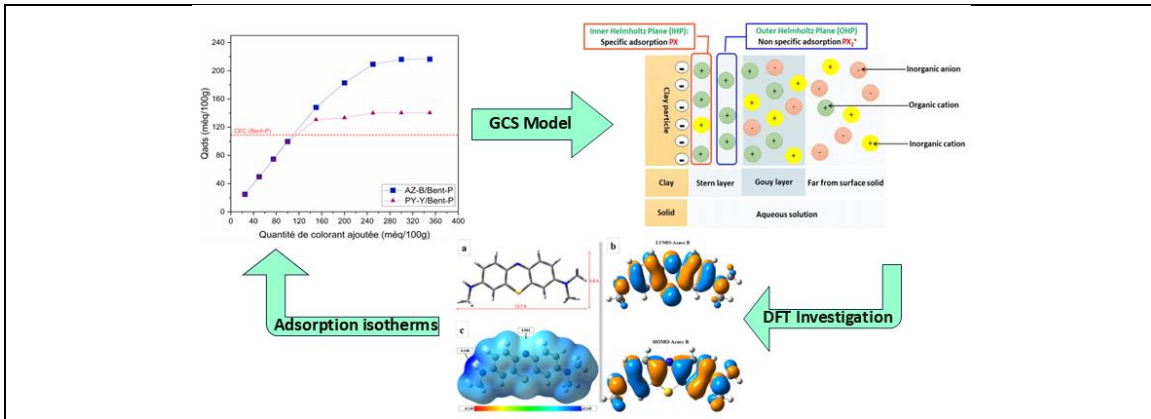
El Houssien Akichouh<sup>1\*</sup>, Anas Butasdit, Mohamed El Miz<sup>2</sup>

<sup>1</sup>Applied Chemistry Team, Faculty of Sciences and Techniques of Al Hoceima, Chemistry  
Department, Abdelmalek Essaadi University, Tetouan, Morocco.

<sup>2</sup>Laboratory of Molecular Chemistry, Materials and Environment (LMCME), Department of  
Chemistry, Faculty Multidisciplinary Nador, Mohamed 1st University, P. B. 300, Nador,  
62700, Morocco.

**Abstract.** This study evaluates the efficiency of Nador bentonite, a natural clay mineral sourced from the Nador region in Morocco, for the adsorption and removal of organic dyes from aqueous solutions. Various experimental parameters—including initial dye concentration, contact time, pH, temperature, ionic strength, and the type of added inorganic salt—were systematically assessed to determine their effects on the adsorption process. Characterization techniques, such as X-ray diffraction, Fourier transform infrared spectroscopy, and thermogravimetric analysis, were employed to investigate the structural and chemical properties of Nador bentonite and its complexes with organic dyes. Adsorption data were analyzed using the Gouy-Chapman-Stern (GCS) model, while kinetic studies were conducted using pseudo-first-order and pseudo-second-order models. The results showed that Nador bentonite exhibits a significant adsorption capacity for various organic dyes, with optimal conditions identified for maximum dye removal. Furthermore, Density Functional Theory simulations demonstrated an enhanced affinity of organic dyes for negatively charged systems compared to other adsorbates. This clay's high efficacy in removing organic dyes from wastewater highlights its potential as a valuable, low-cost adsorbent for environmental cleanup

**Keywords:** Nador Bentonite; Adsorption; Organic Dyes; Wastewater Treatment



**Title:** Adsorption investigation with GCS Models and DFT



## Reactivity of Flavones reaction by DFT method

Loubna Halil<sup>\*1</sup>, Mouna Amor<sup>\*1</sup>, Mouad Boutkbout Nait Moudou<sup>\*1</sup>, Mohamed Reda Chriyaa<sup>\*1</sup>, Walid Iken<sup>\*1</sup>, Soukaina Naciri<sup>\*1</sup>, Hayat EL Ouafy<sup>\*1</sup>, Tarik EL Ouafy<sup>\*2</sup>

<sup>1</sup> Laboratory of Engineering in Chemistry and Physics of Matter, Faculty of Sciences and Technics, Sultan Moulay Slimane University, Beni Mellal, Morocco

<sup>2</sup> Laboratory of Engineering in Chemistry and Physics of Matter, Faculty of Medicine and Pharmacy, Sultan Moulay Slimane University, Beni Mellal, Morocco

**Abstract.** Flavones are flavonoids composed primarily of luteolin and apigenin glycosides. Few sources of flavones have been found, with the majority being parsley, celery, and pepper. Flavone glycosides can be found in grains such as millet or wheat. Flavones comprise one of the largest groups, which are characterized by the presence of a double bond between C-2 and C-3, and the attachment of the B ring to C-2. Flavones serve a variety of activities that help plants adapt to their terrestrial environment, such as UV radiation and oxidative stress protection, interspecies interactions, and plant development. The current work was carried out utilizing the DFT approach at the B3LYP/6-311G(d,p) level to determine global descriptors of the reactive chemistry, which allows us to know the probable sites for electrophilic and nucleophilic assault on the reagents of the Flavones reaction.

**Keywords:** Chemical descriptor; DFT; ESP; Flavones.



## Determination of zones of reactivity to flavonol derivatives by DFT

Loubna Halil<sup>\*1</sup>, Soukaina Naciri<sup>\*1</sup>, Mouna Aamor<sup>\*1</sup>, Mohamed Reda Chriyaa<sup>\*1</sup>, Walid Iken<sup>\*1</sup>, Mouad Boutkbout Nait Moudou<sup>\*1</sup>, Hayat EL Ouafy<sup>\*1</sup>, Tarik EL Ouafy<sup>\*2</sup>

<sup>1</sup> Laboratory of Engineering in Chemistry and Physics of Matter, Faculty of Sciences and Technics, Sultan Moulay Slimane University, Beni Mellal, Morocco

<sup>2</sup> Laboratory of Engineering in Chemistry and Physics of Matter, Faculty of Medicine and Pharmacy, Sultan Moulay Slimane University, Beni Mellal, Morocco

**Abstract.** The most common flavonoids found in food are flavonols, which include quercetin, kaempferol, and Myricetin. They are found primarily in onions and tea, but also in kale, leeks, broccoli, and drinks. Their effectiveness is most likely due to their ability to act as antioxidants, anti-inflammatory agents, and anti-cancer factors. This work was carried out using the Density Functional Theory (DFT) method at the B3LYP/6-311G (d, p) level. The main objective of this investigation was to study the molecular structure and global indices of Flavonol derivatives by analyzing HOMO–LUMO structural distributions, chemical potential, chemical hardness, as well as electronegativity, overall electrophilicity and the nucleophile.

**Keywords:** DFT; Flavonol; Global Descriptors.



## Elaboration of an electrocatalyst based on para-phenylenediamine and Ni-Cu particles for hydrogen evolution reaction

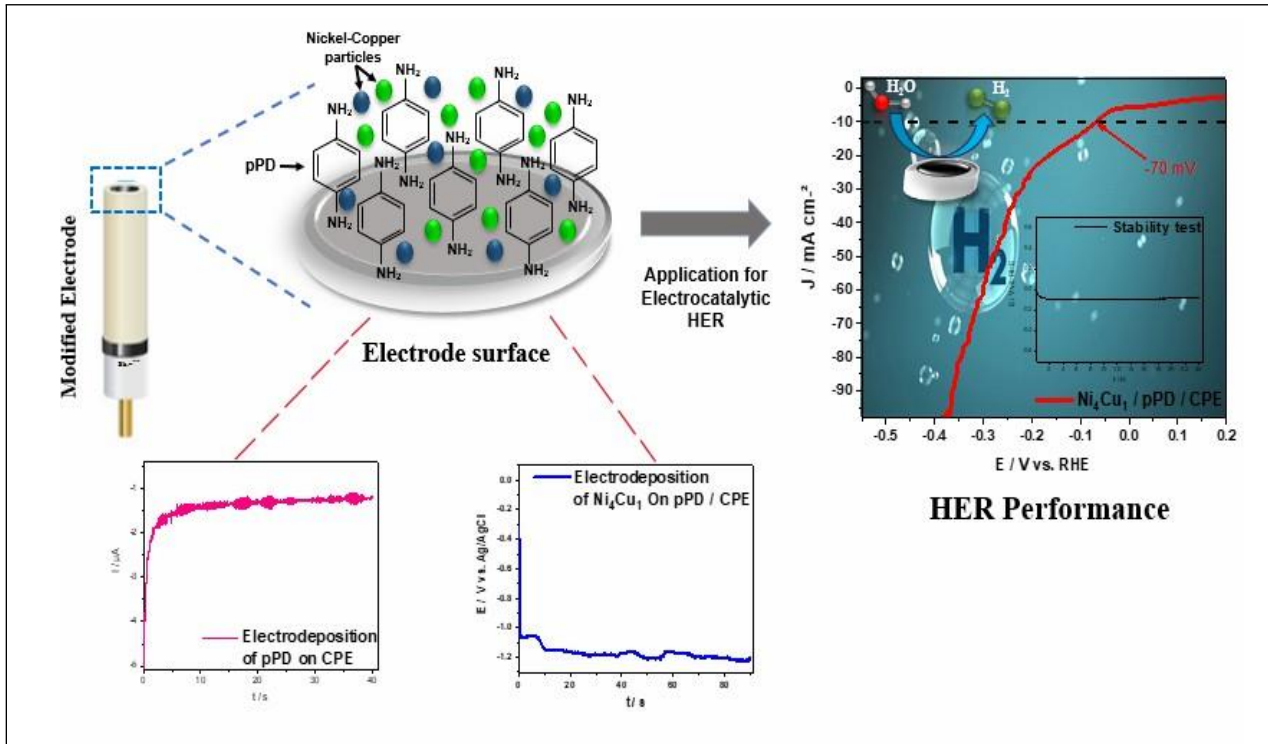
SKAKRI Soufiane<sup>\*1</sup>, EL ATTAR Anas<sup>\*1</sup>, BENHAIBA Saad<sup>\*1</sup>, MOUKKAR Anas<sup>\*1</sup>, EL RHAZI Mama<sup>\*1</sup>

<sup>1</sup> *Laboratory of Materials Membranes and environment, Faculty of Sciences and technologies, University Hassan II Casablanca, Mohammedia, 20830, Morocco*

**Abstract.** With the tremendous increase in the population of the planet, and with the advancements in different technologies, the global demand on energy consumption has brought to the serious issue of human energy requirements. Using a renewable energy source to produce hydrogen by electrocatalytic water splitting has emerged as a viable solution to the issues associated with fossil fuels. Herein, we report an electrochemical synthesis of bimetallic nanomaterials reinforced by a layer of para-phenylenediamine Ni<sub>4</sub>Cu<sub>1</sub>/pPPD/CPE electrocatalyst in order to enhance the electrocatalytic performances of the hydrogen evolution reaction. The surface and the structure of the prepared electrocatalyst was characterized by Field Emission Scanning Electron Microscopy (FE-SEM) and XRD. The electrocatalytic behavior of our prepared electrocatalyst was examined by Electrochemical impedance spectroscopy (EIS), Cyclic Voltammetry (CV), Linear Sweep Voltammetry (LSV), and chronoamperometry (CA) in 1M KOH solution. The electrocatalyst exhibited high activity toward HER in the alkaline medium. Furthermore, the electrocatalyst exhibited an excellent HER activity with a low overpotential at the current density of 10 mA cm<sup>-2</sup>. More interestingly, the results show a remarkable stability and durability of the electrocatalyst. These results suggest that this electrocatalyst could be a prominent catalytic material for effective green hydrogen production.

**Keywords:** Electrochemical deposition; Hydrogen Evolution Reaction; Nickel-Copper particles; Para-Phenylenediamine





**Title:** Schematic illustration of the steps of fabrication of modified electrode  $\text{Ni}_4\text{Cu}_1/\text{pPD}/\text{CPE}$  and his application for electrocatalytic hydrogen evolution reaction in alkaline media.



## Electochemical elaboration of Ni-Co for the hydrogen evolution reaction.

MOUAKKAR Anas<sup>a</sup> \*, EL ATTAR Anas<sup>a</sup> , SKAKRI Soufiane<sup>a</sup> , El RHAZI Mama<sup>a</sup> , AADDANE Abdellah<sup>a</sup>

<sup>a</sup> *Laboratory of Materials, Membrane and Environment, Mohammedia*

**Abstract.** In recent years, with the rapid increase of the demand for energy, fossil fuels remained the primary source of global energy production. However, these resources contribute to a lot of environmental and health issues which becomes very urgent to replace it with clean energies and hydrogen is considered the best solution due to its zero emissions and high efficiency. In this work, we represent a simple technique to deposit nickel and copper on the surface of the electrode. Several parameters have been studied such as potential, current and time of deposition. The structure and electrochemical properties of the deposited material is studied using cyclic voltammetry (CV), electrochemical impedance spectroscopy (EIS) and linear sweep voltammetry (LSV) for the analytical performance for hydrogen evolution reaction HER.

**Keywords:** Nickel-cobalt alloy, Hydrogen evolution reaction, water splitting

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# Allantoin: A Multifunctional Catalyst for Sustainable Biodegradable Material Synthesis and the Efficient Synthesis of 2,3-Dihydroquinazolin-4(1H)-one Derivatives

Houda Serrar<sup>1,2\*</sup>, Said Boukhris<sup>2</sup>, Amina Hassikou, Mohammed lachkar<sup>1</sup>

<sup>1</sup>Engineering Laboratory of Organometallic, Molecular, and Environmental Materials, Faculty of Sciences DharMahraz, Sidi Mohamed BenAbdellah University, Fez, Morocco; P.O. Box 1796 Atlas, Fez 30000, Morocco

<sup>2</sup>Laboratory of Organic Chemistry, Catalysis and Environment- Faculty of Science, Ibn Tofail University, Kenitra, Morocco;

**Abstract.** Allantoin, a well-known active ingredient in skincare products, is highly valued for its ability to support the healing of scar tissue, making it a popular choice in both the cosmetic and pharmaceutical industries. Present in over 1300 cosmetic formulations, its therapeutic properties have been extensively studied and validated<sup>1</sup>. Similarly, 2,3-Dihydroquinazolin-4(1H)-one derivatives, which contain nitrogen heterocycles, are crucial components of various natural plant alkaloids and pharmacological compounds, such as evodiamine, febrifugine, and raltitrexed. These derivatives demonstrate a broad spectrum of biological and pharmaceutical activities, including anticonvulsant, antiparkinsonian, antihypertensive, antibacterial, anticancer, diuretic, and monoamine oxidase inhibition effects, in addition to their roles in regulating plant growth<sup>2</sup>. In this study, we introduce allantoin as a novel catalyst for heterogeneous reactions (scheme 1).



**Scheme 1.** Synthesis of 2,3-Dihydroquinazolin-4(1H)-one via Cyclocondensation

The performance of this catalyst was evaluated under various conditions, including different solvents and catalyst amounts. Our results demonstrate significant efficacy and versatility,



## 1<sup>st</sup> International Conference on Sciences and Techniques for Renewable Energy and the Environment (STR2E 2025)



highlighting the catalyst's potential in promoting environmentally friendly and sustainable chemical processes. This advancement not only underscores the utility of allantoin catalysts in biodegradable material applications but also opens new avenues for research in green chemistry and sustainable development.

**Keywords:** Allantoin, Biodegradable Materials, Green Chemistry, Sustainable Synthesis

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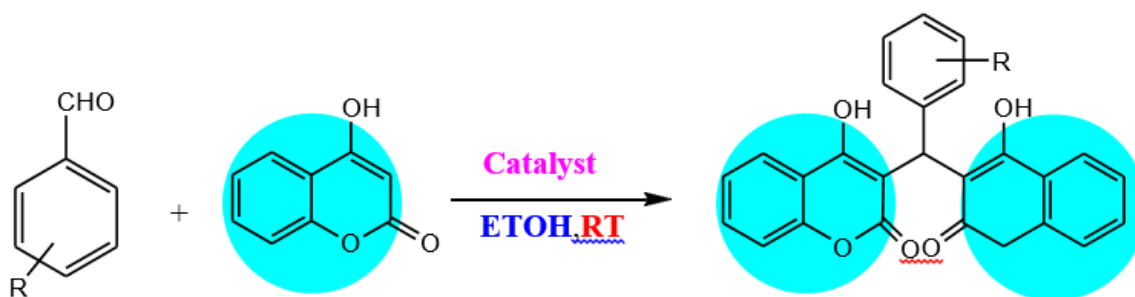
# Allantoin: An Effective Catalyst for the Green Synthesis of Biscoumarin under Ambient Reaction Conditions

Houda Serrar<sup>1,2\*</sup>, Said Boukhris<sup>2</sup>, Amina Hassikou, Mohammed Iachkar<sup>1</sup>

<sup>1</sup>Engineering Laboratory of Organometallic, Molecular, and Environmental Materials, Faculty of Sciences DharMahraz, Sidi Mohamed BenAbdellah University, Fez, Morocco; P.O. Box 1796 Atlas, Fez 30000, Morocco;

<sup>2</sup>Laboratory of Organic Chemistry, Catalysis and Environment- Faculty of Science, Ibn Tofail University, Kenitra, Morocco;

**Abstract.** Coumarin derivatives, especially biscoumarins, are valuable in pharmaceuticals for their therapeutic properties, including anticoagulant and anticancer activities<sup>1</sup>. They also have applications in organic luminescence, polymer synthesis, and semiconductors<sup>2</sup>. Various synthesis methods, such as Knoevenagel and Pechmann reactions, are employed<sup>3</sup>. In this study, we present an efficient method for synthesizing biscoumarins through a domino Knoevenagel–Michael condensation reaction. This process involves 4- hydroxycoumarin and aromatic aldehydes in a 2:1 molar ratio, utilizing allantoin as a solid acid catalyst in ethanol (EtOH). The new approach yields benzylidene bis(4- hydroxycoumarin) derivatives in high to excellent efficiency, highlighting the effectiveness of this protocol.



**Scheme 1:** Benzylidene bis(4-hydroxycoumarin) derivatives using allantoin as a catalyst.

**Keywords:** Allantoin, Biodegradable Materials, bis(4-hydroxycoumarin) derivatives, Green Chemistry, Sustainable Synthesis

## References:

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*1<sup>st</sup> International Conference on Sciences and Techniques for Renewable Energy and the Environment (STR2E 2025)*



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- Rani, S.; Sharma, D.; Choudhary, P.; Rani, N. Coumarin Derivatives as Multifunctional Agents: A Review. *J. Med. Chem.* **2022**, 65(9), 1342–1358. DOI: 10.1021/jm2001026.





## Managing water resources in fish feed using a waste minimization approach

Khadija OUAISSA<sup>1, 2</sup>, M'Hamed HMAMOU<sup>1</sup>, Jamila BOUGHGOUL<sup>1</sup>, Mustapha HASNAOUI<sup>2</sup>

<sup>1</sup> Aquaculture laboratory ; High institute of maritime Fisheries. Agadir. Morocco

<sup>2</sup> Environmental, Ecological and Agro-Industrial Engineering Laboratory. Department of  
Biology, Faculty of Sciences and Techniques. University Sultan Moulay Slimane. Beni-  
Mellal, Morocco.

**Abstract** The development of marine fish farms raises several questions concerning the impact of this type of production on the aquatic environment. It is recognized that a significant portion of this impact is nutritional in origin. Discharges of uneaten food faces and excretion products enrich the aquatic environment. The main of this study is to develop feed formulations for marine fish species based on raw materials available on the local market. The aim is to manufacture sustainable aquaculture feeds that meet the nutritional and environmental requirements of the species and to develop the aquaculture sector in Morocco. The negative environmental impacts of aquaculture are numerous, but the most worrying is the eutrophication of watercourses receiving effluents from aquaculture farms. The main pollutants involved in this phenomenon are phosphorus (P), nitrogen (N), and suspended matter (SM). These pollutants are primarily food-borne, and environmental concerns about aquaculture are not new. They have led researchers and producers to explore ways and means to make aquaculture a viable and sustainable activity.

**Keywords:** Formulation; Feed fish; marine fish farms; aquaculture sector; Morocco.





## Economic performance of rapid composting of casing waste

A. Ait Oumghar <sup>\*1</sup>, F. Sbai El Otmani<sup>1</sup>, Y. Aassem<sup>1</sup>, M. Mbarki <sup>1</sup>, M. Oubenali <sup>1</sup>

<sup>1</sup>Team of Analytical & Computational Chemistry, Nanotechnology and Environment, Faculty of Science and Technologies, Sultan Moulay Slimane University, BP 523, Beni Mellal, Morocco

**Abstract.** The feasibility of a waste composting process for an industry depends not only on the quality of the compost obtained but also on the economic return from the process. This return will directly impact either the cost of designing and building a composting plant or the cost of the process after the commercialization of the final product. To this end, the Bouyaudery El Amal factory located in Beni Mellal aims to evaluate the effect of the initial composition of the composting piles of casing waste and the effect of shredding on this economic efficiency. After 24 days of composting, the results showed that the economic yield of the mixture composed of 50% uncrushed casings does not exceed 47.9%. In contrast, the efficiency of the mixture where the waste is shredded has risen to 65.63%. Additionally, the efficiency of the pile composed of 70% casings exceeds 61.5%.

**Keywords:** C/N ratio, casing waste, grinding, rapid composting





# FTMIR Spectroscopy and Chemometric Approaches for Precise Classification and identification of the Geographical Origins of Olive Mill Wastewater

F. Sbai El Otmani<sup>1</sup>; A. El Orche<sup>1,2</sup>; M. Mouhsin<sup>1</sup>; M. Kasbaji<sup>1</sup>; A. Ait Oumghar<sup>1</sup>; Y. Aassem<sup>1</sup>, M. Mbarki<sup>1</sup> and M. Oubenali<sup>1</sup>

<sup>1</sup>Team of Analytical & Computational Chemistry, Nanotechnology and Environment, Faculty of Science and Technologies, Sultan Moulay Slimane University, BP 523, Beni Mellal, Morocco

<sup>2</sup>Laboratory of drug sciences, biomedical research, and biotechnology, Faculty of Medicine and Pharmacy, Hassan II University of Casablanca, Morocco

**Abstract.** This study explores the geographical classification of olive mill wastewater (OMWW) samples using Fourier Transform Mid-Infrared (FT-MIR) spectroscopy in conjunction with chemometric algorithms. The samples were sourced from two regions in Morocco: Beni Mellal-Khenifra and Fes-Meknes. Principal Component Analysis (PCA) was applied to the spectral data, revealing distinct clustering of the OMWW samples based on their geographical origins. Furthermore, Partial Least Squares Discriminant Analysis (PLS-DA) was employed to create a classification model, which demonstrated high sensitivity and specificity, achieving perfect classification rates during the calibration phase. Model validation confirmed its capability to accurately identify the majority of samples, with only minimal misclassifications. These results underscore the potential of FT-MIR spectroscopy and chemometric methods for authentication and traceability within the olive oil industry. Additionally, the study suggests that future research could extend this methodology to other regions and agricultural by-products, incorporating advanced machine learning techniques to enhance classification accuracy. Overall, this research contributes to the advancement of environmental waste management by addressing the challenges associated with OMWW disposal and promoting sustainable practices for its valorization.

**Keywords:** Olive Mill Wastewater (OMWW), FTMIR, data analysis, traceability, classification and discrimination



## Thermal performance analysis of a radiant floor heating system with phase change material

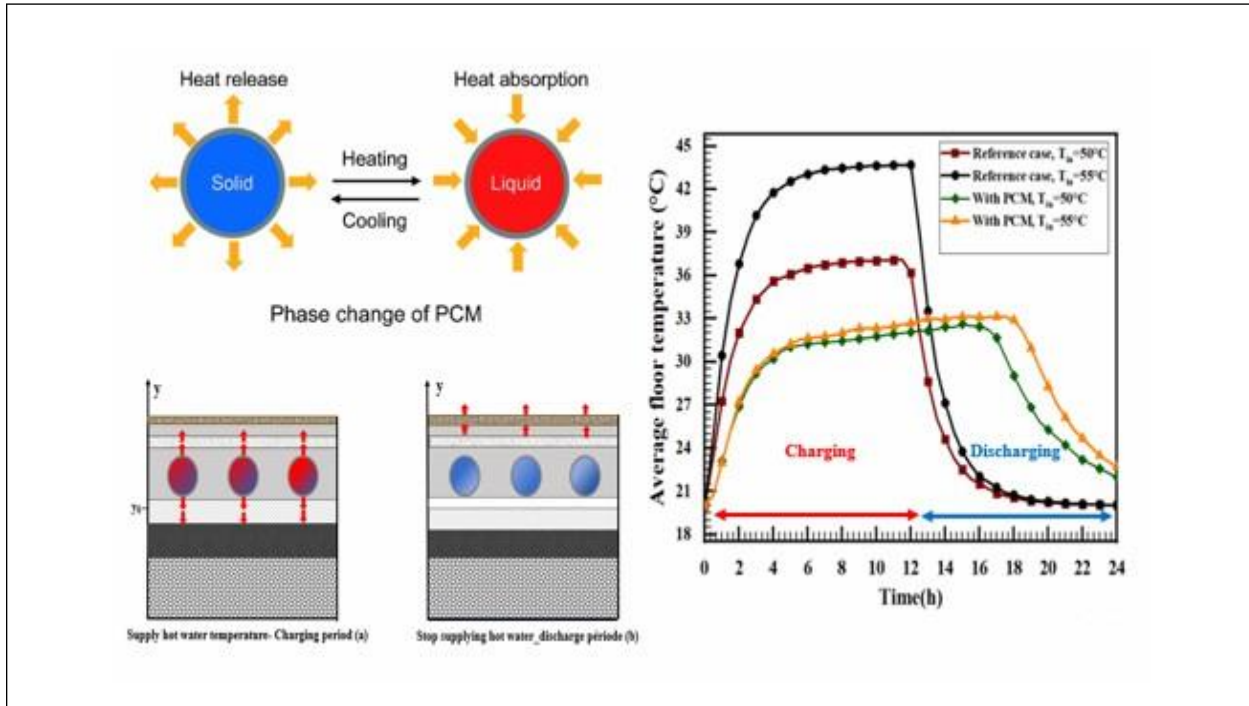
Afaf Charraou\*<sup>1</sup>, Mohamed Errebii\*<sup>2</sup>, Amina Mourid\*<sup>1</sup>, Rachid Saadani\*<sup>1</sup>, Miloud Rahmoune\*<sup>1</sup>, Mustapha El Alami\*<sup>2</sup>

<sup>1</sup> Laboratory of Advanced Materials Studies and Applications, FS-EST, Moulay Ismail University, BP 11201, Meknes, Morocco.

<sup>2</sup> Advanced Materials and Thermal Physics Laboratory (LPMAT), FS Ain Chock, Hassan II University of Casablanca, 20100, Morocco.

**Abstract.** The rapid urbanization and the increasing demand for indoor comfort have resulted in a rise in energy consumption and a negative impact on the environment within the building sector. The integration of phase change materials (PCM) into hydraulic heated floors offers an innovative and effective solution to reduce energy consumption, enhance thermal performance, and ensure optimal thermal comfort for occupants. In this study, a 2D numerical model of a floor heating system incorporating PCM was developed using COMSOL Multiphysics software. The calculations were performed by adopting the effective heat capacity approach and applying the finite element method. The influence of various parameters, such as the type of PCM, layer thickness, and supply temperature, was analyzed and discussed in detail. The results show that the floor heating delivers better performance when a PCM layer made of salt hydrates, with a thickness of 1.5 cm, is integrated into its structure under a supply temperature of 55 °C. This configuration increases the surface temperature amplitude while generating a phase shift of 5 hours and 30 minutes compared to a heated floor without PCM. This system not only reduces energy consumption but also ensures a satisfactory level of thermal comfort for occupant

**Keywords:** Energy storage; Floor heating system; Heat transfer; Phase Change Materials (PCM)



**Title:** Thermal performance analysis of a radiant floor heating system with phase change material



## Monitoring of the physicochemical characteristics of the surface waters of Lake Boudaroua

ECHAYEB Hajar <sup>1</sup>, ELKHARRIM Khadija<sup>1</sup>, Driss Belghyti <sup>\*1</sup>

<sup>1</sup>Laboratory of Natural Resources and Sustainable Development, B.P. 133, postal code 14000,  
University Ibn Tofail, Faculty of Sciences, Kenitra, Morocco.

**Abstract.** Physicochemical monitoring of surface waters is essential to assess water quality and environmental impacts on aquatic ecosystems. Lake BOUDAROUA plays an important role in local water supply, mainly in agricultural irrigation and livestock watering, but its quality can be altered by various factors such as human activities and climatic conditions. The main objective of our present study is to specify the level of pollution of the lake through physicochemical analyses of the water. The physicochemical parameters monitored are: T°C, pH, EC, TDS, DO, Oxidability, BOD5, MES. The dosage of calcium, magnesium, sodium, potassium, chlorides, bicarbonates, sulfates and nitrates. The results reveal averages of Temperature (20.03 °C), pH (8.0245), electrical conductivity (3746.42 µs/cm), TDS is (1.83725 g/l), Oxidation (-61.23 mv), Dissolved Oxygen (3.5375 mg/l), BOD5 reaches (257 mg/l), MES varies between 1225 mg/l and 2310 mg/l. The concentration of chloride ions (1389.55 mg/l), sodium (932.35 mg/l), bicarbonates (159.865 mg/l), sulfates (108.315 mg/l), calcium (129.753 mg/l), magnesium (19.75 mg/l), potassium (9.74 mg/l) and nitrates (7.81 mg/l). Our survey revealed that water pollution has reached worrying levels, particularly pollution by suspended matter, BOD5 and salinity.

**Keywords:** Physicochemical; water quality, Lake Boudaroua ; Morocco

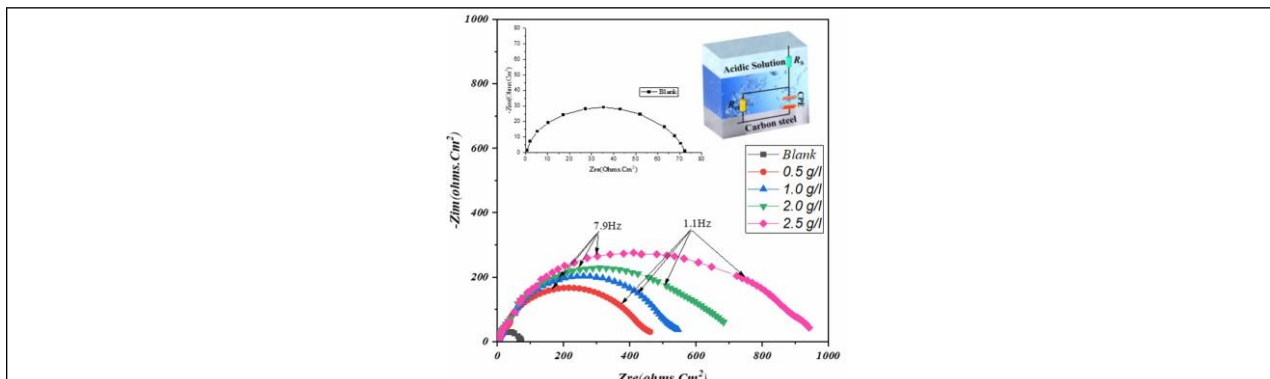
# Etude de l'efficacité inhibitrice d'une substance verte sur la corrosion de l'acier au carbone dans un milieu acide.

TALFANA Abderrahmane\*<sup>1</sup>, Forsal Issam\*<sup>1</sup>

<sup>1</sup> *Laboratory of Engineering and Applied Technologies, School of Technology, Beni Mellal, Morocco*

**Abstract.** Les préoccupations environnementales croissantes liées aux inhibiteurs inorganiques toxiques ont stimulé l'exploration d'alternatives écologiques pour la prévention de la corrosion dans les procédés de décapage acide. Le comportement de corrosion de l'acier au carbone (CS) dans une solution de 1 M HCl a été étudié en utilisant les techniques de perte de masse (PM), de polarisation potentiodynamique (PDP) et de spectroscopie d'impédance électrochimique (EIS). L'influence de l'inhibiteur de corrosion écologique, extrait de plante, a été évaluée; Les mesures PDP ont indiqué que l'extrait de plante agit comme un inhibiteur de type mixte, réduisant considérablement le taux de corrosion de MS par adsorption sur sa surface. Cet effet inhibiteur a entraîné un rendement d'inhibition supérieur à 94% à 298 K. L'analyse morphologique de surface a confirmé la formation d'un film protecteur sur la surface de CS, suggérant un mécanisme de chimisorption pour les molécules d'extrait de plante. L'impact de la température sur l'efficacité d'inhibition de la corrosion a été étudié dans la plage de température de 298 à 328 K. Les résultats ont montré que l'efficacité d'inhibition augmentait avec l'augmentation de la concentration de l'inhibiteur et du temps d'immersion, tout en diminuant avec l'augmentation de la température.

**Keywords :** Analyses électrochimiques ; Extrait naturel ; Corrosion ; Perte de masse.



**Titre :** Diagrammes de Nyquist d'une électrode de CS dans HCL avec différentes concentrations d'extrait à 298K



## Evaluation of OM Extract as an Eco-Friendly Corrosion Inhibitor for Carbon Steel in 1M HCl Solution.

ELHARAMI ANAS <sup>\*,1</sup>, FORSAL ISSAM <sup>1</sup>, KEROUAD SOFIA <sup>1</sup>

<sup>1</sup> Sultan Moulay Slimane university, School of Technology, Laboratory of Engineering and Applied Technologies, Beni Mellal, Morocco.

**Abstract.** With the growing interest in environmentally friendly corrosion mitigation strategies, natural inhibitors have gained considerable importance for their effectiveness as corrosion inhibitors. In this context, this research investigates the inhibitory efficacy of an acetonic extract obtained from (OM) leaves for carbon steel in 1M HCL using various experimental techniques, including Potentiodynamic Polarization (PDP) and Electrochemical Impedance Spectroscopy (EIS). The results indicate that the inhibitory efficacy increases from 0.87% to 94% with increasing concentration of OM extract, decreases with the increase of temperature and stabilizes with immersion time. Polarization curves showed that the extract acted as a mixed inhibitor.

**Keywords:** Carbon steel; Extract of OM; Immersion time; EIS; Sentence case.



# Green synthesis of iron nanoparticles using plant extract and electrochemical application

Bendehhou Atif <sup>1\*</sup>, Benhaiba Saad<sup>1</sup>, Elazhary Imad<sup>1</sup>, El Attar Anas<sup>1</sup>, El Rhazi  
Mama<sup>1</sup>, Ezzahi Amine<sup>1</sup>

<sup>1</sup>Laboratory of Materials Membranes and Environment, Faculty of Sciences and Technologies  
University Hassan II Casablanca, Mohammedia, Morocco

**Abstract.** Iron nanoparticles are utilized across various fields, including engineering, electronics, and medical research, due to their unique and fascinating properties. One of the methods to synthesize these nanoparticles is the biological or green method. This approach is gaining popularity as it provides reliable, sustainable, and environmentally friendly synthesis protocols, which are cost-effective and non-toxic to the environment, while also offering unique physical and chemical properties [1, 2]. The synthesis process involves using plant extracts, microorganisms, or biocompatible reagents. This study aims to synthesize and characterize iron nanoparticles using plant extracts (aloe vera extracts) as a reducing agent through the hydrothermal method, the resulting particles will be analyzed using UV, FTIR, XRD, and SEM. The application of these nanoparticles as electrochemical sensors or in studying the hydrogen evolution reaction will be explored in the next phase [3].

**Keywords:** Green synthesis; Iron nanoparticles; bimetallic nanoparticles; Microwaves; Electrochemical applications; electrochemical sensors

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## Photocatalytic degradation of methylene blue by tetragonal tungsten bronze modified by a heterojunction with graphitic-C<sub>3</sub>N<sub>4</sub> in the presence of sunlight

Amine Bendahhou<sup>1\*</sup>, El Hassan Yahakoub<sup>1</sup>, Khalid Lemrini<sup>1</sup>, Fatima Chaou<sup>1</sup>, Ilyas Jalafi<sup>1</sup>, Karim Chourti<sup>1</sup>, Mohamed El Miz<sup>1</sup>, Soufian El Barkany<sup>1</sup>, Mohamed Abou-salama<sup>1</sup>

<sup>1</sup> Laboratory of Molecular Chemistry, Materials and Environment, Department of Chemistry, Faculty 8 Multidisciplinary Nador, University Mohamed Premier, B.P. 300, Selouane, Nador 62700, Morocco

**Abstract.** The protection of aquatic ecosystems from harmful pollutants is now an essential priority that is receiving a good deal of attention. Especially methylene blue (MB), a poison capable to damage marine life at extremely low concentrations. In this work, we report the preparation of a new heterojunction g-C<sub>3</sub>N<sub>4</sub>/Sr<sub>5</sub>CaTi<sub>2</sub>Nb<sub>8</sub>O<sub>30</sub> for the decomposition of methylene blue contaminants, by employing a self-assembly ultrasonic-assisted technique. The composite prepared was characterised by various techniques. The formation of g-C<sub>3</sub>N<sub>4</sub>/Sr<sub>5</sub>CaTi<sub>2</sub>Nb<sub>8</sub>O<sub>30</sub>, together with the production of a highly reactive material interface, was demonstrated by X-ray powder diffraction (XRD), Fourier transform infrared spectroscopy (FTIR), thermogravimetric analysis (TGA) and scanning electron microscopy (SEM). Compared with pure g-C<sub>3</sub>N<sub>4</sub> and Sr<sub>5</sub>CaTi<sub>2</sub>Nb<sub>8</sub>O<sub>30</sub>, the prepared g-C<sub>3</sub>N<sub>4</sub>/Sr<sub>5</sub>CaTi<sub>2</sub>Nb<sub>8</sub>O<sub>30</sub> composite displays significantly enhancement of the activity photocatalytic for methylene blue degradation under sunlight irradiation. The g-C<sub>3</sub>N<sub>4</sub>/Sr<sub>5</sub>CaTi<sub>2</sub>Nb<sub>8</sub>O<sub>30</sub> also exhibited excellent reusability, with a degradation rate of 87.61% even after the 5th cycle. The kinetics of photocatalytic degradation are of pseudo-first order. The scavenging of active species revealed that superoxide radical (O<sup>•-</sup>), hydroxyl radical (OH<sup>•</sup>) and holes (h<sup>+</sup>) are the principal active species participating in the photocatalytic reaction. The adsorption of g-C<sub>3</sub>N<sub>4</sub> molecules on Sr<sub>5</sub>CaTi<sub>2</sub>Nb<sub>8</sub>O<sub>30</sub> and methylene blue (MB) molecules on g-C<sub>3</sub>N<sub>4</sub>/Sr<sub>5</sub>CaTi<sub>2</sub>Nb<sub>8</sub>O<sub>30</sub> surface was applied by using Monte Carlo (MC) simulation. The negative values of adsorption energy were signified the stability of g-C<sub>3</sub>N<sub>4</sub>/Sr<sub>5</sub>CaTi<sub>2</sub>Nb<sub>8</sub>O<sub>30</sub> and the adsorption of methylene blue (MB) on g-C<sub>3</sub>N<sub>4</sub>/Sr<sub>5</sub>CaTi<sub>2</sub>Nb<sub>8</sub>O<sub>30</sub> surface.

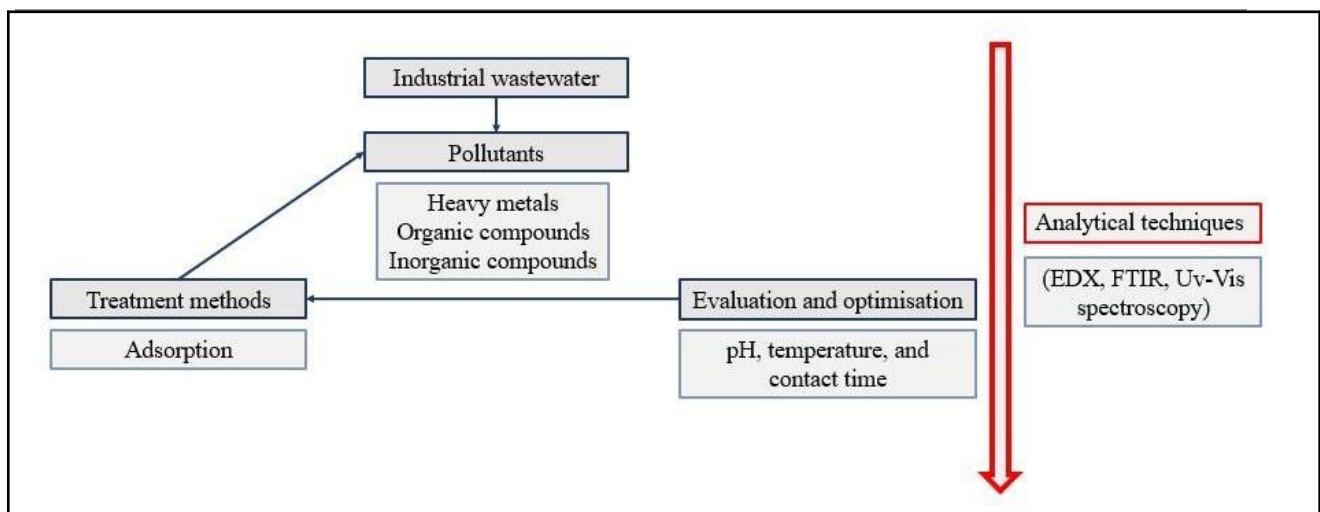
# Optimization of Adsorption for Pollutant Removal in Industrial Wastewater

Fatima El Hankouri <sup>\*1</sup>, Oumaima Fraiha <sup>\*1</sup>, Bahouch Mohamed <sup>\*1</sup>, M’hamed Ahari <sup>\*1</sup>

<sup>1</sup>Applied Chemistry Team, Department of Chemistry, Faculty of Sciences and Techniques of Al Hoceima, Abdelmalek Essaadi, BP 34, Ajdir 32003 Al-Hoceima, Morocco

**Abstract.** Industrial water pollution, caused by heavy metals as well as organic and inorganic compounds, represents a major environmental challenge. Among the various treatment methods, adsorption is recognized for its efficiency and cost-effectiveness in pollutant removal. This study aims to optimize the adsorption process by investigating key parameters such as pH, temperature, contact time, and pollutant concentration to enhance both removal efficiency and sustainability. Advanced analytical techniques, including UV-Visible spectroscopy, Fourier-transform infrared spectroscopy (FTIR), and energy-dispersive X-ray spectroscopy (EDX), will be utilized to characterize pollutant degradation and adsorbent properties. Ultimately, this research seeks to develop an optimized and sustainable wastewater treatment strategy that aligns with environmental regulations and promotes water reuse within a circular economy framework. By integrating innovative technologies with sustainable practices, this study aims to improve the efficiency of industrial wastewater treatment, ensuring environmental protection and resource conservation.

**Keywords:** Adsorption; Process optimization; Spectroscopic analysis; Water pollution



**Title:** Graphical Scheme of Adsorption Optimization for Industrial Effluents



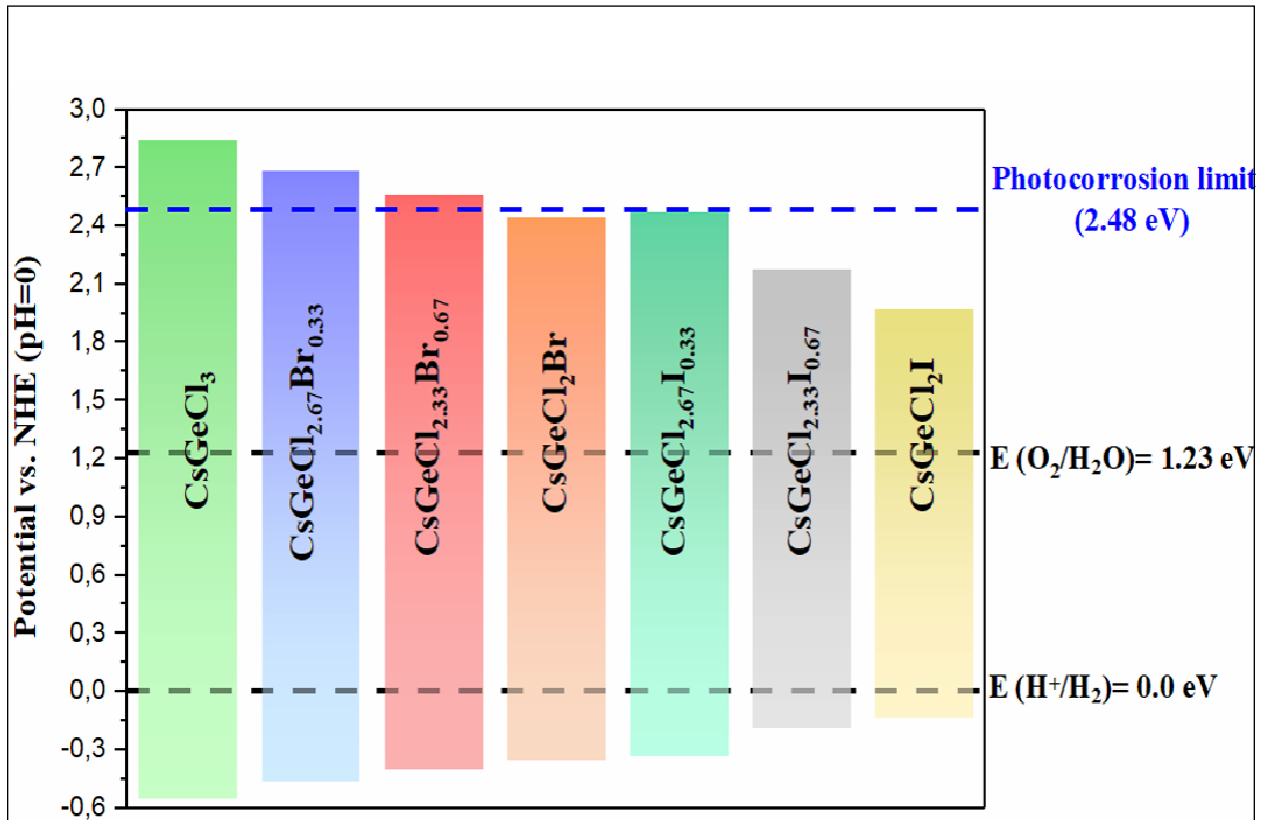
# Tuning the Photocatalytic Performance of Halide Perovskites for Efficient Solar Hydrogen Production: A DFT Study of CsGeCl<sub>3-x</sub>X<sub>x</sub> (X= Br, I)

Mihade El Akkel <sup>\*1</sup>, Hamid Ez-Zahraouy <sup>1</sup>

<sup>1</sup>Laboratory of Condensed Matter and Interdisciplinary Sciences, Unité de Recherche Labellisée CNRST, URL-CNRST-17, Faculty of Sciences, Mohammed V University of Rabat, Morocco

**Abstract.** Photoelectrochemical water splitting holds immense potential for sustainable hydrogen production to address mounting energy demands. However, the development of efficient and cost-effective photocatalysts remains a significant challenge. Perovskites, recognized for their cost-effectiveness and tunable characteristics, show potential as viable candidates in this context. Our investigation is the first to mark the photocatalytic efficacy of CsGeCl<sub>3</sub>. The findings reveal a modest solar-to-hydrogen (STH) efficiency of 0.74% due to its wide bandgap energy. Halide mixing with iodine and bromine significantly improves the STH efficiencies, reaching approximately 8.47%. In addition, applying uniaxial compressive stress further boosts the efficiency to 14.6%. In this study, we employed the density functional theory (DFT) through the WIEN2k software to scrutinize the structural, electronic, optical, photocatalytic, and thermoelectric properties of all the studied structures. Furthermore, the study evaluated the compounds' capacity for CO<sub>2</sub> photoreduction, susceptibility to degradation, and the influence of pH on their photocatalytic performance. The insights gained from this work contribute to the development of efficient and cost-effective perovskite-based photocatalysts for renewable hydrogen production.

**Keywords:** Photocatalysis; Water splitting; CsGeCl<sub>3</sub> perovskite; CO<sub>2</sub> reduction; degradation



**Title:** Tuning the Photocatalytic Performance of Halide Perovskites for Efficient Solar Hydrogen Production: A DFT Study of CsGeCl<sub>3-x</sub>X<sub>x</sub> (X= Br, I)

# Development of a Microbial Electrolytic Capacitor for Energy Storage

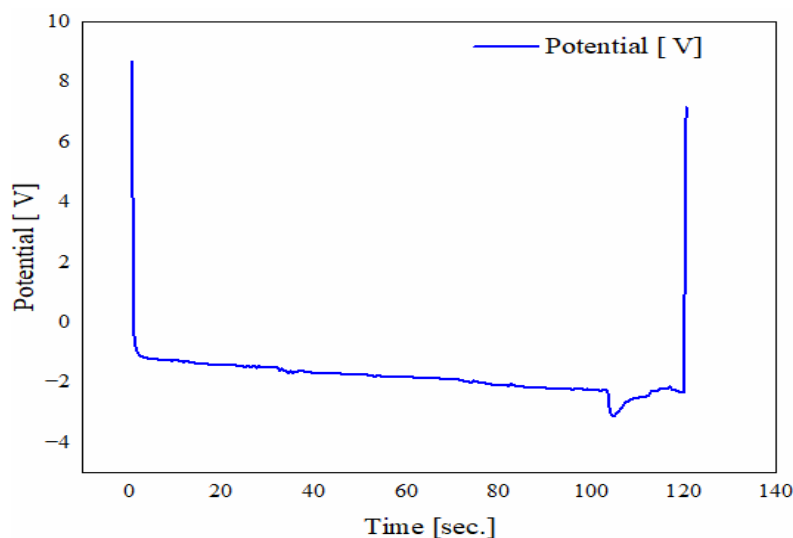
Mustapha Oukbab <sup>\*1</sup>, Abdelilah Chtaini <sup>\*1</sup>, Salah Eddine El Qouatli <sup>\*2</sup>

<sup>1</sup> Molecular Electrochemistry and Inorganic Materials Team, Faculty of Sciences and Technologies, Sultan Moulay Slimane University, Beni-Mellal, Morocco

<sup>2</sup> Physical Chemistry Environment and Material, Moulay Ismail University, Faculty of Sciences and Technologie, Boutalamine, Errachidia, Morocco

**Abstract.** The increasing demand for efficient and sustainable energy storage solutions has led to significant advancements in capacitor technology. This research focuses on the development of a high-performance capacitor for energy storage, aiming to address key challenges in energy density, charging time, and cycle stability. The capacitor is designed using novel electrode materials such as carbon-based composites and metal oxide nanomaterials, which offer enhanced charge storage capacity and conductivity. By optimizing the electrolyte composition and the electrode/electrolyte interface, the capacitor demonstrates promising electrochemical performance, including fast charge-discharge cycles and high energy efficiency. The results highlight the potential of this capacitor for applications in renewable energy systems, electric vehicles, and portable electronics, providing a sustainable alternative to traditional batteries. Further studies will focus on improving the scalability and long-term stability of the device for commercial applications

**Keywords:** Capacitor; Chronoamperometry; E.coli bacteria; Energy



**Title:** Capacitor charge/discharge curve at 10 mA/cm<sup>2</sup>



## Energetic study of the adsorption of alkanethiols on the Au(111) surface

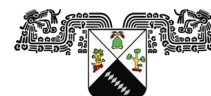
Walid Iken <sup>a</sup>, Mohamed Reda Chriyaa <sup>a</sup>, Soukaina Naciri <sup>a</sup>, Mouna Aamor <sup>a</sup>,  
Loubna Halil <sup>a</sup>, Mouad Boutkbout Nait Moudou <sup>a</sup>, Hayat EL Ouafy <sup>a</sup>, Tarik EL  
Ouafy <sup>\*b</sup>

<sup>a</sup> Laboratory of Engineering in Chemistry and Physics of Matter, Faculty of Sciences and  
Technics, Sultan Moulay Slimane University, Beni Mellal, Morocco

<sup>b</sup> Laboratory of Engineering in Chemistry and Physics of Matter, Faculty of Medicine and  
Pharmacy, Sultan Moulay Slimane University, Beni Mellal, Morocco

**Abstract.** Alkanethiols are used in water purification, as they have the ability to absorb and interact with toxic metals. We studied alkanethiols of different sizes in which carbon atoms change from one to ten on Au(111) surface of three-layer gold plate using density functional theory and based on the functional PBE-DF3. We found a negative value for the adsorption energy, which confirms that the reactions are exothermic. We also found that the absolute value of the adsorption energy increases with the length of the molecule in a linear manner and with a slope estimated at 0.053 eV/atoms, which is very close to that obtained experimentally that 0.055 eV/atoms. As for the energy gap, its value decreased for all molecules after adsorption, which confirms the increase in electrical conductivity. As for the variation in the Fermi energy before and after adsorption, they increased rapidly and exponentially with the increase in the absolute value of the adsorption energy.

**Keywords:** alkanthiol; Au(111); gold; adsorption energy; energy gap; Fermi energy.





# Comparative Analysis of Multiple MPPT Approaches in Photovoltaic Systems Facing Partial Shading Challenges

Sarah Abboud<sup>\*1</sup>, Semma El Alami<sup>1</sup>, Boulal Abdellah<sup>1</sup>, Salwa Naddami<sup>1</sup>

<sup>1</sup> Faculty of Sciences and Technology, Hassan First University, 577 Casablanca Road, 26000 Settat, Morocco

**Abstract.** To meet the increasing global energy demands, renewable energy sources, particularly solar energy, are being increasingly utilized. However, partial shading of photovoltaic systems presents a major challenge by reducing energy production efficiency. It generates multiple local maximum power points (LMPP), complicating the identification of the global maximum power point (GMPP). This research focuses on optimizing Maximum Power Point Tracking (MPPT) in partially shaded photovoltaic systems. The study compares three control strategies: the classic P&O method with a fixed iteration step, an improved version of P&O with an adjustable step (VSP&O), and an unconventional approach based on PSO using artificial intelligence. A system comprising a photovoltaic panel, a boost converter, and a load is introduced to evaluate the performance of these algorithms under varying irradiance conditions. The MATLAB/Simulink environment is used for system modeling, MPPT algorithm design, and testing, enabling an assessment of each technique's capabilities and limitations in tracking the GMPP, even with partial shading. The PSO method stands out for its efficiency and robustness, ensuring optimal power tracking.

**Keywords.** MPPT, PV, P&O, VSP&O, PSO, Partial Shading





# Two-dimensional BC<sub>6</sub>Be: Reversible, high-capacity hydrogen molecule storage material predicted by first-principles calculations

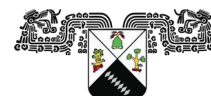
M. Achqraoui <sup>a</sup>, J. Labrousse <sup>a</sup>, N. Bekkioui <sup>a</sup>, H. Ez-Zahraouy <sup>a</sup>, A. Benyoussef <sup>b</sup>

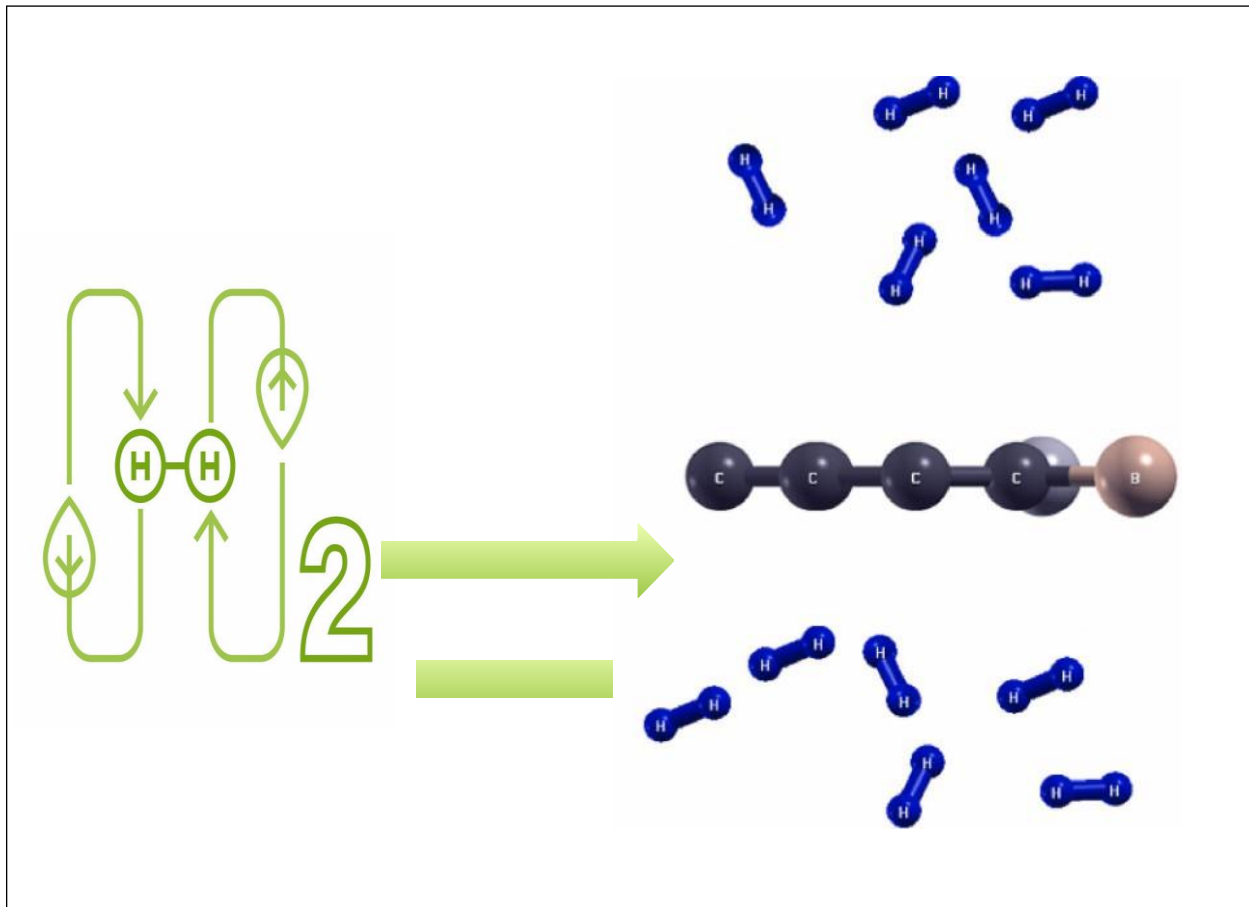
<sup>a</sup> *Laboratory of Condensed Matter and Interdisciplinary Sciences, Unité de Recherche Labellisée CNRST, URL-CNRST-17, Faculty of Sciences, Mohammed V University of Rabat, Morocco*

<sup>b</sup> *Hassan II Academy of Science and Technology, Rabat, Morocco*

**Abstract.** The research was conducted to discover a material that can efficiently and effectively store hydrogen at appropriate conditions. Specifically, its focus was on examining the hydrogen storage properties of unaltered single-layer BC<sub>6</sub>Be using density functional theory techniques. The results revealed an intriguing phenomenon: H<sub>2</sub> molecules spontaneously adhere to the BC<sub>6</sub>Be monolayer, exhibiting average adsorption energy spanning between -0.272 and -0.380 eV. Importantly, this adsorption is driven by physisorption, lacking any chemisorption bonding between the H<sub>2</sub> molecule and the BC<sub>6</sub>Be surface, regardless of the interaction site. Noteworthy is the remarkable gravimetric hydrogen storage capacities of the monolayer BC<sub>6</sub>Be, registering at 11.63 wt%. Comparatively, the desorption temperature (T<sub>d</sub>) stands notably higher at around 247.15 K when juxtaposed with hydrogen's critical point (33.25 K). AIMD simulations were conducted to substantiate the results, confirming the adsorption of 12H<sub>2</sub> molecules on BC<sub>6</sub>Be and verifying the system's stability. Overall, the findings of this work have shown the potential of the BC<sub>6</sub>Be monolayer as a highly promising material that offers efficient, reversible, and substantial hydrogen storage capabilities within real-world scenarios.

**Keywords:** BC<sub>6</sub>Be monolayer, Physisorption, DFT, Gravimetric capacity, Hydrogen storage





**Title:** The ultimate configuration employed for hosting 12H<sub>2</sub> molecules on the BC<sub>6</sub>Be sheet to be applied for different applications.



## Theoretical structural and spectroscopic studies of Tyrosol and Hydroxytyrosol by density functional theory

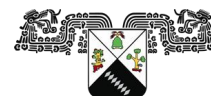
Soukaina Naciri<sup>1</sup>, Mohamed Reda Chriyaa<sup>1</sup>, Walid Iken<sup>1</sup>, Mouad Boutkbout Nait Moudou<sup>1</sup>, Loubna Halil<sup>1</sup>, Mouna Amor<sup>1</sup>, Hayat EL Ouafy<sup>1</sup>, Tarik EL Ouafy\*<sup>2</sup>

<sup>1</sup> Laboratory of Engineering in Chemistry and Physics of Matter, Faculty of Sciences and Technics, Sultan Moulay Slimane University, Beni Mellal, Morocco

<sup>2</sup> Laboratory of Engineering in Chemistry and Physics of Matter, Faculty of Medicine and Pharmacy, Sultan Moulay Slimane University, Beni Mellal, Morocco

**Abstract.** In this work, the structural and spectroscopic data of the molecules Tyrosol and Hydroxytyrosol in the ground state were calculated using the functional density method using. the nuclear magnetic properties were investigated at the  $^{13}\text{C}$  and  $^1\text{H}$ . The results of the theoretical calculation of the chemical shifts of the tyrosol compound shows that the theoretical values calculated by the GIAO method are similar to the experimental results. The chemical shift calculations for hydroxytyrosol were performed utilizing the B3LYP function with the bases 6-31G, 6-311G, 6-311G (d,p), 6-31G (d,p) and 6-311G (d,2p), we can therefore say that the GIAO method is more reliable on the 6-31G basis for calculating the chemical shifts of  $^{13}\text{C}$  and more reliable on the 6-311G (d,2p) basis for calculating the chemical shifts of  $^1\text{H}$ , giving results that are comparable with the experimental results.

**Keywords:** DFT; Tyrosol; Hydroxytyrosol; Chemical shift; RMN.





# DFT investigation of the structural, optoelectronic, thermoelectric, and thermodynamic properties of metal phosphides $MP_2$ (M = Co, Rh, and Ir)

Aya Chelh,<sup>1\*</sup>, Meryem Ziati<sup>1</sup>, Hamid Ez-Zahraouy<sup>1</sup>

<sup>1</sup>Laboratory of Condensed Matter and Interdisciplinary Sciences, Unite de recherche labellisee CNRST, Faculty of Sciences, Mohammed V University of Rabat, Morocco

**Abstract.** Materials science is concerned with the development of novel materials that possess specified physical characteristics. In this work, we study  $MP_2$  (M = Co, Rh, Ir) compounds which crystallize in the monoclinic structure with formation energy equal to -11.72eV, -11.62, and -11.13 for  $CoP_2$ ,  $RhP_2$ , and  $IrP_2$ , respectively. These materials in high temperature present an important advance for thermoelectric applications. First-principles calculations with density functional theory (DFT) are employed to investigate the electrical, optical, thermoelectric, and thermodynamic properties of  $MP_2$  (M = Co, Rh, and Ir) compounds. All computations are performed using density functional theory (DFT) and the Wien2K method. By combining the modified Becke-Johnson of Tran-Blaha potential (TB-mBJ) with the approximated gradient généralisé (GGA), the precision of the restricted band has been optimized. This approach, in conjunction with tools like GIBBS2 and Boltzmann's theory of transport, has made it possible to ascertain the thermodynamic and thermoelectric properties of the materials under study. The results show that these materials have a straight band gap of  $CoP_2$  is 4.78 eV, whereas the indirect band gaps of  $RhP_2$  and  $IrP_2$  are 0.575 eV and 0.875eV, respectively. The optical characteristics indicated good optical absorption and conductivity in the ultraviolet and visible ranges. Furthermore, using Boltzmann's theory, it was revealed that the figure of merit  $ZT$  is more than 1.7 at a temperature of  $T = 700K$ , notably for  $CoP_2$ . In fact, our study demonstrates that  $MP_2$  (M = Co, Rh, and Ir) compounds might be effective in ultraviolet and visible photoelectric applications, as well as thermoelectric applications.

**Keywords:** Formation energy, Density functional theory, GIBBS2, Figure of merit.

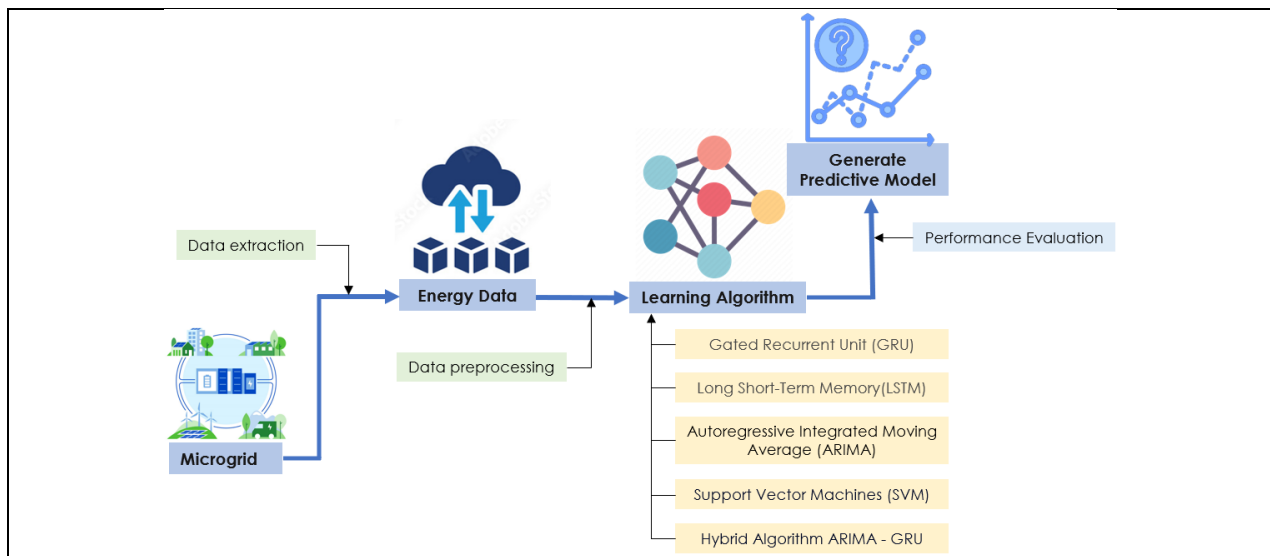
# Forecasting Energy Consumption on a Microgrid using ARIMA-GRU Model

Lahoucine Oumiguil <sup>\*1</sup>, Ali Nejmi <sup>1</sup>

<sup>1</sup>Laboratory of Automation, Energy Conversion, and Microelectronics, Faculty of Sciences and Technics, Sultan Moulay Slimane University, Campus Mghilla, BP 523, 23000, Beni Mellal Morocco

**Abstract.** Accurate forecasting of energy consumption is crucial for the efficient management and control of modern power grids, especially with the increasing integration of renewable energy sources. This study proposes a hybrid approach that combines the Autoregressive Integrated Moving Average (ARIMA) and the Gated Recurrent Unit neural network (GRU) to forecast energy consumption in a microgrid setting. The proposed ARIMA-GRU model leverages the strengths of both statistical and deep learning techniques to capture the temporal dynamics and non-linear patterns in energy consumption data, enabling more precise and reliable forecasting for effective grid management and control.

**Keywords:** Autoregressive Integrated Moving Average; Energy consumption; Gated Recurrent Unit; Microgrid



**Title:** Microgrid Energy Consumption Forecasting using ARIMA-GRU model and comparative evaluation with existing approaches



# Investigation of Thermal Characteristics of BeAlH<sub>3</sub>, BeGaH<sub>3</sub>, and BeInH<sub>3</sub> Perovskites for Hydrogen Storage

Ayoub Koufi <sup>\*1,2</sup>, Younes Ziat <sup>1,2</sup>, Hamza Belkhanchi <sup>1,2</sup>

<sup>1</sup>Engineering and Applied Physics Team (EAPT), Superior School of Technology, Sultan Moulay Slimane University, Beni Mellal, Morocco

<sup>2</sup>The Moroccan Association of Sciences and Techniques for Sustainable Development (MASTSD), Beni Mellal, Morocco

**Abstract.** The present paper explores the structural, electrical, gravimetric and thermoelectric properties of crystalline beryllium hydrides BeXH<sub>3</sub> (X = Al, Ga, In) using the generalized gradient approximation (GGA) within the framework of density functional theory (DFT). The analysis is performed with the BoltzTrap package, integrated with the Wien2k code, and the Murnaghan equation of state to determine total energy and atomic volume, while providing detailed information on band structure and electronic densities of state. Key thermoelectric properties, including power factor (PF), figure of merit (Zt), thermal conductivity ( $\kappa$ ) and electrical conductivity ( $\sigma$ ), were investigated over a temperature range from 300 to 900 K. The results reveal that BeGaH<sub>3</sub> shows the best thermoelectric performance over the whole temperature range, making it the most promising for energy applications. The BeAlH<sub>3</sub> and BeInH<sub>3</sub> materials also show interesting thermoelectric behaviors, with increased efficiency at higher temperatures, making them potentially suitable for high-temperature thermoelectric applications. Thermal conductivity increases linearly with temperature, influenced by electron vibrations, while electrical conductivity and Zt and PF factors show material-specific variations, highlighting the optimization potential of these compounds for thermoelectric devices. Beryllium metal hydrides such as BeXH<sub>3</sub> thus present themselves as promising candidates for safer, more compact energy storage, although further research is needed to refine their performance. These discoveries contribute to the advancement of modern thermoelectric materials, requiring scientific and industrial collaboration to exploit their potential in practical applications.

**Keywords:** DFT, Gravimetric, Hydrogen, Thermal



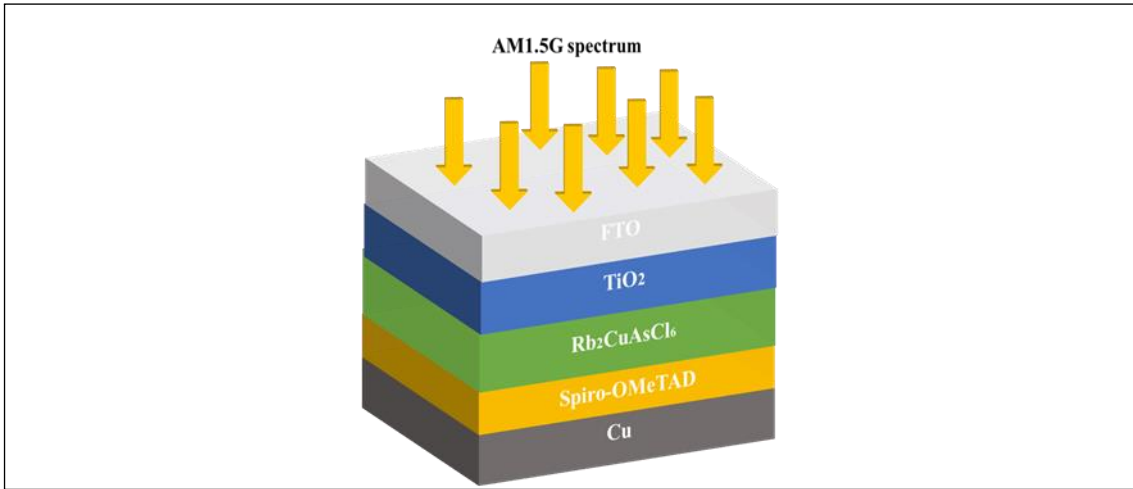
# Comprehensive Analysis of Optoelectronic and Photovoltaic Performance of $Rb_2CuAsX_6$ ( $X = Br, Cl$ ) Double Perovskite-based Solar Cells Using DFT Calculations and SCAPS-1D Simulations

Kamal Assiouan<sup>1\*</sup>, Jamal EL Khamkhami<sup>1</sup>, Abdelfattah Achahbar<sup>1</sup>

<sup>1</sup>Artificial intelligence and Computational Physics, Faculty of Sciences, AbdelmalekEssaadi University, B. P. 2121 M'Hannech II, Tetouan, 93030, Morocco

**Abstract.** The structural, thermodynamic, elastic, optoelectronic, and photovoltaic properties of the emerging double perovskites  $Rb_2CuAsX_6$  ( $X = Br, Cl$ ) were comprehensively investigated using density functional theory (DFT). The cubic phase stability was confirmed through the calculation of formation energy, while the elastic parameters indicated thermodynamic and mechanical stability. Electronic band structure calculations revealed indirect band gaps of 0.64 eV and 1.09 eV for  $Rb_2CuAsBr_6$  and  $Rb_2CuAsCl_6$ , respectively, using the HSE06 functional. Optical analysis demonstrated significant absorption in the visible and near-infrared regions for both materials, establishing their potential for optoelectronic solar cell applications.  $Rb_2CuAsCl_6$  was studied as an absorber layer in lead-free inorganic solar cells.  $TiO_2$  and Spiro-OMeTAD were employed as the electron transport layer (ETL) and hole transport layer (HTL), respectively. A n-i-p perovskite solar cell with the structure FTO/n- $TiO_2$ /i- $Rb_2CuAsCl_6$ /p-Spiro-OMeTAD/Cu was designed and simulated using SCAPS-1D software. The effects of absorber defects and thickness variations of the HTL, ETL, and absorber layers on photovoltaic parameters; fill factor (FF), power conversion efficiency (PCE), open-circuit voltage ( $V_{oc}$ ), and short-circuit current density ( $J_{sc}$ ) were analyzed. Simulations revealed a maximum PCE of 20.62% and FF of 67.41%, demonstrating the material's solar energy potential.

**Keywords:** Double Perovskites; density Functional Theory (DFT); optoelectronic Properties; solar cells



**Title:** Schematic of the FTO/TiO<sub>2</sub>/Rb<sub>2</sub>CuAsCl<sub>6</sub>/Spiro-OMeTAD/Cu solar cell



# Prediction of the effects of C, N, Si, and P doping in CaTiO<sub>3</sub> on optoelectronic properties: A DFT study

Abdellah Bouzaid <sup>\*1,2</sup>, Younes Ziat <sup>1,2</sup>, Hamza Belkhanchi <sup>1,2</sup>, Ayoub Koufi <sup>1,2</sup>, Mohammed Miri <sup>1,2</sup>

<sup>1</sup>Engineering and Applied Physics Team (EAPT), Superior School of Technology, Sultan Moulay Slimane University, Beni Mellal, Morocco

<sup>2</sup>The Moroccan Association of Sciences and Techniques for Sustainable Development (MASTSD), Beni Mellal, Morocco

**Abstract.** This study utilizes density functional theory (DFT) with the generalized gradient approximation and modified Becke-Johnson potential (GGA-mBJ) to investigate the structural, electronic, and optical properties of Y-doped CaTiO<sub>3</sub> (CTO) perovskite materials, where Y = C, N, Si, or P, substituted at oxygen sites with a doping concentration of  $x = 0.16$ . Structural optimization results reveal negative formation energies for undoped and doped CTO, confirming their thermodynamic stability. Y-doping significantly reduces the band gap energy compared to undoped CTO (2.766 eV). Specifically, the band gaps for C-, N-, Si-, and P-doped CTO are reduced to 0.87, 1.63, 0, and 0.6 eV, respectively. While doping with C, N, and P maintains the indirect band gap nature with electronic transitions between the  $\Gamma$  and L points in the Brillouin zone, while Si-doping induces a complete overlap of the valence and conduction bands, resulting in metallic behavior with a zero-band gap. Furthermore, the Fermi level shift toward the valence band suggests p-type semiconductor characteristics for the doped systems, except for Si-doped CTO, which exhibits metallic behavior. Optical property analysis indicates that doping increases the static dielectric constant,  $\epsilon_1(0)$ , with the following values for different dopants: 7.1 for C, 6.72 for N, 36.63 for Si, and 23.69 for P-doped CTO. Additionally, the optical conductivity ( $\sigma$ ) exhibits peak values of 4651.01  $\Omega^{-1} \text{ cm}^{-1}$  for C doped, 5423.62  $\Omega^{-1} \text{ cm}^{-1}$  for N doped, 4656.04  $\Omega^{-1} \text{ cm}^{-1}$  for Si-doped, and 4748.27  $\Omega^{-1} \text{ cm}^{-1}$  for P doped CTO. Notably, Y-doped CTO shows significantly enhanced absorption properties, particularly with N doping, making N-doped CTO a promising candidate for photovoltaic and optoelectronic applications.

**Keywords:** DFT; (C, N, Si, P) doped CaTiO<sub>3</sub>; electronic structure; optical properties;





# Reusable Castor Plant Materials for Cationic Dye Adsorption: A Promising Alternative

Ait oukharaz Nouzha <sup>\*1</sup>, Lakhmiri Rajae <sup>\*1</sup>, Eladnani Ikram <sup>1</sup>, Sguillar Mohamed <sup>1</sup>, Albourine Abdallah <sup>2</sup>, Safi Mohamed <sup>3</sup>, Cherkaoui Omar <sup>4</sup>

<sup>1</sup>Team of Chemical Engineering and Valorization of the Resources, Faculty of Sciences and Techniques of Tangier, Abdelmalek Essaadi University, Km 10 route de Ziaten, BP 416, 90000 Tangier, Morocco

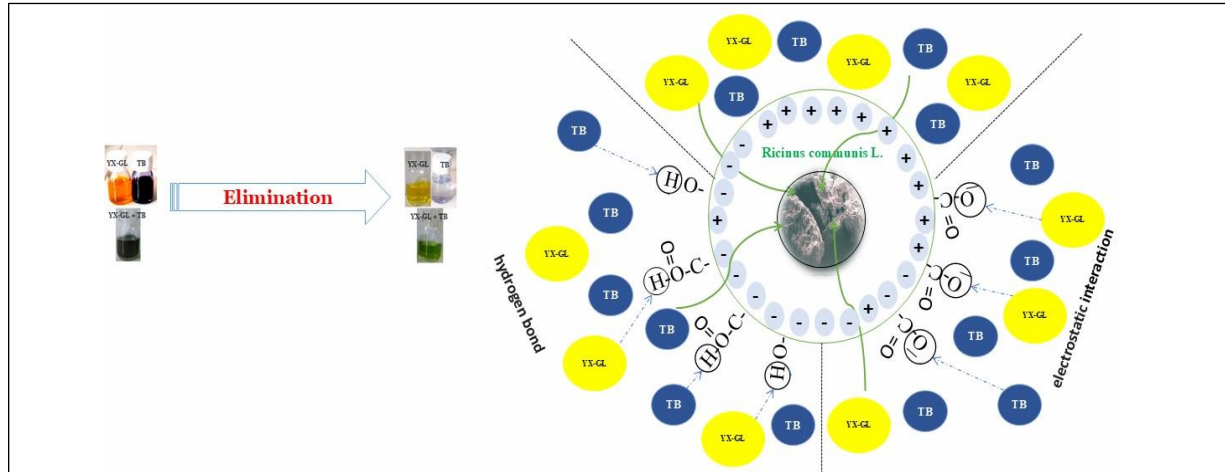
<sup>2</sup>Laboratory of Materials and Environment, Team of Coordination Chemistry, Faculty of Sciences, IbnZohr University, BP 8106, 80000 Agadir, Morocco

<sup>3</sup>Laboratory of Physical Chemistry and Bio-Organic Chemistry, Faculty of Sciences and Techniques-Mohammedia, URAC 22 University of Hassan II Mohammedia-Casablanca, BP 146, Morocco.

<sup>4</sup>Laboratory REMTEX, Higher School of Textile and Clothing Industries, Casablanca, Morocco

**Abstract.** Castor plant parts *Ricinus communis* L. (shell, envelopes and leaves) was used to remove cationic dyes from textile wastewater. The materials were characterized by various techniques such as FTIR, XRD SEM and EDXA. Batch experiments showed that castor plants have a significant and remarkable potential of removing cationic dyes; Toluidine Blue (TB) and Reactive Yellow X-GL 200% (X-GL 200%) with a maximum adsorption capacities exceeded 2107 mg.g<sup>-1</sup>. The adsorption was better described with the Langmuir and the second-order kinetic models. The thermodynamics analysis indicated that the adsorption was an exothermic, spontaneous, and physical process. Castor plants revealed also their capacity to be used several times without losing their potential to remove cationic dyes. The results suggest that castor plant materials could serve as effective and reusable options for adsorbents.

**Keywords:** Adsorption; Castor plant; Cationic dyes; Regeneration; Sustainable development; Wastewater.



**Title:** Mechanisms of Dye Removal by Castor Plant-Based Adsorbents



# Understanding the effects of Zn doping on cobalt oxide thin films deposited by spray pyrolysis and its application in photovoltaic solar cells

Z. Barbouch<sup>1\*</sup>, A. El-habib<sup>2</sup>, J. Zimou<sup>1</sup>, M. Beraich<sup>3</sup>, Y. Khaissa<sup>1</sup>, A. Talbi<sup>1</sup>, A. Raidou<sup>1</sup>, K. Nouneh<sup>1</sup>, N. Elharfaoui<sup>1</sup>, M. Fahoume<sup>1</sup>

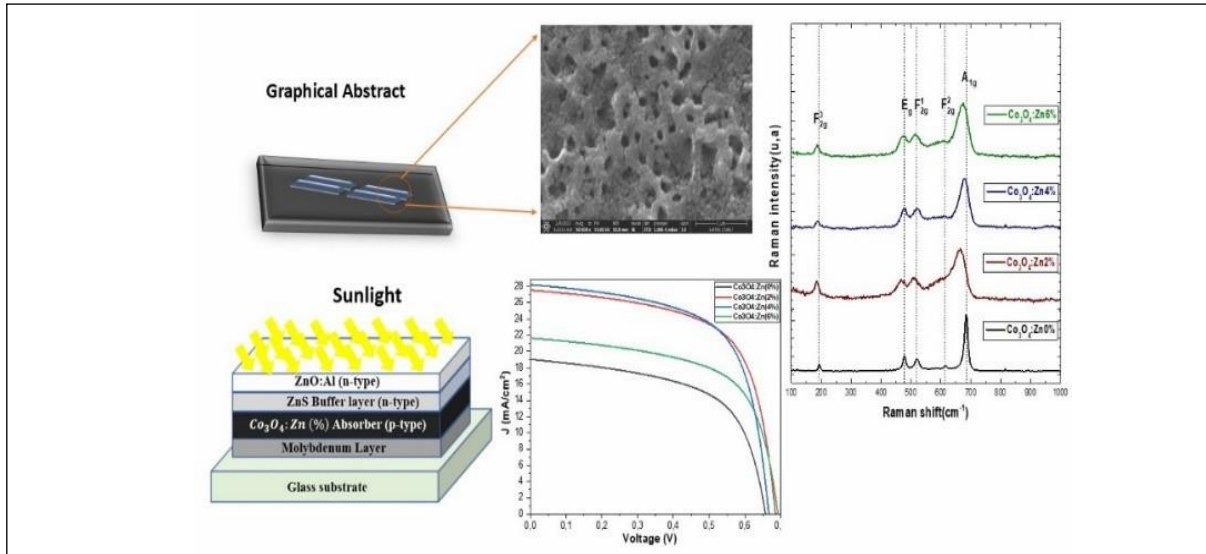
<sup>1</sup>Laboratory of Materials Physics and Subatomic, Department of Physics, Faculty of Science, Ibn Tofail University, BP 133, 14000 Kenitra, Morocco

<sup>2</sup>Materials, Systems and Energy Engineering Laboratory (MaSEEL), Faculty of Sciences and Techniques Tangier, Abdelmalek Essaâdi University, Tetouan, Morocco

<sup>3</sup>Laboratory of Materials, Energy and the Environment (LaMEE), Faculty of Science Semlalia, CadiAyyad University, P. O. Box 2390, Marrakech 40000, Morocco

**Abstract.** Thin films of pure and zinc-doped nanostructures have been successfully grown using the spray pyrolysis technique. Different characterization techniques were used to study the impact of zinc incorporation into the material at different concentrations (0–6%) on their microstructural, morphological, optical and electrical behaviors. XRD results revealed that all films displayed a spinel-like polycrystalline cubic structure, with a preferential orientation of crystallites along the (311) plane. SEM images revealed a uniform surface with a porous structure and nanocrystalline grain size in all films. Optical absorption was enhanced by doping, suggesting the creation of voids and/or the replacement of Co ions by Zn ions in the film structure. In addition, electrical measurements show a noteworthy enhancement in electrical conductivity following the Zn doping process, particularly for dopant concentrations of 2% and 4%. Numerical simulation using SCAPS-1D also reveals that the solar cell, based on our experimental results, can achieve a notable efficiency of up to 12%.

**Keywords:** Thin films, Zn doped Co<sub>3</sub>O<sub>4</sub>, Electrical conductivity, Solar photovoltaic cells, SCAPS-1D





# First-Principles Investigation of S, Si, and F-Doped Rutile GeO<sub>2</sub>: Structural, Electrical, and Optical Properties

Hamza Belkhanchi<sup>\*1, 2</sup>, Younes Ziat<sup>1, 2</sup>

<sup>1</sup>Laboratory of Engineering and Applied Physics Team (EAPT), Sultan Moulay Slimane University, Beni Mellal, Morocco.

<sup>2</sup>The Moroccan Association of Sciences and Techniques for Sustainable Development (MASTSD), Beni Mellal, Morocco

**Abstract.** Using density functional theory (DFT) with the FP-LAPW method, we investigate the impact of S, Si, and F doping (6.25%) on the structural, electronic, and optical properties of rutile-type GeO<sub>2</sub>. The results confirm structural stability and consistency with reported lattice parameters. Doping significantly reduces the band gap, from 4.09 eV in pure GeO<sub>2</sub> to 1.98 eV in the Si-doped variant. Optical properties, such as dielectric function, conductivity, refractive index, and absorption, were evaluated up to 13 eV, revealing notable anisotropy along the crystallographic *zz* and *xx* directions. These findings indicate the potential of doped GeO<sub>2</sub> as a high-performance material for UV photodetectors operating efficiently under sunlight and in high-luminosity environments.

**Keywords:** Rutile-type GeO<sub>2</sub>; structural properties; electronic properties; optical properties,





## Advances in Metallic Oxides for Enhancing the Performance of Dye-Sensitized Solar Cells (DSSC)

Imane Lmachraa\*<sup>1</sup>, Lamia Elmaazouzi<sup>1</sup>, Khadija El idrissi<sup>2</sup>, Mohammed El idrissi<sup>3</sup>, Abdellah Zeroual<sup>2</sup>, Zouhair Lakbaibi\*<sup>1</sup>

<sup>1</sup> Laboratory of Process, Signals, Industrial Systems, Computer Science, Superior School of Technology, Cadi Ayyad University, Dar Si-Aiessa Road, BP 89, 46000 Safi, Morocco.

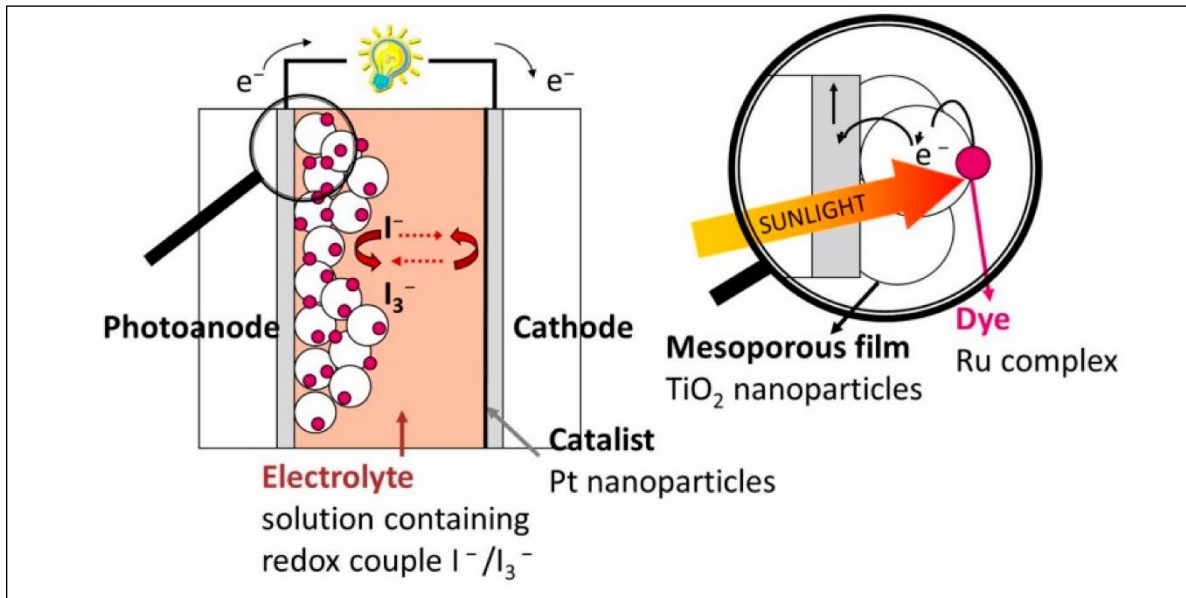
<sup>2</sup> Molecular Modeling and Spectroscopy Research Team, Faculty of Science, Chouaib Doukkali University, P.O. Box 20, 24000 El Jadida, Morocco

<sup>3</sup> Department of Chemistry, Multidisciplinary Faculty, Sultan Moulay Slimane University, P.O. Box 591, Béni-Mellal, Morocco

Abstract. Dye-sensitized solar cells (DSSCs) are gaining attention as cost-effective and versatile photovoltaic technologies. Their efficiency strongly depends on the photoanodes, which influence photon capture and electron generation. To address these challenges, Density Functional Theory (DFT) calculations have become essential for exploring new semiconductor materials and optimizing active layer morphologies. Wide-bandgap metallic oxides, such as TiO<sub>2</sub>, ZnO, SnO<sub>2</sub>, and WO<sub>3</sub>, are central to these studies. TiO<sub>2</sub> is particularly favored due to its superior efficiency, high dye adsorption capacity, and stability in acidic conditions, despite ZnO's better electron mobility. The morphology of TiO<sub>2</sub> significantly impacts photon-to-electron conversion rates. DFT studies help optimize parameters like particle size, porosity, and surface area to enhance dye adsorption and electron density. Advanced TiO<sub>2</sub> nanoarchitectures, including mesoporous structures, nanotubes, and nanorods, are modeled to improve performance and electron mobility. This research leverages DFT-based theoretical approaches to explore recent advancements in metallic oxides and develop innovative strategies for improving DSSC efficiency through material and structural optimization. These findings highlight the potential of TiO<sub>2</sub> nanoarchitectures for advancing DSSC technology.

**Keywords:** Adsorption; Anatase; DFT; Photoanodes.





**Title:** Schematics of a DSSC (left) and detail of the photoanode (right): illustrating the operating principle of a DSSC with TiO nanoparticles serving as the photoanode

# Impact of Thermal Insulation on Vehicle Cabin Heat Loads and Energy Use: A CFD Analysis

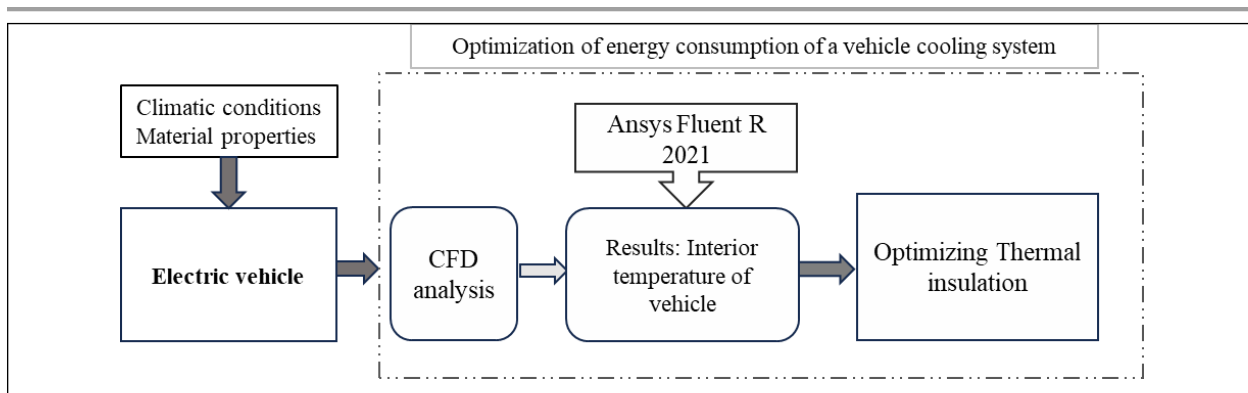
Oubnaki Hasnaa <sup>\*1</sup>, Charifa Haouraji <sup>\*1</sup>, Ilham Mounir <sup>\*2</sup>, Badia Mounir <sup>\*2</sup>, Abdelmajid Farchi <sup>\*1</sup>

<sup>1</sup> IMMI Laboratory, Faculty of sciences and techniques, Hassan 1st University Settat, Morocco

<sup>2</sup> LAPSSII Laboratory, Graduate School of Thechnology, Safi, Morocco

**Abstract.** A car's passenger cabin's heating, ventilation, and air conditioning system is the biggest auxiliary charge, other than the primary traction charge. It may cause a vehicle with a motor to increase its energy consumption by up to 25%. The main factor contributing to the passenger compartment's excessive warmth is the car's exposure to maximum sun radiation. In this article, energy-saving measures such as using various types of insulating and storing materials, have been implemented to investigate the temperature drop in the car's cabin based on their thermal characteristics to predict their impact on the vehicle's interior thermal loads. ANSYS FLUENT was utilized to model and simulate the interior fluid domain of a cabin. Computational Fluid Dynamics (CFD) simulations were used to predict thermal loads of vehicle. Using a vehicle cabin CFD model that was verified by climatic measurements, simulation information covering the full range of boundary conditions that affect thermal loads was methodically generated. The efficacy of the CFD simulation tool in examining the several parameters that determine an automobile's interior thermal load was demonstrated by the results of multiple simulations.

**Keywords:** Automobile cabin; CFD; Energy; Thermal insulation.



**Title:** Impact of Thermal Insulation on Vehicle Cabin Heat Loads and Energy Use: A CFD Analysis



# The impact of magnesium doping on the structure properties and linear/nonlinear optical performance of BT ceramics

Mohammed Bouzid<sup>\*1</sup>, Abdelilah Rjeb<sup>1</sup>, Abdelhalim Elbasset<sup>2</sup>, Rachid Ahfir<sup>1</sup>

<sup>1</sup>Laboratory of Theoretical and Applied Physics Faculty of Sciences, Dhar El Mehraz, BP 1796 Fez-Atlas, Morocco

<sup>2</sup>Laboratory of Signals Systems and Components Faculty of Sciences and Technology Street Immouzar BP 2202 Fez, Morocco

**Abstract.** In this paper, we investigated the structural and optical properties of pure and Magnesium-doped BaTiO<sub>3</sub> ceramics, for various doping rates, from 0 to 8%. XRD analysis showed that our samples of composition Ba<sub>1-x</sub>Mg<sub>x</sub>TiO<sub>3</sub> crystallize in the pure perovskite type structure indicating that Mg<sup>2+</sup> of small radius is inserted into the BT phase for low Mg levels ( $x < 0.08$ ). Magnesium incorporation reduces the tetragonality from 1.0061 to 1.0024, as the dopant concentration increases, which translates the transition to a pseudo-cubic phase. This observation is confirmed by the Rietveld refinement procedure. The Debye-Scherrer equation estimates the crystallite size in the range of 18 to 31 nm. UV-visible spectroscopy shows that Mg has no discernible effect on the band gap energy of the BT matrix. Additionally, an improvement in the non-linear optical properties of the samples was observed with increasing Magnesium concentration, particularly in their non-linear refractive index ( $n_2$ ) and non-linear susceptibility ( $\chi^{(3)}$ ). A notable exception was observed for the BM1T sample, which exhibited exceptionally good performance, and could be an attractive material for high optical response devices.

**Keywords:** BaMgTiO<sub>3</sub>; XRD; IR; UV-visible; Non-linear optical properties; Band gap.





# Study of the electronic and optoelectronic properties of perovskite materials via DFT

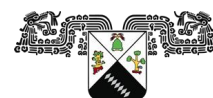
Hamza Belkhanchi<sup>\*1, 2</sup>, Younes Ziat<sup>1, 2</sup>

<sup>1</sup>Laboratory of Engineering and Applied Physics Team (EAPT), Sultan Moulay Slimane University, Beni Mellal, Morocco.

<sup>2</sup>The Moroccan Association of Sciences and Techniques for Sustainable Development (MASTSD), Beni Mellal, Morocco

**Abstract.** This study explores the electronic properties of perovskite materials, including  $\text{MgTiO}_3$ ,  $\text{MgCrH}_3$ , and  $\text{MgFeH}_3$ , using density functional theory (DFT). The calculations revealed metallic behavior with a zero band gap, indicating potential for applications in optoelectronic devices. Band structure analysis showed an interesting distribution of electronic states, favoring optical transitions in the visible spectrum. These results open the way for applications in photovoltaics and catalysis, where control over electronic transitions is crucial for energy efficiency.

**Keywords:** perovskite materials; electronic properties; photovoltaics; catalysis.





# The vacancy-ordered halide double perovskite (B = Zr, Hf) for photovoltaic and photocatalytic hydrogen production by splitting water applications: First- principal calculations

B. Akenoun<sup>1</sup>, S. Dahbi<sup>1</sup>, H. Ez-Zahraouy<sup>1</sup>, N. Tahiri<sup>1\*</sup>

<sup>1</sup>Laboratory of Condensed Matter and Interdisciplinary Sciences, «Unite de Recherche Labellisee CNRST» URL-CNRST- 17, Faculty of Sciences, Mohammed V University of Rabat, Morocco

**Abstract.** The structural, electronic, optical, and photocatalytic properties of pure and Ti-doped on the B- site of are explored using the first principal calculation based on the Density Functional Theory (DFT). Our finding band gap values are 3.175 eV for and 4.153 eV for by PBE-GGA + mBJ approximation, is closer to the experimental data. Besides, (B = Zr, Hf and x = 0, 0.25, 0.5, 0.75) compounds studied are p-type semiconductors with direct band gap. However, has an indirect band gap when the compounds are completely doped with Ti atom (x = 1) at the B-site. In addition, the band gap reduced after the Titanium impurities were substituted on the Zr or Hf sites, from 2.983 eV for (x = 0) to 1.802 eV for (x = 0.75) and from 3.865 eV for (x = 0) to 1.871 eV for (x = 0.75) taking into consideration spin-orbit coupling (SOC). The band gap reduction enables the absorption to reach more than in the visible region, especially for (B = Hf and Zr) doped. Furthermore, from the enthalpy of formation, all structures studies are thermodynamically stable, as well as can produce hydrogen by splitting water. With all of these results, we are expecting (B = Zr, Hf) doped compounds to be employed as semiconductors in photovoltaic and photocatalytic devices.

**Keywords:** Halide double perovskite, Solar cell, Optical properties, Photocatalytic, Ab-initio calculations.



## Thermodynamic modeling of molten salts as phase change materials

Nadia Namat <sup>\*1</sup>, Mohamed Idbenali<sup>1, 2</sup>, Khadija Achgar<sup>1</sup>, Fatima Zahra Chrifi Alaoui<sup>1</sup>, Fatima-ezzahra Kerkoubi<sup>1</sup>, Meriam Boulgana<sup>1</sup>,

<sup>1</sup> Laboratory of Thermodynamics and Energy (L. T. E.), Department of Physics, Faculty of Sciences, University Ibn Zohr, P O 8106, Hay Dakhla, 80000, Agadir, Morocco

<sup>2</sup> Center for Education and Training Professions Souss Massa, Agadir, Morocco

**Abstract.** The binary system NaCl-CsCl is of great interest for thermal energy storage applications, particularly in the development of molten salt mixtures. Based on the knowledge acquired during studies on phase-changing materials, this research aims to study in a computational way the phase balances of the NaCl-CsCl system using the CALPHAD approach. Experimental data, including phase diagrams and thermodynamic properties, were used as the basis for the modeling process. The binary phases of the system (NaCl), (CsCl), and the liquid phase were treated as alternatives. The standard thermodynamic functions of the system were derived from the available experimental data, with a particular emphasis on heat capacity and mixing enthalpy. The Thermo-Calc software was used to minimize the Gibbs free energy, calculate phase equilibria, and construct phase diagrams. This study produced a detailed phase diagram for the NaCl-CsCl system, in agreement with the experimental data, and identified compositions with clear and reversible phase transitions. These results contributed to the optimization of molten salt mixtures for high-temperature thermal storage, particularly in solar power plants. In addition, the thermodynamic parameters obtained will provide valuable information for the development of efficient and economically viable energy storage materials.

**Keywords:** NaCl-CsCl ; thermal storage ; phase equilibrium ; CALPHAD





# Exploring How Iron Doping Affects the Structural, Microstructural, Dielectric, and Electrical Properties of Barium Titanate Ceramics

Driss Akhlidej<sup>1\*</sup>, Abdelhalim Elbasset<sup>1</sup>, Farid Abdi<sup>1</sup>, Taj-dine Lamcharfi<sup>1</sup> Nor-Said Echatoui<sup>1</sup>

<sup>1</sup>Signals, Systems and Components Laboratory, University Sidi Mohammed Ben Abdellah USMBA, Faculty of Science and Technology of Fez, BP 2202, Route d'Imouzzer, Fez, Morocco

**Abstract.** Polycrystalline  $\text{BaTi}_{1-x}\text{Fe}_x\text{O}_3$  ceramics, with Fe doping levels of  $x = 0, 2,$  and  $4\%$ , were synthesized using the sol-gel method and subsequently calcined at  $1000^\circ\text{C}$ . The structural, microstructural, dielectric, and electrical properties of these ceramics were thoroughly investigated using X-ray diffraction (XRD), Fourier-transform infrared spectroscopy (FTIR), scanning electron microscopy (SEM), dielectric spectroscopy, and UV-Visible spectroscopy. XRD analysis confirmed the successful formation of a well-crystallized perovskite phase without any detectable secondary phases. The Rietveld refinement further revealed that the ceramics crystallize in a tetragonal lattice symmetry, which is characteristic of the  $\text{BaTiO}_3$  system. SEM analysis of the samples sintered at  $1250^\circ\text{C}$  revealed spherical grains with size variations as a function of Fe concentration. Indeed, grain size initially decreased with  $2\%$  Fe doping, followed by a gradual increase at higher doping levels. Dielectric measurements showed a significant enhancement in the dielectric constant and dielectric loss at  $x = 2\%$ , which then decreased at  $x = 4\%$ . This trend was attributed to the influence of Fe doping on the polarization mechanisms within the material. Additionally, the AC conductivity followed Joncher's law, with Fe substitution causing a reduction in conductivity at  $x = 2\%$ , followed by an increase at  $x = 4\%$ . These findings suggest that controlled Fe doping in  $\text{BaTiO}_3$  ceramics can effectively tailor their dielectric and electrical properties for potential applications in capacitors and other electronic devices.

**Keywords:** Barium Titanate, Fe Doping, X-ray Diffraction (XRD), Fourier-transform Infrared Spectroscopy (FTIR), Scanning Electron Microscopy (SEM), Dielectric Constant, AC Conductivity.





## Robust Control for DFIG-Based Intelligent MPPT

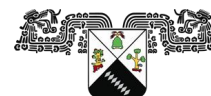
Achraf EL OUALI <sup>1</sup>, Yassine LAKHAL<sup>1</sup>, Mohamed BENCHAGRA<sup>1</sup>, Hamid Chojaa <sup>2</sup>

<sup>1</sup>Department Team of engineering and applied physics Higher school of Technology of Beni Mellal, Morocco

<sup>2</sup>Higher School of Technology, Sidi Mohamed Ben Abdellah University, Fez 30000, Morocco

**Abstract.** Mitigating nonlinearities and parameter fluctuations in high-rated wind energy systems is crucial for efficient energy conversion and grid integration. This paper presents a robust Integral Sliding Mode Control (ISMC) strategy for monitoring active and reactive power in a DFIG-based wind turbine. An artificial neural network-based MPPT algorithm enhances speed control, addressing power fluctuations. The proposed ISMC ensures optimal dynamic response to wind variations. Its performance is compared using a PI controller in Field-Oriented Control (FOC\_PI) in MATLAB/Simulink on a wind system of 1.5 MW and tested under real-wind conditions. Simulation results confirm that ISMC outperforms FOC\_PI in reference tracking, accuracy, dynamic behavior, and current distortion reduction.

**Keywords:** Keywords: ANN, DFIG, MPPT, ISMC.





# Effect of Cu Doping on Structural, microstructural and Dielectric Properties of $Ba_{1-x}Cu_xTiO_3$ Ceramics Prepared by Sol-Gel technique

Z. el khalafi<sup>1</sup>, A. Elbasset<sup>1</sup>, T. Lamcharfi<sup>1</sup>, F. Abdi<sup>1</sup>, S. Echatoui<sup>1</sup>, M. Ahabboud<sup>1</sup>, L. E. omari<sup>2</sup>

<sup>1</sup>Signals, Systems and Components Laboratory (LSSC), Electrical Engineering Department, Faculty of Sciences and Technologies Fez, Imouzzer Road B.P. 2202, University Sidi Mohamed Ben Abdellah Morocco

<sup>2</sup>LPMMT, Faculté des Sciences Ain-chok, Université Hassan II, casablanca, Maroc

**Abstract:** In This work, we studied the effect of copper doping on the structural, microstructural and dielectric properties of  $Ba_{1-x}Cu_xTiO_3$  (BC<sub>x</sub>T) ceramics where  $x = 0, 0.01$  and  $0.04$  were studied. Powder of the compositions (BC<sub>x</sub>T) was obtained by sol-gel route, the powders were calcined at 1000 °C for 4 h and sintered at 1250 °C for 6 h. X-ray diffraction analysis and Raman spectroscopy suggest the formation phase of tetragonal structure which was confirmed by Rietveld refinement. Dielectric measurements of the compounds were studied as a function of temperature (from room temperature to 200 °C at different frequencies) and as a function of frequency (from 100 Hz to 2 MHz at different temperatures). The temperature variation of the real permittivity gives evidence of the ferroelectric phase transition as well as of the resonance behaviour also observed in the dielectric permittivity frequency-dependent variation, doping reduces dielectric losses.

**Keywords:**  $Ba_{1-x}Cu_xTiO_3$  ceramics, Dielectric properties, Raman spectroscopy, Rietveld refinement.



# Design and Theoretical Investigation of Modified Spiro-Type HTMs for Enhanced Optoelectronic Properties in Perovskite Solar Cells: Theoretical Simulation and Experimental Exploration

Y .Baddi<sup>1</sup> , A. Staoui<sup>1\*</sup>, A. Idrissi<sup>1</sup>, Z. El Fakir<sup>1</sup>, S. Bouzakraoui<sup>1</sup>

<sup>1</sup>Laboratory of Advanced Materials and Process Engineering, Faculty of Sciences, Ibn Tofail University, Campus Universitaire, Kénitra, Maroc

**Abstract.** The high efficiency and low cost of materials and processes make perovskite solar cells a promising alternative to commercial silicon or other organic and inorganic solar cells. Perovskite solar cells have made remarkable progress their power conversion efficiency (PCE) has significantly increased and now stand at 26.1% in an incredibly short time (period of 2009-2024). Hole transport material (HTM) is considered an essential component of PSCs, and several HTMs have been synthesized to date. The small molecule 2,2',7,7'-tetrakis (N, N-di-p-methoxyphenyl)- amine-9,9'-spirobifluorene (spiro-OMeTAD, commonly referred to as 'Spiro'), is among the most effective hole transport materials (HTMs) used in perovskite solar cells (PSCs). However, its versatility remains suboptimal. To enhance its performance, structural or chemical modifications are being explored. The development of HTM is an important approach to promote the PCE of PSCs. In this theoretical study, four small molecules (DP1–DP4) were designed by introducing  $\pi$ - bridges to investigate their impact on the optoelectronic properties of hole-transporting materials (HTMs) for perovskite solar cells (PSCs) or as donor materials for organic solar cells. These modifications were inspired by the reference molecule (DP), a synthesized spiro-based HTM, which served as the foundation for the design. Using density functional theory (DFT) and time- dependent DFT (TD-DFT) with Gaussian 09, we carried out an in-depth investigation of the structural, electronic, and optical properties of the proposed molecules. The designed molecules exhibit appropriate frontier molecular orbital levels, enabling efficient hole transfer from perovskite materials to the HTMs in the hole-transporting layer of PSC devices. Additionally, all the molecules demonstrate good efficiency, pore-filling ability, and stability, along with solubility in dichloromethane. These properties highlight the potential of the newly designed molecules as efficient HTMs for perovskite solar cells or as donor materials for organic photovoltaics, paving the way for the development of next-generation photovoltaic devices.

**Keywords:** Hole transporting materials (HTMs), PSC, Density functional theory, solar cells ,optoelectronic properties



# 1<sup>st</sup> International Conference on Sciences and Techniques for Renewable Energy and the Environment (STR2E 2025)



## References

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# Computational Analysis of Heat Transport in Nanostructured Porous Silicon Thermal Interface Materials for Enhanced Photovoltaic Cooling

Othman SOUBAI \*<sup>1</sup>, Younes ABOUELHANOUNE \*<sup>1</sup>, Mohamed TAIBI \*<sup>1</sup>

<sup>1</sup>LSA, EMAO, ENSAH, UAE, Morocco

**Abstract.** Thermal management in photovoltaic systems remains a critical challenge, as excessive heat significantly reduces solar cell efficiency and lifetime. This computational study investigates the thermal transport behavior of Nanostructured porous silicon-based Thermal Interface Materials (TIMs) using the Boltzmann Transport Equation (BTE) framework implemented in OpenBTE. Through systematic simulation of various pore architectures and distributions, we analyze how nanoscale thermal transport mechanisms influence overall heat dissipation performance. The study focuses on optimizing pore size distribution and morphology to achieve enhanced thermal management. Our computational approach employs the Boltzmann Transport Equation to model heat transfer. Results demonstrate the relationship between pore characteristics and thermal performance under typical photovoltaic operating conditions, providing design guidelines for thermal management solutions in solar energy systems.

**Keywords:** Thermal management ; Nanostructured porous silicon ; Nanoscale thermal transport





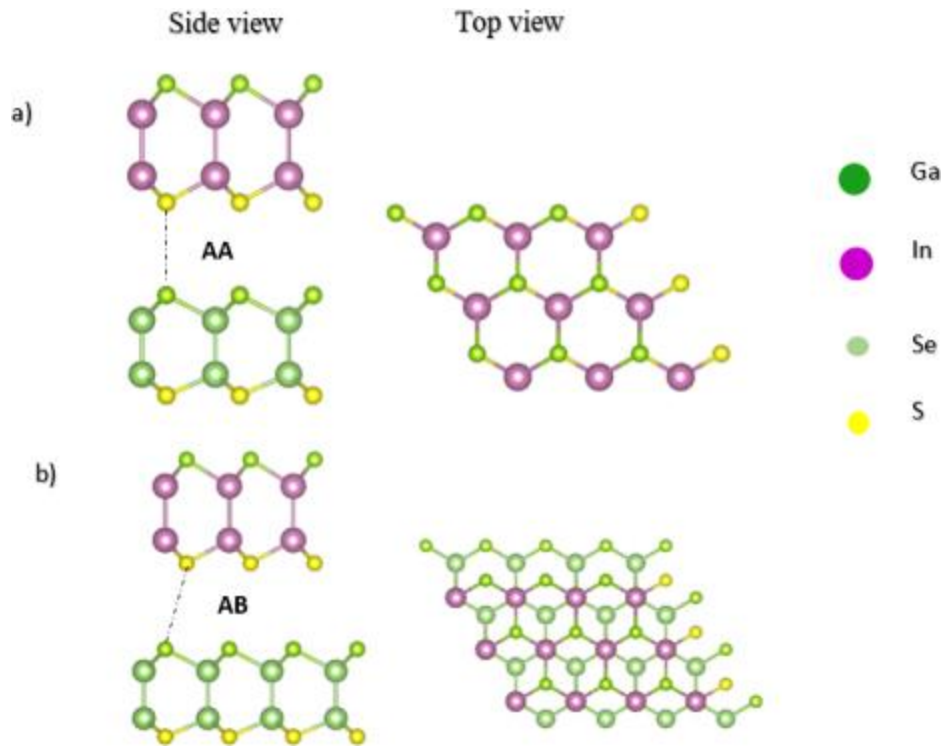
# Exploring the Structural and Optoelectronic Characteristics of GaSeS/InSeS Type-II heterostructure Using First-Principles Calculations

ZIANI Hanan<sup>1\*</sup>, El Hassan El Harouny<sup>1</sup>, El Hadri Mustapha<sup>1</sup>, and Ben Abdelouahab Farid

<sup>1</sup>Condensed Matter Physics Team, Abdelmalek Essaâdi University, Tetouan 93000, Morocco

**Abstract.** The electronic structure and optical properties of a two-dimensional (2D) GaSeS/InSeS van der Waals heterostructure, formed by stacking GaSeS and Janus InSeS monolayers, were studied using first-principles calculations based on Density Functional Theory (DFT). The monolayers exhibit semiconductor behavior with direct and indirect bandgaps of 1.556 eV and 2.03 eV for InSeS and GaSeS, respectively. The GaSeS/InSeS heterostructure demonstrates a type-II band alignment with an indirect bandgap in both AA and AB stacking configurations, having values of 1.3207 eV and 1.3452 eV (PBE), and 2.0997 eV and 2.1242 eV (HSE), respectively. Optical analysis shows that both stacking (AA and AB) exhibit similar absorbance spectra, primarily in the UV range, with maximum absorption around  $10^6 \text{ cm}^{-1}$ . In the visible range, the peak absorption coefficient for both models is  $2.122 \times 10^5 \text{ cm}^{-1}$  at 400 nm. These findings highlight the potential of the GaSeS/InSeS heterostructure for applications in photovoltaic solar cells and optoelectronic devices.

**Keywords:** Density functional theory (DFT); Electronic and optical properties; GaSeS/InSeS van der Waals heterostructure; Photovoltaic solar cells



**Title:** Top and side views of a schematic representation of optimized structure of a) AA-stacking and b) AB-stacking of The GaSeS/InSeS heterostructure.



# Structural, Elastic, and Optoelectronic Properties of Half-Heusler LiYN (Y = Ca, Mg, Zn) Alloys: A DFT Study

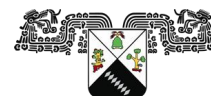
Younes Ziat<sup>1, 2</sup>, Hamza Belkhanchi<sup>1, 2</sup>

<sup>1</sup> *Laboratory of Engineering and Applied Physics Team (EAPT), Sultan Moulay Slimane University, Beni Mellal, Morocco.*

<sup>2</sup> *The Moroccan Association of Sciences and Techniques for Sustainable Development (MASTSD), Beni Mellal, Morocco*

**Abstract.** This study investigates the structural, elastic, and optoelectronic properties of half-Heusler LiYN (Y = Ca, Mg, Zn) alloys using Density Functional Theory (DFT). The materials were analyzed for their potential use in optoelectronic applications. Changes in their electronic properties, such as the type and behavior of the bandgap, were observed under varying conditions. The study also explored the stability of these materials by examining key elastic constants, which are crucial for understanding their mechanical properties. Furthermore, optical characteristics, including dielectric functions and refractive indices, were evaluated. The findings provide valuable insights into the behavior of these alloys, highlighting their suitability for use in optoelectronic devices.

**Keywords:** Half-Heusler, LiYN, structural properties; optoelectronic properties





# X-ray diffraction and Raman spectroscopy study of composition-induced phase transitions in $Ba_{2-x}Sr_xMgWO_6$ double perovskites

Moulay Abdelaziz EL AAMRANI<sup>\*1</sup>,

<sup>1</sup> *Laboratoire Matériaux et Environnement (LME), Faculty of Science, Ibn Zohr University,  
80000 Agadir, Morocco.*

**Abstract.** The materials with double perovskite structure  $(AA')(MM')O_6$ , are solid solutions of two perovskites :  $AMO_3$  and  $A'M'O_3$ . In  $(AA')(MM')O_6$ , A and A' represent alkaline rare earth cations ( $Ca^{2+}$ ,  $Sr^{2+}$  or  $Ba^{2+}$ ), while M and M' are two heterovalent transition-metal elements. The crystallographic phase transitions as a function of temperature are common in this type of perovskite. These structural changes are often intimately related to the physical properties of materials. Because of these properties, these materials have recently attracted the interest of materials scientists [1] for possible applications in magneto-resistive devices [2] that revolutionized the computing world today. In previous studies, similar double perovskites showed other properties such as superconductivity [3], antiferromagnetic to ferri- and ferromagnetic, ferromagnetic and ferroelectric in the same phase [4], ionic conductivity [5] and catalytic properties [6], etc. Indeed, because of their important applications cited above in diverse fields, oxides with the perovskites structure in modern materials continue to grow. In this work, we report the preparation, X-ray diffraction with Rietveld refinement and Raman spectroscopic study of phase transitions induced by composition in the new solid solutions  $Ba_{2-x}Sr_xMgWO_6$  (with  $0 \leq x \leq 2$ ).

**Keywords:** Double perovskite, Phase transition, Raman spectroscopy, X-ray diffraction.

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# Parametric study of the impact of insulation and wall thickness in straw-reinforced adobe structures on energy performance in a Moroccan desert climate

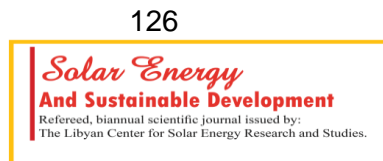
Abdelmounaim Alioui<sup>\*1,2</sup>, Youness Azalam<sup>2</sup>, Mohammed Benfars<sup>2</sup>, El Maati Bendada<sup>1,2</sup>, Mustapha Mabrouki<sup>2</sup>

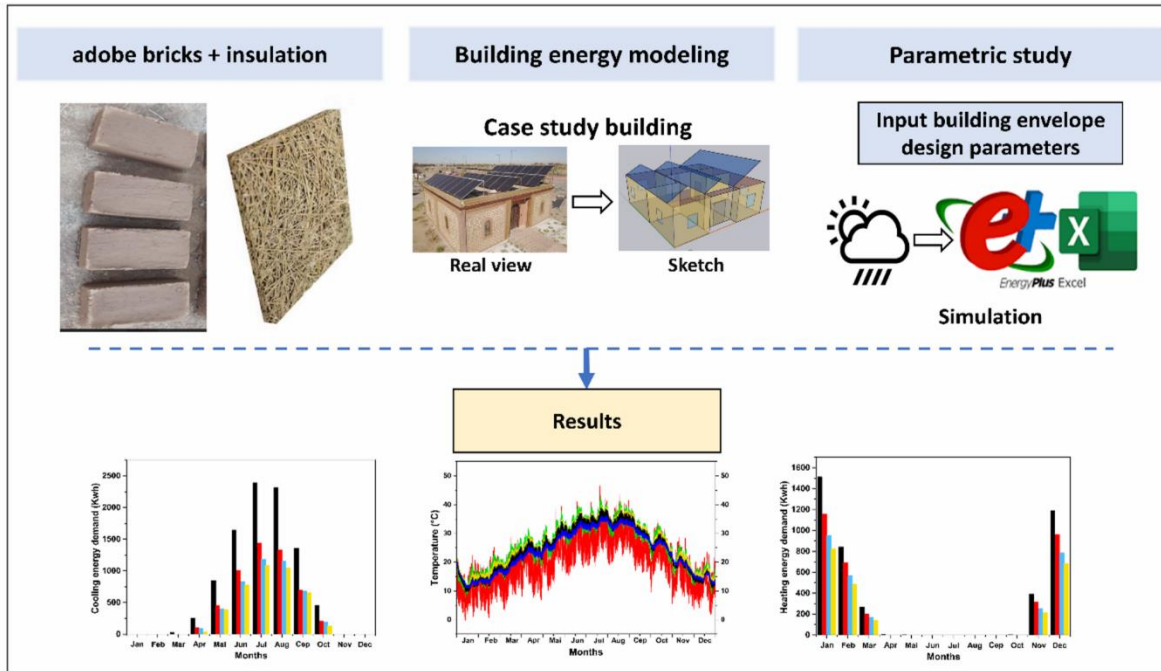
<sup>1</sup>*Polydisciplinary Faculty Sultan Moulay Slimane University Beni Mellal, Morocco*

<sup>2</sup>*Laboratory of Industrial and Surface Engineering Sultan Moulay Slimane University Beni Mellal, Morocco*

**Abstract.** In hot and arid desert climates, the thermal performance of passive buildings is strongly influenced by external climatic factors such as solar radiation, air temperature, humidity, and wind speed. However, these challenges can be mitigated through a judicious selection of construction materials and the optimization of their properties to ensure occupant thermal comfort. This study aims to identify the optimal combinations of insulation and wall thickness in straw-reinforced adobe structures to enhance the energy performance of buildings in a Moroccan desert context. Using a validated energy model, the study investigates two key parameters: the addition of natural fiber insulation and the variation of wall thickness. Preliminary results show that adding 0.10 m of insulation significantly improves thermal performance compared to non-insulated walls. In the absence of insulation, wall thicknesses between 0.4 m and 0.55 m reduce thermal fluctuations by up to 25%. With insulation, an optimal wall thickness of 0.3 m reduces external temperature variations by 21% while minimizing the use of construction materials. This study highlights the importance of designing walls tailored to specific climatic conditions to optimize energy efficiency, reduce the ecological footprint, and promote sustainable architecture in desert regions.

**Keywords:** Straw-reinforced adobe structures; insulation; Building energy performance; Desert climate





Title: Graphical abstract of the study



# DFT and BoltzTraP Study of the Structural and Thermoelectric Properties of Perovskite Materials

Younes Ziat<sup>1,2</sup>, Hamza Belkhanchi<sup>1,2</sup>

<sup>1</sup>Laboratory of Engineering and Applied Physics Team (EAPT), Sultan Moulay Slimane University, Beni Mellal, Morocco.

<sup>2</sup>The Moroccan Association of Sciences and Techniques for Sustainable Development (MASTSD), Beni Mellal, Morocco

**Abstract.** This study investigates the structural and thermoelectric properties of perovskite materials using density functional theory (DFT) with the GGA functional. Computational simulations were performed using the Wien2k code, incorporating the BoltzTraP package to analyze thermoelectric behavior. The structural stability was examined through the Murnaghan equation of state, while electronic properties were explored via band structure and density of states calculations. The results indicate a metallic nature, with conduction and valence bands overlapping, leading to a zero bandgap. Thermoelectric properties were analyzed across a temperature range of 300–900 K. Electrical conductivity showed material-dependent variations, while thermal conductivity exhibited a linear increase with temperature, reflecting enhanced heat transfer. The figure of merit (ZT) and power factor (PF) displayed temperature-dependent trends, revealing the potential of these materials for thermoelectric applications. These findings contribute to the understanding of perovskite materials and their suitability for energy-related technologies.

**Keywords:** Density Functional Theory (DFT); BoltzTraP; Perovskite; Thermoelectric Properties.





# Thermal and Physical Performance of Adobe Bricks Reinforced with Wood Fibers for Energy-Efficient Construction in Semi-Arid Climates

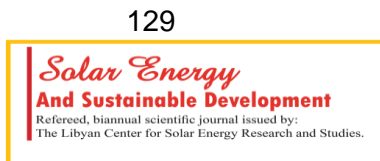
Mohammed Benfars<sup>1\*</sup>, Abdelmounaim Alioui<sup>1,2</sup>, Youness Azalam<sup>1</sup>, Mourad  
Kaddiri<sup>1</sup> and Mustapha Mabrouki<sup>1</sup>

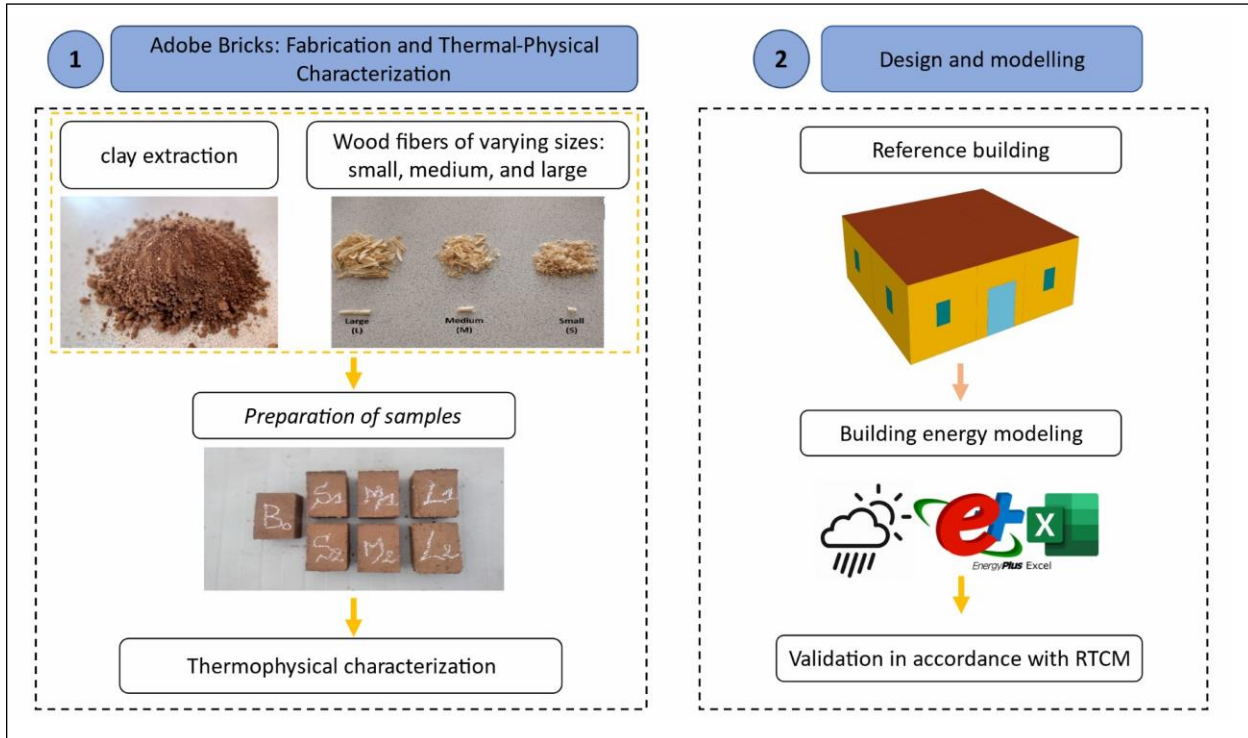
<sup>1</sup>Laboratory of Industrial and Surface Engineering Sultan Moulay Slimane FST, Mghila, B.P.  
592, Beni Mellal, Morocco, 23000

<sup>2</sup>FP, Mghila, B.P. 592, Beni Mellal, Morocco, 23000

**Abstract.** The transition towards sustainable construction practices drives the exploration of biobased materials that combine local resources and technical innovations. This study evaluates the thermal and physical performance of adobe bricks reinforced with wood fibers of varying sizes (ranging from 0.3 to 2 cm) to make them more suitable for energy-efficient construction. The bricks were manufactured using local materials, and the physicochemical properties of the clay used were first characterized. The thermophysical properties of the bricks, including their thermal conductivity, density, and compressive strength, were analyzed in the laboratory. Annual thermal simulations were conducted using the TRNSYS software for a typical building located in Beni Mellal, a semi-arid city in Morocco, based on representative meteorological data. The results reveal that incorporating wood fibers, particularly those of smaller size (0.3 cm), significantly enhances the thermal insulation properties of the adobe bricks. These improvements lead to a notable reduction in energy demands for heating and cooling. This research highlights the importance of local clay-based materials and natural reinforcements to optimize the energy efficiency of buildings. It also offers new perspectives for their integration into sustainable construction practices, contributing to global sustainable development goals.

**Keywords:** Adobe bricks, Wood fibers, Thermal performance, Physical properties, Energy efficiency, Sustainable construction.







# First study the impact of pressure on the structural, optical and mechanical properties of the LiGeCl<sub>3</sub> perovskite

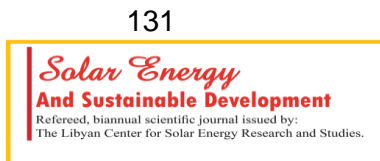
Mohammed Miri <sup>\*1,2</sup>, Younes Ziat <sup>1,2</sup>, Hamza Belkhanchi <sup>1,2</sup>, Abdellah Bouzaid <sup>1,2</sup>, Youssef Jouad <sup>1,2</sup>, Youssef Ait El Kadi <sup>1</sup>

<sup>1</sup>Engineering and Applied Physics Team (EAPT), Sultan Moulay Slimane University, Beni Mellal, Morocco

<sup>2</sup>The Moroccan Association of Sciences and Techniques for Sustainable Development (MASTSD), Beni Mellal, Morocco

**Abstract.** The study focuses on the lithium-based crystalline perovskite material LiGeCl<sub>3</sub>, which exhibits semiconducting properties. The aim is to improve its structural, electronic, and optical properties by exploiting the effect of hydrostatic pressure using the DFT method and the GGA approximation. The application of pressure reduces the lattice parameter, which enhances the self-cohesion, leading to stabilization of the atomic structure. The elastic moduli meet the stability conditions, and the B/G and  $\nu$  ratios indicate that the material is stable and ductile. In terms of optoelectronic properties, the pressure reduces the electronic band gap to 0eV at pressure 6GPa, thereby improving the absorption in the visible region, spectral reflectivity, and refractive index. These improvements make LiGeCl<sub>3</sub> important and more efficient in photovoltaic applications.

**Keywords:** Absorption; Optical; semiconductor; Stability



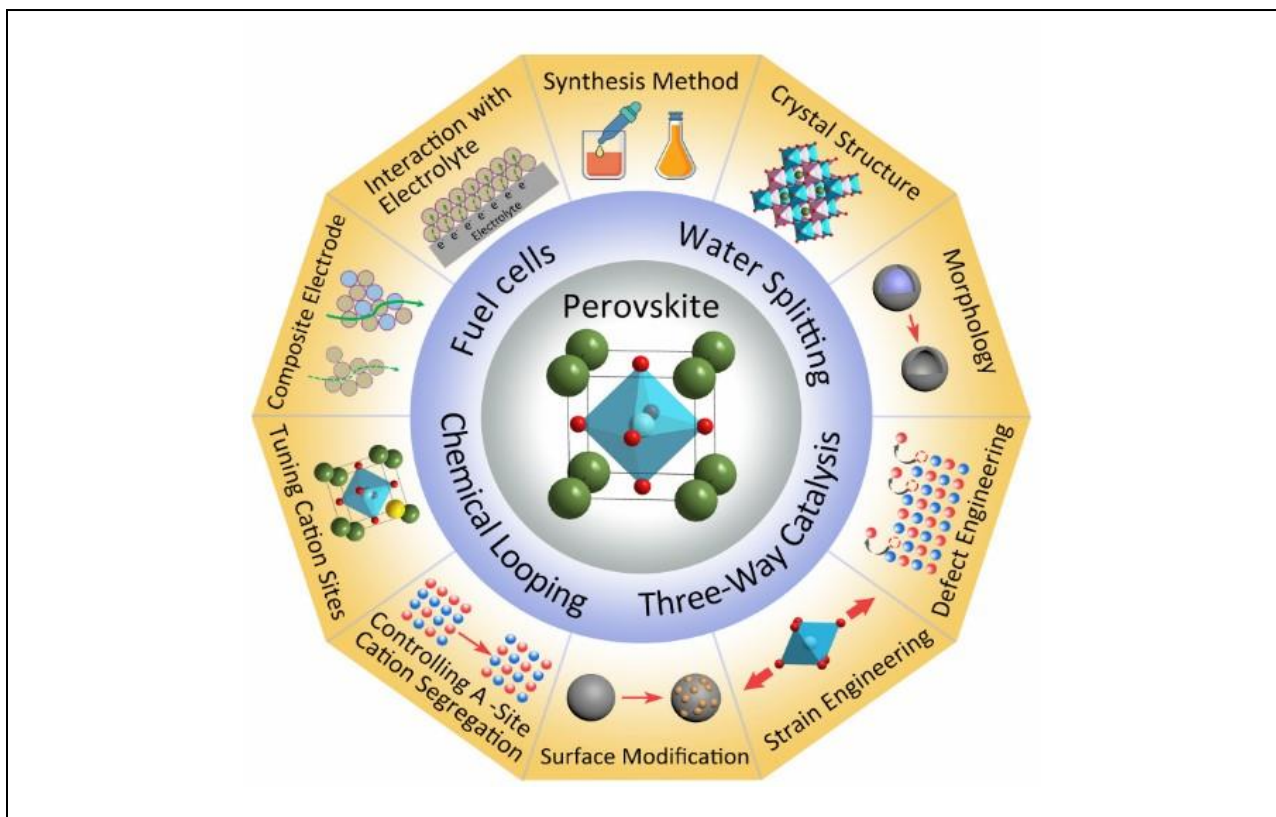
# Investigation of novel perovskite materials for solar energy applications

A. Waqdim <sup>\*1</sup>, M. Agouri <sup>\*1</sup>, H. Ouhenou <sup>\*1</sup>, E. Darkaoui <sup>\*1</sup>, A. Zaghrane <sup>\*1</sup>, A. Abbassi <sup>\*1</sup>, S. Taj <sup>\*1</sup>, B. Manaut <sup>\*1</sup>, M. El Idrissi <sup>\*1</sup>

<sup>1</sup>Sultan Moulay Slimane University, Beni Mellal, Morocco.

**Abstract.** Investigations of physical properties of the simple cubic perovskite oxides  $XGeO_3$  and ( $X=Sr, Ca$ ). These calculations were studied using the Wien2k code based on Density Functional Theory (DFT). For the precise calculation of electronic properties, the Perdew–Burke–Ernzerhof for solids (PBE-sol) and modified Beche Jhonson (mBJ) approaches based on generalized gradient approximation (GGA) have been incorporated. Finally, the results of our calculations indicate that our materials are well suited for various renewable energy applications.

**Keywords:** Density Functional Theory; Wien2K; Simple Perovskite; renewable energy.





# Towards Green Hydrogen: S, Se, and Te Doping of MgTiO<sub>3</sub> for Visible-Light Photocatalysis

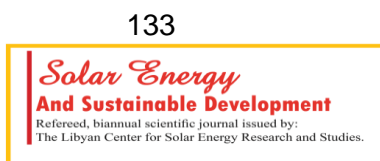
Hamza Belkhanchi<sup>\*1, 2</sup>, Younes Ziat<sup>1, 2</sup>

<sup>1</sup>Laboratory of Engineering and Applied Physics Team (EAPT), Sultan Moulay Slimane University, Beni Mellal, Morocco.

<sup>2</sup>The Moroccan Association of Sciences and Techniques for Sustainable Development (MASTSD), Beni Mellal, Morocco

**Abstract.** The growing demand for clean energy drives the exploration of efficient photocatalysts for hydrogen production. Here, we use DFT-based simulations (GGA-mBJ) to investigate the doping of MgTiO<sub>3</sub> perovskite with S, Se, and Te. The substitution of oxygen with chalcogen atoms at concentrations of 8.33%, 16%, and 25% reduces the band gap and enhances visible light absorption. Fermi level shifts indicate a transition to p-type behavior, favorable for photocatalysis. Among the studied systems, Se-doped MgTiO<sub>3</sub> at 8.33% and 16% exhibits alignment with water redox potentials at neutral pH, suggesting its suitability for sustainable hydrogen generation. This work underscores the potential of doped perovskites in green energy applications.

**Keywords:** Photocatalysts; hydrogen production; GGA-mBJ; MgTiO<sub>3</sub> perovskite





## Industrial Rock Packed-Bed Heat Storage System: Thermal Behavior and Performance Assessment

Aicha Eddemani <sup>\*1</sup>, Omar Achahour <sup>2</sup>, Hayat El Baamrani <sup>1</sup>, Ahmed Aharoune <sup>1</sup>,  
Lahcen Bouirden <sup>1</sup>, Ahmed Ihlal <sup>2</sup>

<sup>1</sup>Thermodynamic and Energetics Laboratory, Faculty of Science, Ibn Zohr University, BP8106,  
80006 Agadir, Morocco

<sup>2</sup>Materials and Renewable Energies Laboratory, Faculty of Science, Ibn Zohr University,  
BP8106, 80006 Agadir, Morocco

**Abstract.** The first industrial-scale packed bed of rocks Thermal Energy Storage (TES) system, with a thermal capacity of 100 MWh<sub>th</sub>, has been constructed for a Concentrated Solar Power (CSP) plant in Ait Baha, Morocco. It is based on the use of eco-friendly materials: natural rocks as storage material and air as heat transfer fluid (HTF). The storage unit has an original design: it has a truncated cone shape, it is immersed in the ground, and it operates at a high temperature ranging from 293K to 843 K. A CFD numerical approach validated previously is followed to study the thermal behavior of the storage system and assess its performance over 30 days of operation according to its daily conditions. The results show that the thermal stratification during charging and discharging processes is significantly enhanced in cyclic operation. Additionally, the performance of the storage system is improved during thermal cycles, reaching an efficiency of 80% by the 30th cycle.

**Keywords:** Air; Rocks; Storage material; Thermal stratification; Industrial packed-bed; CFD analysis



# Towards Pressure-Engineered Perovskite Materials: InGeF<sub>3</sub> for Optoelectronic and Solar Energy Devices

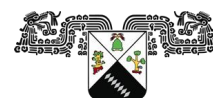
Younes Ziat<sup>1,2</sup>, Hamza Belkhanchi<sup>1,2</sup>

<sup>1</sup>Laboratory of Engineering and Applied Physics Team (EAPT), Sultan Moulay Slimane University, Beni Mellal, Morocco.

<sup>2</sup>The Moroccan Association of Sciences and Techniques for Sustainable Development (MASTSD), Beni Mellal, Morocco

**Abstract.** This computational study employs DFT to evaluate how pressure influences the mechanical, electronic, and optical behavior of InGeF<sub>3</sub> perovskite. Initially an indirect band gap semiconductor (1.51 eV at 0 GPa), InGeF<sub>3</sub> undergoes a band gap reduction to 0.67 eV under 9 GPa, approaching metallic behavior. Pressure enhances both ductility and optical absorption in the low-energy range. The interplay between halogen and metal orbitals in the density of states supports efficient charge transport under compression. These findings suggest InGeF<sub>3</sub> as a promising platform for pressure-modulated optoelectronic and renewable energy technologies.

**Keywords:** InGeF<sub>3</sub> perovskite; pressure; mechanical properties; electronic properties





# DFT approach for improving the electronic and optical properties of KZnF<sub>3</sub> perovskite: Impact of copper doping

Noureddine Elmeskini <sup>\*1,2</sup>, Younes Ziat <sup>1,2</sup>, Hamza Belkhanchi <sup>1,2</sup>, Ayoub Koufi <sup>1,2</sup>

<sup>1</sup>Engineering and Applied Physics Team (EAPT), Superior School of Technology, Sultan Moulay Slimane University, Beni Mellal, Morocco

<sup>2</sup>The Moroccan Association of Sciences and Techniques for Sustainable Development (MASTSD), Beni Mellal, Morocco

**Abstract** .This study investigates the structural, electronic and optical properties of cubic perovskite KZnF<sub>3</sub>, in its pure state and doped with copper (Cu) at a concentration of 12%, using the full-potential linearized augmented plane wave (FP-LAPW) method within the framework of density functional theory (DFT) which is implemented in the Wien2k code. Density-of-state (DOS) analysis reveals that doping significantly alters electronic properties, notably through the emergence of 3d-Cu impurity states near the Fermi level, resulting in a shift towards the valence band and a decrease of the band gap to 2.72 eV. Optical properties were also analyzed through dielectric functions (real and imaginary parts), absorption coefficient, optical conductivity, refractive index and reflectivity. Cu doping enhances absorption in the visible spectrum, increases electron polarization and optimizes charge carrier mobility, boosting the material's performance in optoelectronic devices. These results highlight the key role of doping in engineering perovskite properties for advanced applications, including photovoltaic technologies, optical sensors and next-generation electronic systems.

**Keywords:** KZnF<sub>3</sub>; Wien2k code; Absorption coefficient; Optical conductivity.



# Improving PEM Water Electrolysis Efficiency with ANN- Based Control to Handle Rapid Photovoltaic Power Fluctuations

Abdellah EL IDRISSE<sup>a,\*</sup>, Belkasem IMODANE<sup>a</sup>, Hamid HAMDANI<sup>b</sup>, M'hand  
OUBELLA<sup>a</sup>, Mohamed Benydir<sup>a</sup>, Mohamed Ajaamoum<sup>a</sup>

<sup>a</sup>Laboratory of Engineering Sciences and Energy Management (LASIME), Ibn Zohr University,  
National School of Applied Sciences, 80000 Agadir, Morocco

<sup>b</sup>Engineering and Applied Physics Team (EAPT), Higher School of Technology, Sultan Moulay  
Slimane University, Beni Mellal, Morocco

**Abstract.** This research introduces an innovative method for improving hydrogen production through Proton Exchange Membrane (PEM) water electrolysis, powered by photovoltaic (PV) energy. The system leverages the Maximum Power Point Tracking (MPPT) Perturb and Observe (P & O) method with a boost converter to maximize energy capture, and a buck converter to stabilize the DC voltage, ensuring compatibility with the PEM electrolyser. An Artificial Neural Network (ANN)-based control manages the buck converter, effectively minimizing the effects of fluctuations in solar irradiance on the electrolyser's performance. By utilizing ANN's adaptive learning capabilities, the proposed approach increases hydrogen production efficiency under varying solar energy levels. Simulation results indicate that the ANN controller surpasses the conventional PI controller, delivering quicker response times and enhancing system efficiency. This study advances renewable hydrogen production technologies, bolstering the development of smarter and more resilient energy systems.

**Keywords:** Hydrogen production, Renewable energy, PEM electrolyzer, DC-DC Converter, Sliding Mode Control.





# Parametric Design and Energy Optimization in the AEC Industry: Leveraging Visual Scripting and BIM Models with ladybugs

Aboubane Fatima\*<sup>1</sup>, Oumoumen Keltoum \*<sup>1</sup>, Ech-Charqy Younes<sup>1</sup>

<sup>1</sup> LGEMS Laboratory, Department of Civil Engineering, National School of Applied Sciences, IBNZOHR University, Morocco,

**Abstract.** This paper explores energy optimization in buildings, addressing the significant energy consumption concerns within the civil engineering and AEC industry. It introduces a smart system leveraging visual scripting techniques to enhance energy efficiency through architectural analysis. The study focuses on a visual scripting framework designed for AEC professionals, utilizing parametric design based on Building Information Modeling (BIM). By applying the LadyBugs visual language, the framework automatically analyzes various architectural configurations, taking into account factors like location, solar radiation, and environmental conditions. The methodology underwent rigorous testing, demonstrating effectiveness in optimizing energy use in architectural models. Despite being in early programming stages, the script yielded promising results, highlighting its potential to transform decision-making in building design. By facilitating informed choices through comprehensive analysis, the framework aims to promote sustainable building practices and reduce the environmental impact of energy-intensive structures.

**Keywords:** Smart systems, energy optimization, civil engineering, AEC industry, visual scripting, sustainability, BIM models





# Thermoelectric analysis of doped Heusler alloys via DFT and BoltzTraP

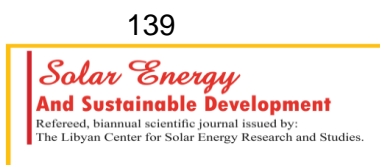
Younes Ziat<sup>1, 2</sup>, Hamza Belkhanchi<sup>1, 2</sup>

<sup>1</sup> *Laboratory of Engineering and Applied Physics Team (EAPT), Sultan Moulay Slimane University, Beni Mellal, Morocco.*

<sup>2</sup> *The Moroccan Association of Sciences and Techniques for Sustainable Development (MASTSD), Beni Mellal, Morocco*

**Abstract.** The thermoelectric properties of doped Heusler alloys were investigated using Density Functional Theory (DFT) in combination with the BoltzTraP method. The study focused on alloys such as LiYN, with Y = Ca, Mg, and Zn, and revealed their potential as p-type semiconductors with enhanced thermoelectric performance. These materials exhibit a high figure of merit (ZT), indicating their promising applicability in thermoelectric devices, which are used for efficient energy conversion. The results demonstrated a favorable balance between electrical conductivity and low thermal conductivity, both of which are essential characteristics for optimizing thermal energy conversion. By maintaining high electrical conductivity while minimizing thermal conductivity, these doped Heusler alloys can effectively convert waste heat into electricity, making them suitable for energy harvesting applications. The study also highlighted the importance of doping elements like Ca, Mg, and Zn in tuning the electronic and thermal properties of these alloys. These findings offer new insights into the development of high-performance thermoelectric materials and open avenues for future research in enhancing the efficiency of thermoelectric devices, potentially contributing to sustainable energy solutions. The investigation paves the way for further exploration into the optimization of Heusler alloys for energy conversion technologies.

**Keywords:** Heusler alloys; thermoelectric properties; BoltzTraP; p-type semiconductors



# Improving renewable energy systems with powerful artificial intelligence solutions.

Omar ELKHOUNDAFI<sup>1</sup>, Rachid ELGOURI<sup>1</sup>

<sup>1</sup>Laboratory of Advanced Systems Engineering, National School of Applied Sciences, Ibn Tofail University, Kenitra, Morocco

**Abstract.** Transitioning to renewable energy sources has become a primary issue as the world's attention shifts toward sustainability. However, because of their inherent instability and intermittency, renewables such as solar and wind power pose substantial hurdles when integrating into current energy networks. AI provides a ground-breaking solution to these challenges. This article investigates the critical role of artificial intelligence (AI) in easing renewable energy integration, from employing predictive analytics to maximize energy generation to deploying smart grid technologies that increase system stability. This article provides light on how innovative technologies can push the worldwide transition to a more sustainable energy future by investigating the interface of AI and renewable energy.

**Keywords:** Renewable energy, energy management systems, climate change, artificial intelligence.



**Title:** Schematic of the outline for this study



# Identification of Optimal Sites for Hybrid Renewable Energy Stations in Northern Morocco: A GIS-Based Approach

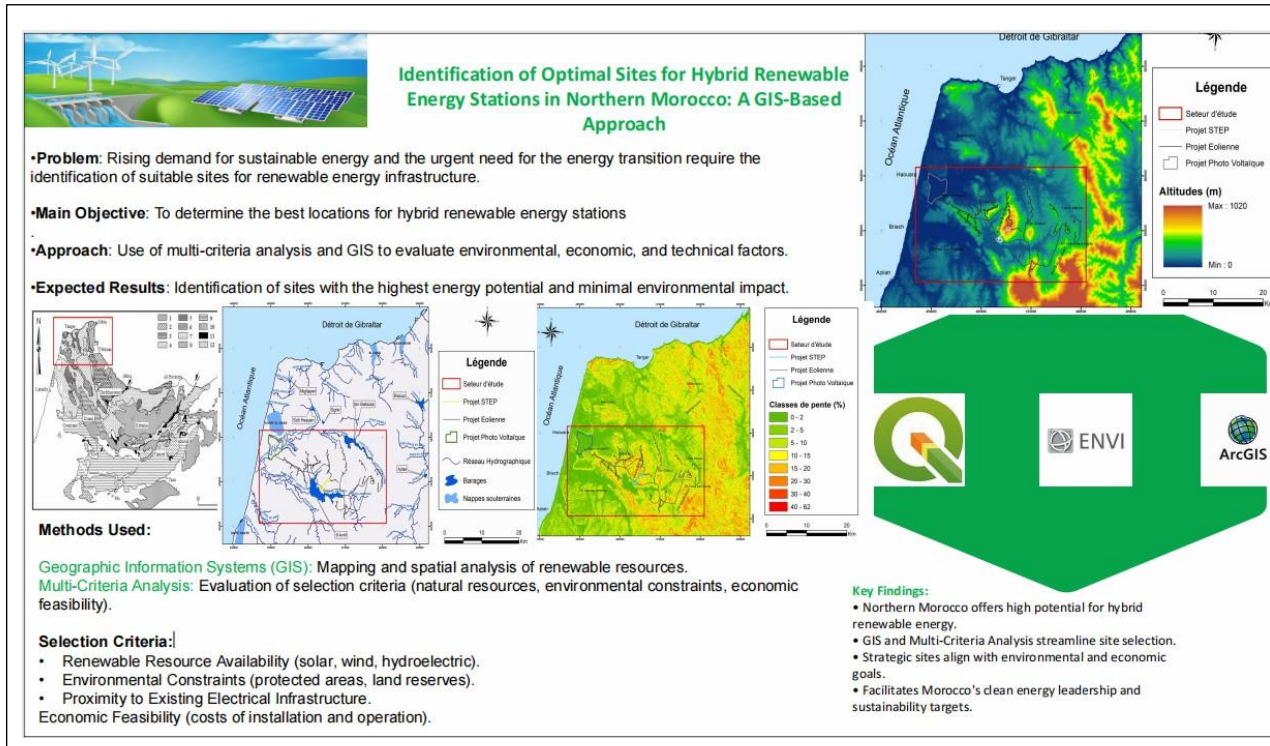
EL CHEDDADI Ihsane<sup>1</sup>, EL ARRIM Abdelkrim<sup>1</sup>

<sup>1</sup>Marine Environment and Natural Hazards Research Team, Faculty of Sciences and Techniques, Abdelmalek Essaadi University, Tangier, 90000, Morocco

**Abstract.** The purpose of this study is to identify the best locations for hybrid renewable energy stations in the region of Tanger-Tetouan-Al Hoceima -northwestern Morocco. Due to the rising need for sustainable energy, this study implements an integrated Geographic Information Systems (GIS) and Multi-Criteria analysis method in order to determine the best location for renewable energy infrastructure. Located between the Mediterranean Sea and the Rif mountains, this area has noteworthy topography and climate providing opportunities for solar, wind, and hydro energy resources. The research will help emphasize sites with the greatest potential energy output capacity with the least impact to the environment by considering availability of renewable resources, environmental constraints such as land and water set-asides, proximity to existing electrical infrastructure and other economic feasibility indicators. This strategically chosen suite of sites gives us a tool to facilitate regional development goals and the clean energy transition. These results highlight the feasibility of such a renewable energy integration pathway, which has implications not only for economic development but also sustainability and security agendas at both national and international levels in this northern Moroccan region. They are aimed at helping policymakers and investors prepare for better investments to reach a sustainable energy future and further advance Morocco leadership in renewable energy innovation.

**Keywords:** Environmental sustainability, Geographic information systems, Hybrid energy stations, Renewable energy.





**Title:** Graphical abstract: Identification of Optimal Sites for Hybrid Renewable Energy Stations in Northern Morocco: A GIS-Based Approach



# Modeling of Physicochemical Processes in Water Pollution

Soukayna MAITOUF\*<sup>1</sup>, Nadia FASKA \*<sup>1,2</sup>

<sup>1</sup>Laboratoire de Génie des Procédés, Faculté des sciences, Université Ibn Zohr Agadir, 80000,  
Morocco

<sup>2</sup>Faculté des sciences appliquées Ait-Melloul, Université Ibn Zohr Agadir, 80000, Morocco

**Abstract.** Water is essential for life; however, water resources are increasingly being depleted due to climate change and pollution. There are various methods for treating wastewater, with adsorption emerging as a cost-effective and efficient solution. This technique involves capturing pollutants on the surface of adsorbent materials, thereby reducing water contamination. The integration of artificial intelligence into this process helps optimize adsorbent selection and predict treatment performance based on water characteristics. AI is particularly effective in reliably mapping nonlinear relationships between input and output data in experiments. This combination offers new opportunities to improve treatment efficiency and ensure access to clean water for future generations. In this study, the equilibrium for sorption was examined using two widely used isotherm models the Langmuir and Freundlich isotherm models and the adsorption process was analyzed according to the kinetics of both the pseudo-first-order and second-order models to better understand its behavior.

**Keywords:** Adsorption; Artificial intelligence; Water pollution;



# IoT control system for the smart house: an embedded platform for the remote management of a connected home

Hajar TOUZANI<sup>1</sup>

<sup>1</sup>Laboratory Intelligent Systems, Georesources and Renewable Energies, Faculty of Sciences and Technologies, Sidi Mohamed Ben Abdellah University, Fez, Morocco

**Abstract.** This paper explores the design and implementation of a smart house automation system that enhances both comfort and energy efficiency. The system achieves this by automatically regulating lighting and temperature based on real-time environmental data gathered through embedded sensors. The system architecture is built around an embedded processing board, such as a Raspberry Pi, which serves as the central controller for processing sensor data and managing actuators. It receives real-time inputs from light and temperature sensors, and based on this data, adjusts actuators like LED lights and climate control devices to maintain optimal conditions. A remote web interface allows users to monitor sensor data and manually control the actuators, providing real-time interaction with the system via IoT technologies, such as MQTT (Message Queuing Telemetry Transport). The integration of Internet of Things (IoT) technologies, including the MQTT protocol, enables seamless communication between devices and facilitates remote access to system controls. This system not only improves home comfort by ensuring optimal lighting and temperature conditions but also contributes to energy savings by dynamically adapting to changing conditions. The work also sets the stage for future improvements, such as the incorporation of presence sensors to further optimize energy use and the potential integration of artificial intelligence to predict and personalize environmental adjustments. Additionally, the sensor data collected provides a valuable resource for future machine learning applications, enabling more intelligent and adaptive systems.

**Keywords:** smart house, energy, real-time, MQTT, IoT





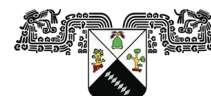
# Evaluation and Prediction of Groundwater Quality for Irrigation Using Global Water Quality Index, Machine Learning Models and GIS Approaches

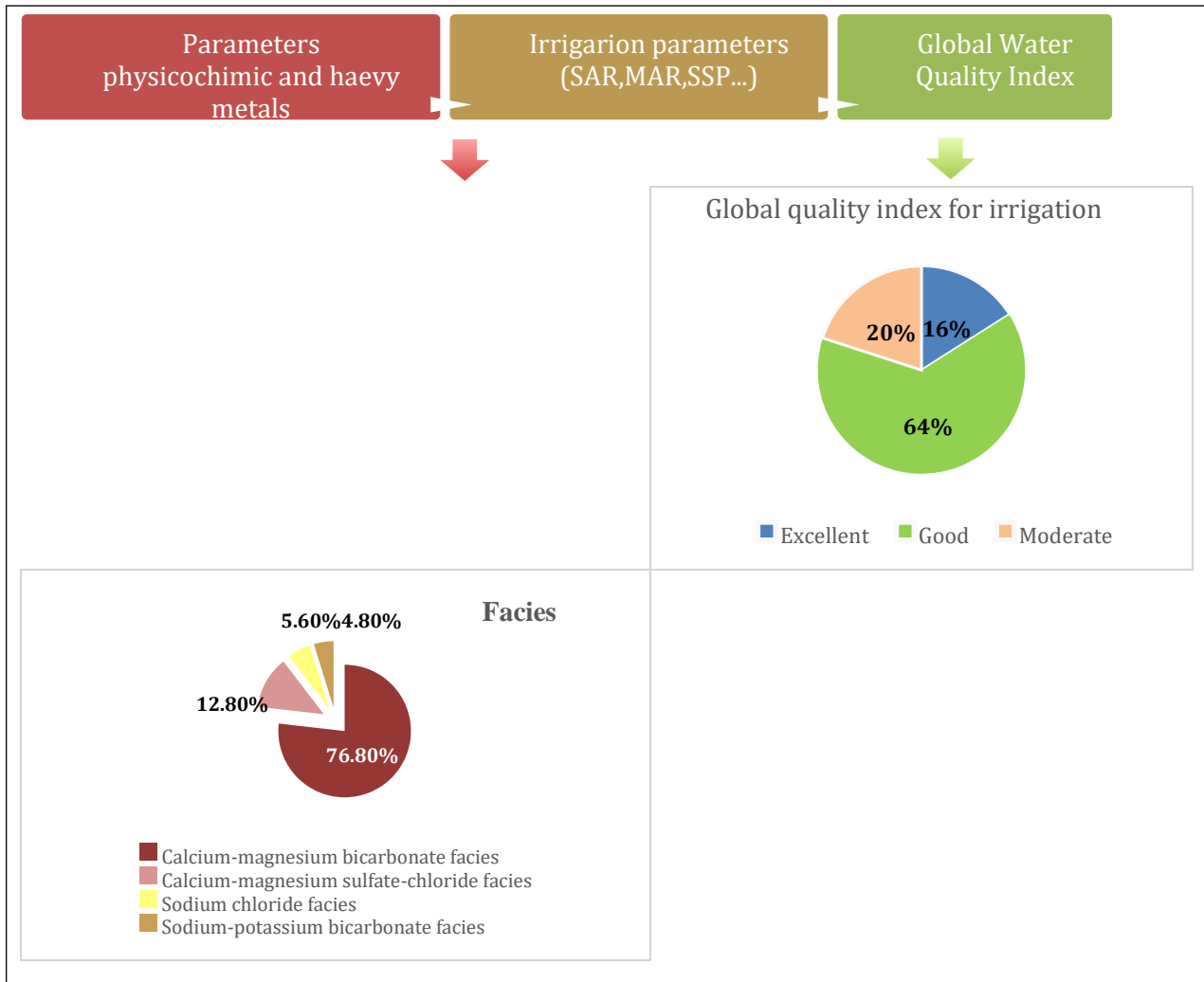
Ouafae KAIBI<sup>\*1</sup>, My Hachem AOURAGH<sup>\*1</sup>, Abdelhadi EL OUALI<sup>\*1</sup>

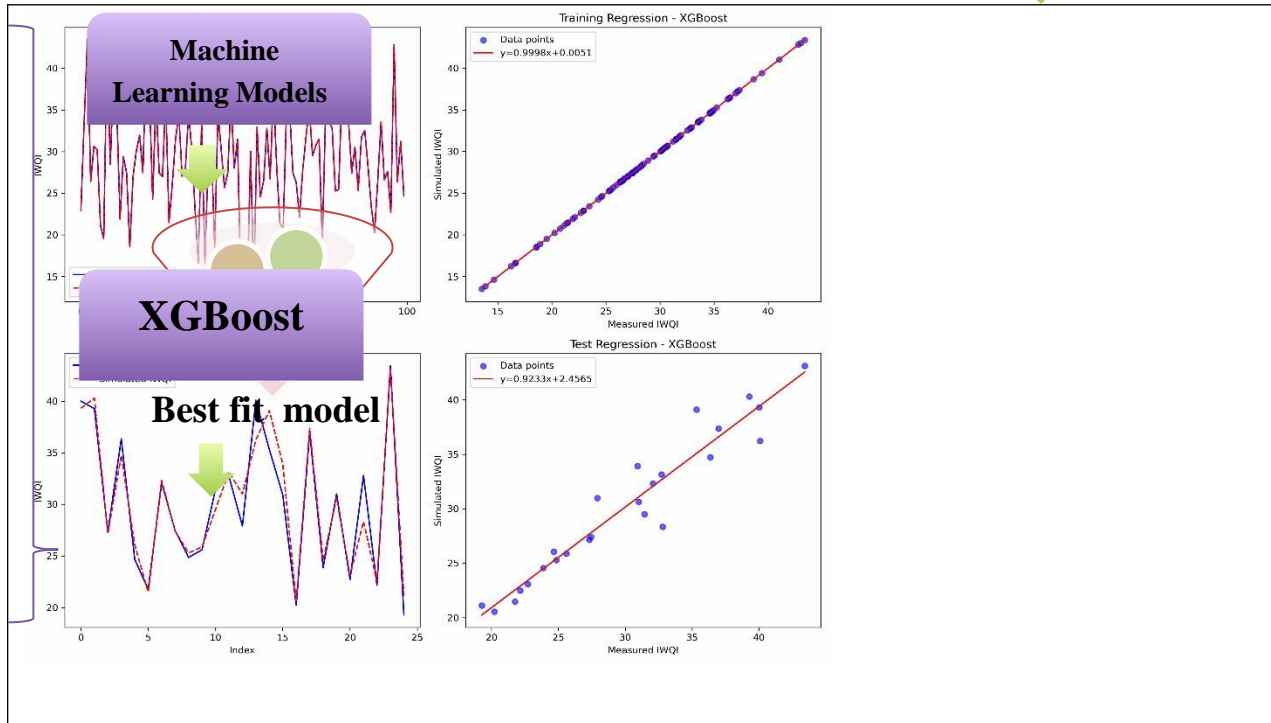
<sup>1</sup>Moulay Ismail University, Faculty of Sciences, Meknes, 50500, Morocco

**Abstract.** The Saïss plain, renowned for its fertile soils and high agricultural productivity, faces significant challenges in groundwater quality due to agricultural intensification, urbanization, and overexploitation. This study evaluates groundwater quality for irrigation using the global irrigation water quality index (IWQI global) and predictive Machine Learning models. Groundwater quality was analyzed based on physicochemical parameters (e.g., pH, EC, TDS, major ions), heavy metals (Cu, Pb, Fe), and irrigation-specific indices like SAR, SSP, PI, RSC, and MAR. Hydrochemical analysis identified that the most dominant facies is calciummagnesium bicarbonate facies, reflecting the influence of carbonate rock alterations. IWQI analysis showed that 80% of groundwater samples ranged from excellent to good quality for irrigation, while the remaining 20% were of average quality. Machine Learning models were developed to predict water quality, with Random Forest (RF) and XGBoost outperforming others. RF achieved an  $R^2$  of 91% and an MSE of 4.28, while XGBoost reached an  $R^2$  of 93% and an MSE of 3.3. XGBoost emerged as the most reliable model, excelling due to its ability to manage complex variable interactions and optimize hyperparameters effectively. These results highlight the potential of advanced models for sustainable groundwater management in the Saïss plain.

**Keywords:** Global water quality index; Groundwater; irrigation; ML







**Title:** Evaluation and Prediction of Groundwater Quality for Irrigation Using Global Water Quality Index, Machine Learning Models



# Fuzzy TOPSIS Approach for ranking Sustainable Energy Planning in Morocco

KARKOUR Youssef<sup>\*1</sup>, TAJANI Chakir<sup>\*1</sup>

<sup>1</sup> Department of Mathematics, Polydisciplinary Faculty of Larache, Abdelmalek Essaâdi University, Tetouan, Morocco

**Abstract.** Energy development is essential for Morocco, so as to promote economic development while protecting the environment. The objective of this study is to understand how the Fuzzy Technique for Order Preference by Similarity to Ideal Solution (FTOPSIS) could be used in decision-making regarding the choice of sustainable energy options. The FTOPSIS is a combination of fuzzy logic and the traditional TOPSIS in which several criteria such as cost considerations, environmental effects, energy efficiency and social acceptability are combined into one evaluation in the presence of uncertainty and imprecise criteria. Such an approach allows for a fuzzy framework that substantiates expert opinions and accommodates the vagueness of common linguistic terms used in evaluations. This method ranks the energy alternatives in terms of their proximity to the most desired state of affairs, and accordingly assists policymakers in determining the alternatives that are most sustainable. The methodology is examined on the Moroccan energy context, taking into account both renewable sources, like solar, wind and water, and traditional alternatives. Results show the effectiveness of the results in prioritizing the strategies that are consistent with the renewable energy targets set by Morocco, while considering the socio-economic constraints. This study demonstrates that the FTOPSIS is effective for aiding the sustainable energy planning process in the context of uncertainty and complexity.

**Keywords:** ahp method; fuzzy ahp; decision



# Hydrology and GR2M rain-flow modelling: case of the Oued Ansegmir catchment area (Upper Moulouya, Morocco)

Abdelfettah Es-seqally<sup>\*1</sup>, Abdelghani Qadem<sup>\*2</sup>, Yassine Eljaouhary<sup>\*3</sup>

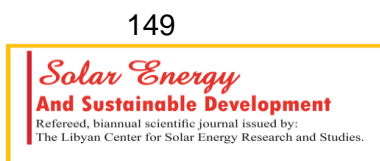
<sup>1</sup>*Geographic Landscape Dynamics, Risks and Heritage (LDPRP), FLSH, Sultan Moulay Slimane University, Beni Mellal, Morocco*

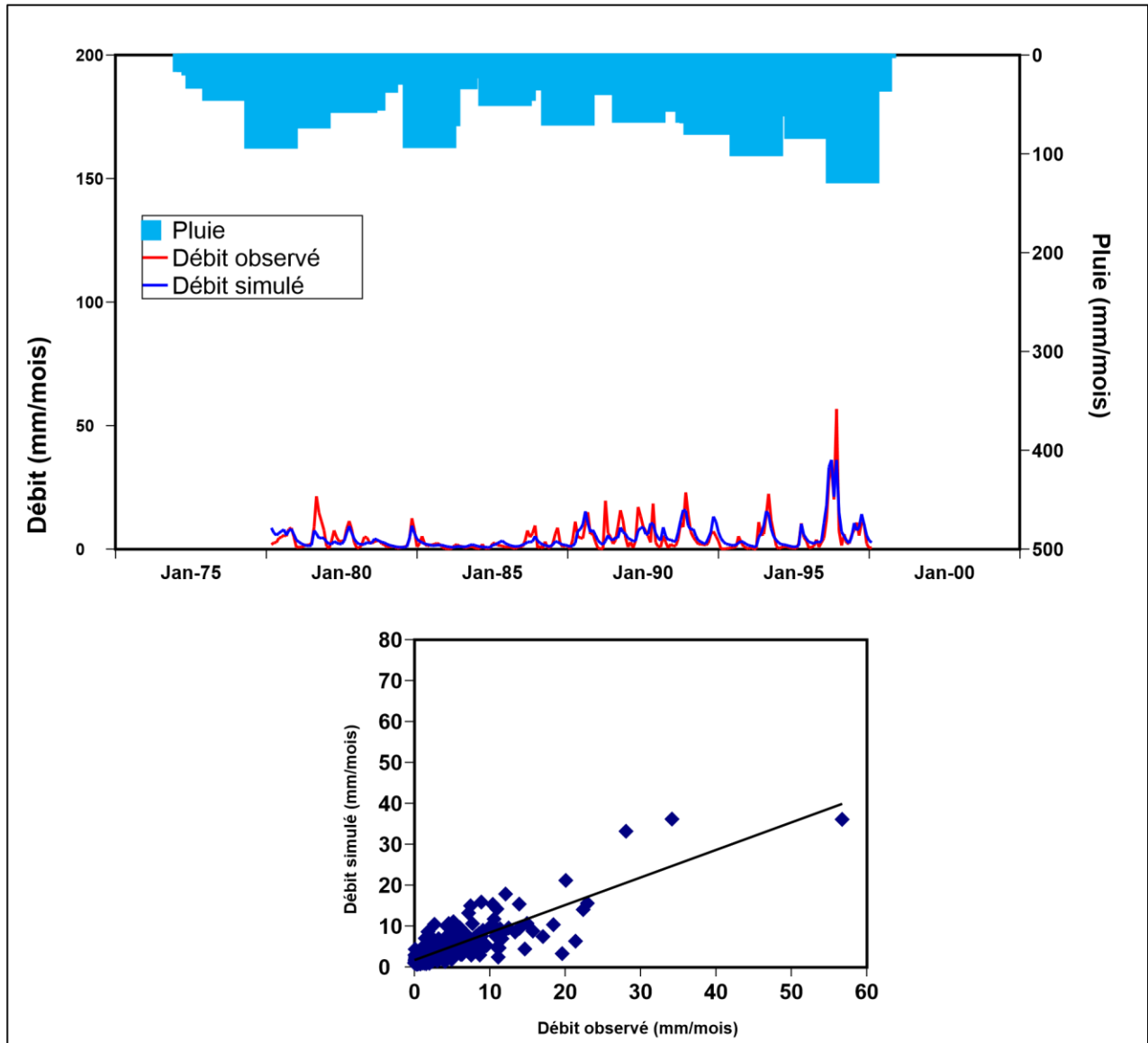
<sup>2</sup>*University Professor, FLSH, Sultan Moulay Slimane University, Beni Mellal, Morocco*

<sup>3</sup>*Geographic Landscape Dynamics, Risks and Heritage (LDPRP), FLSH, Sultan Moulay Slimane University, Beni Mellal, Morocco*

**Abstract.** The hydrological model is an essential tool for understanding the dynamics of a watershed. In this study, we used the Rural Engineering "GR" model, which is a global reservoir model, to better understand the hydrological behavior of the Wadi Ansegmir watershed. Our aim was to apply rainfall-flow modelling to obtain precise information on flow variations as a function of precipitation. Hydrological modeling is used to simulate the transformation of rainfall into flow in natural basins, which is very useful for many practical applications related to water resource management. In this study, we applied monthly rainfall-runoff modeling (GR2M) to the Oued Ansegmir watershed, located in the Midelt province of northeastern Morocco. We initially attempted to use a correlative approach based on rainfall-runoff modeling, however, the results obtained proved inconclusive. We used the GR2M model for our study, with flow, precipitation and PTE (potential evapotranspiration) as input parameters. The output parameter we considered was runoff. The GR model calibration process produced very satisfactory results. In order to verify the validity of the adjustment obtained during calibration, it is necessary to evaluate the model's performance over a period distinct from that used to adjust the model parameters. The results obtained are very encouraging. These results indicate that the model takes into account the various

**Keywords:** Hydrology, Watershed, Oued Ansegmir, Modeling, Rainfall-Flow, Model GR2M.





**Title:** Plots of hydrographs observed and calculated by GR2M for the Oued Ansegmir catchment area with rainfall calculated by the IDW method between 1977/78 and 1996/97



# Le millet, une culture résiliente face au changement climatique

Rajae Errafia<sup>1</sup>, Mourabit Fouad<sup>1</sup>, Nadira Mourabit<sup>1</sup>

<sup>1</sup>Faculté des sciences et techniques Al Hoceima, Morocco

**Abstract.** Ces dernières années ont connu des changements climatiques dans le monde entier. Ces changements affectent l'ensemble de la planète même si les conséquences et l'impact varient d'une région à l'autre. Le véritable déficit c'est d'arriver à cerner les problèmes engendrés par ces changements. L'un des secteurs les plus touché c'est le secteur de l'agriculture selon des estimations pour les trois prochaines, décennies qui prévoit une réduction jusqu'à 50% de la productivité agricoles dans plusieurs pays si la question de la résilience aux crises n'est pas envisagé d'urgence. L'issue pour une agriculture durable est fonction de son niveau de résilience basé sur une bonne gouvernance qui doit pleinement exploiter les technologies, la recherche et le développement en intégrant d'avantages les bonnes solutions. Face à ces changements, l'appel à une culture résiliente qui fait référence aux pratiques, techniques et stratégies mises en place pour permettre au système agricole de s'adapter. Le millet fait partie des solutions à proposer pour les agriculteurs et ce grâce à sa grande tolérance à la chaleur et à l'épuisement des ressources en eau. Les millets à cycle court poussent facilement sans engrais, ce qui en fait une option plus saine et plus sûre à la fois pour le consommateur et pour le sol. Bien que le millet est sans gluten, il est également très riches en nutriments et permettant ainsi d'être une bonne source alimentaire au consommateur. La région du Rif en particulier la ville d'AL Hoceima fait partie des zones au Maroc les plus touchées par les changements climatiques. Des faibles quantités de précipitations sont enregistrées ces dernières années. Cette recherche, centrée sur le Millet, vise à démontrer que cette graine peut à la fois être une solution pour les agriculteurs pour faire face aux changements climatiques, et un atout pour la sécurité alimentaire en l'intégrant dans la culture alimentaire des marocains, avec tous les bienfaits qu'elle procure pour la santé.

**Mot clés :** Millet, changement climatique, culture résiliente, sécurité alimentaire



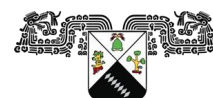


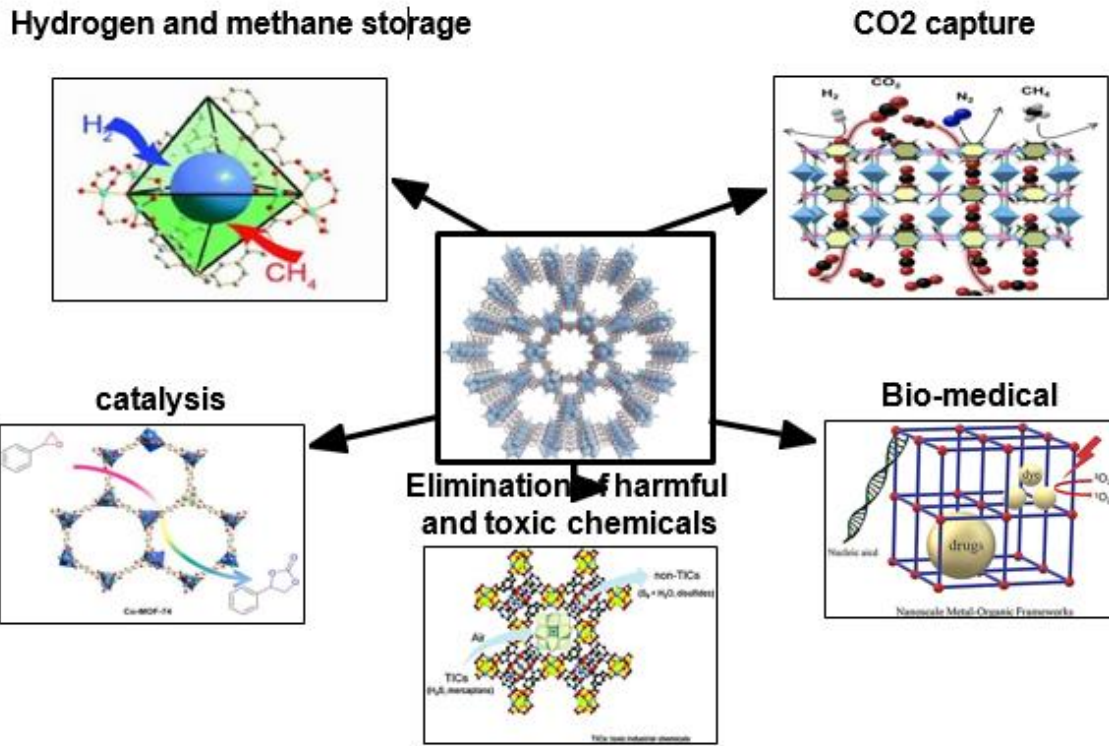
## Metal–organic framework-based materials: Synthesis, physicochemical characterization and applications

Asmae Laksir\*, Marieme kacem, Mustapha Dib, Rachid Touzani, Aziz Boulouiz

*Mohammed First University, 60000, Oujda, Morocco.*

**Abstract.** Metal-organic frameworks (MOFs) are innovative materials composed of metal ions coordinated to organic ligands, forming porous crystalline structures with tunable properties. Their synthesis can be achieved through various methods, including hydrothermal, solvothermal, electrochemical, and mechanochemical, each offering distinct advantages in terms of cost and efficiency. The physicochemical characterization of MOFs is crucial for understanding their structural and functional properties, employing techniques such as X-ray diffraction (XRD), Brunauer-Emmett-Teller (BET) surface area analysis, and Fourier-transform infrared spectroscopy (FTIR). These characterizations reveal insights into the framework's stability, porosity, and chemical functionality. MOFs have a wide array of applications across different fields; they are utilized in catalysis for enhancing reaction rates, in gas storage for efficient energy solutions, in drug delivery systems for targeted therapies, and in environmental remediation to adsorb pollutants. The unique properties of MOFs make them a focal point of research and innovation in materials science, promising significant advancements in technology and sustainability.







# Real-Time Monitoring of Agricultural Parameters to Improve Crop Productivity Using IoT

Ettajrini Hicham<sup>1</sup>, El Wardani Dadi<sup>1</sup>

<sup>1</sup>Abdelmalek Essaâdi University, Morocco

**Abstract.** Accurate monitoring of environmental parameters such as soil humidity, ambient humidity, and temperature is essential for optimizing cannabis cultivation and preventing plant diseases. This study presents an innovative prototype designed to monitor these critical parameters in real-time over a two-month period. The system integrates Internet of Things (IoT) technologies with advanced sensors to continuously collect and analyze data. Commenting on this study, the results highlight the system's ability to detect critical variations in humidity and temperature, enabling proactive management of plant needs. These data can be applied in various fields, such as precision agriculture and automated irrigation systems. The study concludes that real-time monitoring significantly enhances decision-making processes, ensuring optimal conditions for the growth and health of cannabis plants. This prototype provides a cost-effective and scalable solution, promoting sustainable agriculture and efficient resource management.

**Keywords:** Cannabis cultivation; Internet of Things (IoT); Real-time monitoring; Smart agriculture

