International Symposium on Physics of Energy Storage and Ferroic Materials

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Prof. Gustau CATALAN

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de Nanociencia i Nanotecnologia,Barcelona, Catalonia

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Prof. Pierre SAINT-GRÉGOIRE

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A Novel Approach to Interface Engineeringin Perovskite Hybrid Solar Cells

Prof. Philippe LANG

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Antiferroelectrics:impact of critical end point and triple point on functional properties

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PC 1

Energy harvesting with polarized materials

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Two important sources of energy that can be harvested from the environment are solar (photovoltaic) and vibrational noise (electromechanical). Polar materials, including but not limited to ferroelectrics, can be useful for both. In photovoltaics, polar materials are interesting because they can generate record-breaking photovoltages, much higher than the bandgap (which is the traditional limit for conventional solar cells). And in electromechanics, polar materials are useful because of their ability to convert pressure into voltage via piezoelectricity. However, ferroelectrics tend to have very large bandgaps, and therefore low light absorption in the visible range. Also, some of the best ferroelectrics tend to contain lead, which is toxic.
In this context, it is desirable to find either polar materials with lower bandgap OR, as we propose, take non-polar materials that already have a low bandgap and find a way to polarize them. A universal mechanism that allows polarizing ANY material -including semiconductors and even metals- is flexoelectricity: the coupling between strain gradients (e.g. curvature) and polarization, which is allowed in any crystal structure. As we will show, flexoelectricity can be used to achieve either solar cells with enhanced efficiency and photovoltage via the flexophotovoltaic effect, or to achieve multi-harvesting devices that gather energy simultaneously from light and from vibrations via the photoflexoelectric effect.

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PC 2

Strategies of development for Africa based on energy: Perspectives and scientific implications

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The title of this abstract may seem presumptuous given that each african country has its own specificities and that the concept of development has multiple facets, but it expresses in fact a desire to seek common points, while remaining on a fairly general level of approach.
The problem of energy is fundamental taking into account the energetical transition that is taking place in the world, which on the other hand should also be able to usher in a prosperous period for Africa, rich in resources.
The aim of this talk is to focus on energy and its peculiarities in Africa, to try to propose or update large-scale projects, in the sense of building an "energy bouquet" on African soil and to maintain its sustainably. We will provide an overview of the scientific and technical aspects involved with a view to seeking a global guideline that could be adapted to each country and in several areas as wind energy, photovoltaics, solar energy, energy storage and transportation, etc. Financial and political aspects are not treated here but the scope of this presentation will go far beyond the physics aspects.

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PC 3

Women's renewable energy initiatives in Côte d'Ivoire (sharing experiences)

Mme Diane PENDA[1], Mme Yakiema KOUYATE[2], Mme Marina NOBOUT[3], Mme PENDA Diane[4], Mme KOUYATE Yakiema[5], Mme NOBOUT Marina[6]

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ABSTRACT:

Experts will discuss their experiences in the field of energy and energy efficiency. In particular, they will discuss the various initiatives undertaken to promote green energies, as well as the opportunities offered by this sector to women. Female entrepreneurship in the field of renewable energies will be discussed to encourage young girls to get involved in this area of activity. The aim is to offer young women in the apprenticeship phase valuable support, expert advice and personal development opportunities to prepare them for the job market. This activity is organised in partnership with GIZ as part of the female mentoring programme developed to motivate young women in training to embark on a career in the RE/EE field and to strengthen their personal skills for their entry into working life. The young women recruited as part of the female mentoring programme will be present at this conference.

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PC 4

A Novel Approach to Interface Engineering in Perovskite Hybrid Solar Cells

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ABSTRACT:

Recent breakthroughs in hybrid and organic solar cells have highlighted the pivotal roleof hybrid perovskites (HPs) in optoelectronic applications, particularly in photovoltaics, due to their exceptional light absorption and outstanding optoelectronic properties. With power conversion efficiencies (PCE) reaching an impressive 26.1% in single-junction perovskite solar cells (PSCs), HPs are rapidly emerging as one of the leading contenders in next-generation photovoltaic technologies. However, challenges remain—most notably, the operational instability of these devices.

Defects at the critical perovskite/metal oxide (MOx) interface often lead to non-radiative recombination, negatively impacting overall efficiency. To address these issues, precise control of the interfacial chemistry between the layers of PSCs is essential. In this work, we present the development of amino-terminated self-assembled monolayers (SAMs) that enhance both the structural stability and performance of hybrid perovskites. Our approach demonstrates how strategic interface engineering can mitigate degradation, improve perovskite film morphology, and optimize charge collection. This advancement not only enhances device stability but also represents a key milestone towards the long-term commercialization of PSC technology

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PC 5

Antiferroelectrics: impact of critical end point and triple point on functional properties

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ABSTRACT:

DC-link, snubber, and filter capacitors are some of the most important components in high-power and high-speed electronics used in electromotive and renewable energy applications, medical equipment, and weapons platforms. Demands for these capacitors are typically high capacitance which increases with DC bias, low losses at higher frequencies, high operational temperature, and no limitation of slew rate. Antiferroelectric ceramics meet these demands and are therefore used for the development of novel capacitors. In particular, the increase of the dielectric constant with DC bias, i.e., dielectric tunability, is one of the most interesting and still not fully understood properties of these materials. We investigated the origin of the dielectric tunability enhancement in antiferroelectric PNZST ceramics, using in-situ dielectric and thermal measurements. At low AC fields, the enhanced dielectric tunability is most likely related to intrinsic response. It therefore exhibits its maximum value around the critical point of the antiferroelectric-to-paraelectric phase transition. However, by increasing the AC measurement signal, the dielectric tunability of 375% can be achieved in the vicinity of the phase coexistence point. The large enhancement is attributed to the enhanced nonlinear contributions due to the minimization of the domain structure.

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Research Interest*: Antiferroelectrics

PC 6

"Development of renewable energies in Côte d'Ivoire: initiatives and regulatory framework"

Direction Générale de l'énergie in charge of renewable energies, Côte d'Ivoire

ABSTRACT:

In accordance with the Paris Agreement ratified by Côte d'Ivoire, renewable energies are set take an important role in electricity production, and the sector is set to significantly increase the share of renewable energies in its electricity mix by 2030. This conference will provide an opportunity to discuss the various actions and projects undertaken to develop renewable energies in Côte d'Ivoire, as well as legislation and regulations in the sector. In particular, the speaker will talk about the various actions taken to promote green energies, as well as the share of renewable energies in the Côte d'Ivoire energy mix. Competitive renewable energies available in large quantities in Côte d'Ivoire are hydroelectricity, biomass and photovoltaic solar energy.

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Research Interest*: Competitive renewable energies

PC 7

Introduction of wind technology in five rural areas in Côte d'Ivoire: Challenges of production and demand

Olivier KARANA

PDG to KOC Bridges to Peace

KOC Bridges to Peace focuses on change for a better future through peacebuilding, ecology and governance through the introduction of wind turbine technology. We work with rural communities to develop solutions using locally available resources. Energy in a Box is a project designed to help rural villages in windy coastal regions and the Sahel harvest wind power from recycled materials. Several wind turbines have been installed in various locations in Côte d'Ivoire, including Ouangolo, Tehini, Man, Assinie and San-Pedro. The aim of the conference was to present the technology used, the challenges associated with wind turbines and to propose possible solutions based on the experience gained from the installation of wind turbines in various regions of Côte d'Ivoire.

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Theme 1

Energy production

Green energy, Photovoltaic, Photocatalyse, Photochromism, Electrochemical, Electrochromism, engineering, Waste Recycling, Hydrogen, Wind Energy, Green chemistry, Renewable energy, Management of the energies production, intermittency of renewable, Solar Energy, Energy Transition and Society,

Theme 2

Energy storage

Batteries, Supercapacitors, fuel cells, Bioelectrochemistry, Biosensors and Biobatteries, Energy storage, Electrometallurgical processes, Materials for intelligent construction, Electroluminescence, conversion technologies, Electrolytes

Theme 3

Materials for Energy

Electrocaloric, Magnetocaloric, Barocaloric, Piezocaloric, Ferroelectricity, Piezoelectricity, Antiferroelectricity, Ferromagnetism, Environmental protection, Antiferromagnetism, Nanoparticle, Ferrimagnetism, Energy and load shedding, Materials chemistry, Biomass, Photodetection.

Conference 1 – Theme 2

Development of renewable energies in Côte d'Ivoire: initiatives and regulatory framework

General Department for Energy in charge of renewable energy, Côte d'Ivoire.

In line with the Paris Agreement ratified by Côte d'Ivoire, renewable energies are set to play an important role in electricity generation, and the sector is expected to significantly increase the share of renewable energies in its electricity mix by 2030. This conference will provide an opportunity to discuss the various initiatives and projects undertaken to develop renewable energy in Côte d'Ivoire, as well as legislation and regulations in the sector. In particular, the speaker will discuss the various initiatives being taken to promote green energies, and the share of renewable energies in Côte d'Ivoire's energy mix. The competitive renewable energies available in large quantities in Côte d'Ivoire are hydroelectricity, biomass and photovoltaic solar energy.

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Conference 2 – Theme 1

Study of the Degradation and Optoelectronic Properties of CsPbX3 and Mixed Halide Perovskite Thin Films for the Development of High-Performance Solar Cells

Donafologo SORO [1*], A. Gbané [2], Siaka Touré[2], Bernabé Marí[3]

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ABSTRACT:

Results: CsPbBr3 films exhibit dominant crystallographic peaks at 15° and 30°, while CsPbI3 shows a main peak at 26.80°. The mixed samples have preferred orientations on the (111) and (220) planes at 26.80° and 51.80°. Morphologically, the surfaces of $CsPbBr_3$, CsPbBr2Cl, and $CsPbI_2Cl$ samples are not entirely covered by large grains, while $CsPbBr_2I$ and CsPbI2Br samples display the best surfaces, being dense, well-coated, and free of holes and cracks. CsPbI2Br has the highest absorbance, covering the entire visible spectrum (300-900 nm), with a bandgap of 1.94 eV. After four weeks in ambient conditions, CsPbBr3, CsPbBr2Cl, and $CsPbI_3$ show a slight decrease in their XRD peaks, while $CsPbBr_2I$, $CsPbI_2Cl$, and especially $CsPbI_2Br$, show a significant decrease, with the latter losing its main peaks entirely. In terms of absorption, $CsPbBr_2I$ and $CsPbI_2Cl$ show a slight decrease, while $CsPbBr_3$ and $CsPbI_2Br$ experience a moderate decrease. $CsPbI_3$, however, shows an increase in absorption.

Keywords: Solar cells, $CsPbX_3$, optoelectronic properties, mixed halide perovskites, degradation.

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Research Interest*: Thin films for photovoltaic applications

Conference 3 – Theme 2

Synthesis of Organic Solid Electrolyte for All-Solid State All-Organic Battery

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ABSTRACT:

Reliable, cheap, and simple access to energy has always been synonymous with technological progress and improved quality of life for humanity. The major challenge of the 21st century is to ensure energy supply while maintaining environmental sustainability. The transition from fossil fuels to renewable energy sources, both in transport and energy production, requires efficient electricity storage devices to meet the growing demand driven by new technologies. Lithium-ion batteries currently dominate this sector, although they rely on rare, non-sustainable inorganic materials. In response to this issue, organic electroactive materials (OEMs) offer promising potential due to advantages such as multi-electron reactions and design flexibility, while being more environmentally friendly. However, these organic batteries still require improvements in performance and safety.

Research on all-solid-state metal-ion organic batteries, which use solid electrolytes instead of traditional liquid electrolytes, remains underdeveloped. OEMs present solubility issues in liquid electrolytes, leading to degraded electrochemical performance. One solution is to design fully solid-state cells. In this context, we explore covalent organic frameworks (COFs) for their potential as solid electrolytes due to their structural properties, modularity, and ease of synthesis.

We synthesized and studied specific members of the COF family, particularly boronbased ones incorporating lithium salts, to determine their ionic conductivity through electrochemical impedance spectroscopy, their electrochemical stability window via cyclic and linear voltammetry, and finally their stability against lithium metal through galvanostatic testing. COFs prove to be promising candidates for developing solid electrolytes in allsolid-state organic batteries, opening up perspectives for the design of more efficient and ecofriendly batteries.

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Conference 4 – Theme 1

Contribution to improving the performance of photovoltaic modules against shading: simulation of a new quarter-cell photovoltaic module technology.

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ABSTRACT:

The fight against global warming has prompted disinvestment in fossil fuels and investment in environmentally friendly renewable energy sources such as solar power. However, one challenge researchers face is shading on photovoltaic (PV) modules. Shading on PV modules is a critical aspect of the design and efficiency of solar PV systems. It has a significant impact on the performance of solar panels, leading to a reduction in electrical energy production. Studying shading on PV modules is essential to ensure the optimal performance of solar installations.

The purpose of this contribution is to propose a new shading-resilient PV module technology. The results show that when half of the module is shaded, the conventional module loses all its power, while the half-cell and quarter-cell modules lose 50% of their power. When 3/4 of the module is shaded, both the conventional and half-cell modules lose all their power, while the quarter-cell module still produces 25% of its power.

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Research Interest*: Monitoring of power transformers and PV system simulation.

Conference 5 – Theme 3

First Principal Hysteresis Loop Modeling through Constrained Electric Displacement Protocol Accessible via the Berry Polarization Approach: Applications & Insights

Aimad Belboukhari[1*], Souad Ait Essaghir[1], Said El Jallal[1], My Abdelaziz Koumina[1], Khaled Ait Bentaleb[3], Daoud Mezzane[2,4], and Yaovi Gagou[4]

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ABSTRACT:

The hysteresis loop has been a key experimental feature for characterizing ferroelectric materials. It is essential for identifying intrinsic properties such as coercive field, remanent polarization, and spontaneous polarization. These properties are fundamental for assessing energy storage efficiency and electrocaloric performance when coupled to temperature. Many empirical and semi-empirical approaches have attempted to provide a comprehensive understanding of the origins of hysteresis behavior, focusing on macroscopic features like grain size, thickness, aging, and grain/phase boundaries. While these methods have provided valuable insights, they are limited in their ability to describe ferroelectric behavior at the atomistic level. Fortunately, recent theoretical advances in quantum simulations provide a more fundamental approach to modeling ferroelectric behavior at the atomistic level without relying on empirical parameters. Notably, the concept of Berry polarization as a quantum geometrical observable has become increasingly valuable in studying the ferroelectric and piezoelectric properties of materials. When combined with the constrained electric displacement method, this approach addresses several technical challenges, such as longrange electrostatic forces and domain wall dynamics, thereby providing a more reliable pathway to extract valuable insights and to enable comprehensive modeling of the bulk ground state hysteresis loop. Therefore, our study aims to systematically apply these theoretical advancements to elucidate the relationship between chemical bonding, and ferroelectric and piezoelectric properties in the promising hypothetical ferroelectric SnTiO3, in comparison to its prototypical isomorphe PbTiO3. Subsequently, our analysis extends to provide a comprehensive model of the ground state hysteresis loop, focusing on energy storage efficiency as application.

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Conference 6 – Theme 2

Strategy Development for Hydrogen-Conversion Businesses in Côte d'Ivoire

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ABSTRACT:

Côte d'Ivoire has substantially neglected crop residues from farms in rural areas, so this study aimed to provide strategies for the sustainable conversion of these products to hydrogen. The use of existing data showed that, in the Côte d'Ivoire, there were up to 16,801,306 tons of crop residues from 11 crop types in 2019, from which 1,296,424.84 tons of hydrogen could potentially be derived via theoretical gasification and dark fermentation approaches. As 907,497.39 tons of hydrogen is expected annually, the following estimations were derived. The three hydrogen-project implementation scenarios developed indicate that Ivorian industries could be supplied with 9,026,635 gigajoules of heat, alongside 17,910 cars and 4732 buses in the transport sector. It was estimated that 817,293.95 tons of green ammonia could be supplied to farmers. According to the study, 5,727,992 households could be expected to have access to 1718.40 gigawatts of electricity. Due to these changes in the transport, energy, industry, and agricultural sectors, a reduction of 1,644,722.08 tons of carbon dioxide per year could theoretically be achieved. With these scenarios, around 263,276.87 tons of hydrogen could be exported to other countries. The conversion of crop residues to hydrogen is a promising opportunity with environmental and socio-economic impacts. Therefore, this study requires further extensive research.

Keywords: Côte d'Ivoire; strategy; business; hydrogen; crop residues

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Research Interest*: Renewable energy and green hydrogen Technology

Conference 7 – Theme 1

Effect of RGPP (Reactive Gas Pulsing Process) deposition parameters on physical properties and electrochromic performances of WOx thin films.

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ABSTRACT:

WOx electrochromic films have been widely deposited using the conventional magnetron sputtering process. In this process, oxygen is injected into the deposit reactor at a constant flow rate, which can lead to instability. A possible way to limit this instability phenomena is to pulse the oxygen into the reactor between a minimum and maximum flow rate. This innovative method is known as RGPP.

The RGPP parameters tON and тmou allowed us to elaborate a wide range of substoichiometric, transparent and electrically insulating films. We also observed that optimizing interface states and ions density in the films enabled us to control the coloration and decoloration times, as well as the coloration efficiency and optical modulation, which can reach ~51 cm²/C and ~55% respectively at 632 nm. This coloration efficiency could optimize absorption of solar energy such as light and heat.

The RGPP parameters allowed us to deposit a wide range of substoichiometric films with variable physical properties and electrochromic performances. These performances are controlled by optimizing the electrical properties measured using a mercury probe capacitance meter.

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Conference 8 – Theme 2

Design and automation of a battery charging system powered by A 1.5 kw piggott wind turbine

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ABSTRACT:

In many developing countries, the harnessing of wind energy is hindered by the lack of ground-based measurement data, leading to uncertainty in resource estimation. In Côte d'Ivoire, the wind potential remains largely untapped due to the average wind speed being below 4.8 m/s, making it unsuitable for large commercial wind turbines (0.1 to 8 MW). However, small wind turbines (0.1 to 10 kW) offer a promising alternative, particularly for remote or sparsely populated rural areas with limited access to electricity. These areas primarily require energy for lighting and phone charging. These locally designed and manufactured wind turbines are then deployed for testing and validation in various rural areas across the country. Design a battery charging system using a 1.5 kW Piggot wind turbine to showcase its feasibility in Côte d'Ivoire.

A Piggot wind turbine was installed in a rural village, with a measurement station for monitoring production. Energy production data was collected over a period of three months. The wind turbine produced an average of 2.6 kWh per month, providing constant lighting and charging services for the community. The system reliably met local energy needs. Small wind turbines, such as the Piggot model, are a viable solution in Côte d'Ivoire. Future work will aim to optimize the efficiency of the turbines and adapt the system for larger communities.

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Conference 9 – Theme 2

Contribution to the Study of an electrical Copper - Tin Cell using sulfuric acid as electrolyte. Effect of the acid concentration

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ABSTRACT:

The world is facing today several challenges regarding the energy problem. The world population is always growing resulting in the increasing of energy consumption, environment pollution, greenhouse effect gas emissions and climate worming. Hence new sources of energy are looked for, that may allow the energy transition. To product electricity by means of an electrochemical cell that also yields materials useful in batteries and photovoltaic conversion. Electrical cells were built, using sulfuric acid as electrolyte. The two electrodes are copper for the positive electrode and tin for the negative electrode. Cells with several acid concentrations were made. The electromotive force E (V) and the intensity I (mA) were measured for each cell. The resulting electrical power P (mW) was calculated for each cell. The products deposited at the electrodes were examined. The plotting of E = f (I) and P = f (I) were made and analyzed. From the plottings, the internal resistance r and the electromotive force E_{cell} of the cell were determined. The experiments showed deposits of tin sulfate SnSO4 and CuSO4. Tin sulfate can be used as anode material for lithium battery. Tin oxide SnO2 can be gotten from tin sulfate. It is an n-type direct gap semiconductor, which has an interesting band gap for photovoltaic conversion. The electrical cell studied here is interesting for electricity production. One of his deposits, SnSO4, is interesting for battery production and can yield SnO2 useful for photovoltaic conversion.

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Conference 10 – Theme 2

Innovative urban solutions for the storage and distribution of green energy in African cities in the face of climate change: the case of the city of Abidjan

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ABSTRACT:

Faced with the challenges posed by climate change and increasing urbanization, African cities like Abidjan need to explore innovative solutions for the storage and distribution of green energy. This article examines the specific challenges faced in Côte d'Ivoire and proposes technologies and models adapted to local realities. The focus is on decentralized solutions, such as microgrids and solar battery storage systems, to maximize the use of renewable resources. In addition, it explores public private partnerships and innovative financing as levers to accelerate this energy transition. The Abidjan model proposes a sustainable approach where the integration of smart technologies would reduce dependence on fossil fuels, contributing to greater resilience in the face of climate impacts. The article also highlights the potential for adapting these solutions in other African cities, notably through the use of locally available energy sources such as solar and biomass.

Analysis of energy technologies for Abidjan revealed that lithium-ion batteries and hydraulic storage are the most appropriate solutions. Mapping of optimal areas identified locations for solar panels and urban wind turbines. Solar micro-grids could cover 30% of residential energy needs and reduce dependence on the central grid by 40% in a pilot district. Smart technologies could improve energy efficiency by 25%.

Abidjan must adopt a sustainable energy transition in the face of the challenges of climate change and rapid urbanization. The article highlights the importance of decentralized solutions, such as micro-grids and solar batteries, to maximize renewable energies. Innovative financing and public private partnerships are essential to reduce dependence on fossil fuels and strengthen climate resilience.

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Conference 11 – Theme 3

The second revolution of relativity

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ABSTRACT:

Energy, this vital entity that we need, and that everyone consumes and liberates, in different forms, has been since the dawn of time the greatest concern of the human being. Over the centuries, energy has transformed lifestyles in all societies of the world, contributing to the emergence of new cities and major cosmopolitan cities. Scientific research has contributed to much of this extraordinary advance of energy in the conquest of the world, thanks to the many works and discoveries of scientists from the golden age of Islamic civilization to the renaissance in Europe, to the great technological revolution that has emerged in the North and in the South. The continuous need for energy has always been the main driver, for various discoveries, whether related to energy matter or those related to energy reactions. Between pure matter and an active reaction, energy has become the focus of several hybrid studies, manipulating energy as a source on the one hand, and as a finished product on the other. While most of the work carried out on the electric current, during the first years of the 17th century, showed the precariousness of the materials as regards their conductivity, the arrival on the scientific scene of new chemical elements, discovered then around the 18th century, have strengthened the quality of the works and consequently the improvement of the electrical productivity in the world. Nuclear energy will suffer the same fate of development as that of electrical energy, passing through critical periods, especially those relating to the discovery of high-activity materials. Nevertheless, the arrival at the beginning of the 18th of the famous formula of Albert Einstein on relativity, ($E= mc^2$) , put an end to the major concerns of scientists on energy, to know finally, the nature and value of the energy compensation of the material during its activity.

Keywords: Relativity, Thermodynamics, nanotechnology, energy, the black nano holes.

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Conference 12 – Theme 3

Physical characterization and electrical conductivity in the $Bi_5Fe_{0.5}Co_{0.5}Ti_3O_{15}$ multiferroic ceramic system

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ABSTRACT:

Multiferroics have been widely investigated over the last decades because of their very interesting physical properties. Their integration in the manufacture of electronic devices, such as sensors, transducers, storage memories, and others, where the coupling between the electric and magnetic components (magneto-electric response) becomes one of the most important characteristics for the developing of new-classes electronic devices, guarantees their use in several practical applications. However, from the fundamental point of view, it has been reported that the dielectric response in multiferroic systems could be strongly dominated by conduction mechanisms because of their intrinsic semiconductor character, mostly promoted by the magnetic component. Therefore, for producing high-performance electronic devices with desired technological capabilities such conduction processes have to be carefully studied. The physical properties have been investigated in the $Bi_5Fe_{0.5}Co_{0.5}Ti_3O_{15}$ multiferroic ceramic system, synthesized by the conventional solid-state reaction method. The conduction processes have been analyzed considering different formalisms based on the dielectric relaxation processes (from the electric modulus analysis) as well as the Jonscher's universal response (through the DC and AC electrical conductivities). The obtained results have been discussed in the framework of the theoretical models reported in the literature. $Bi_5Ti_3Fe_{0.5}Co_{0.5}O_{15}$ (BFTCo) ceramic system was prepared by the solid-state reaction method. High purity starting materials, Fe_2O_3 (99.65%), Co_2O_3 (99.48%), Bi_2O_3 (99.99) and TiO_2 (98.00%), were mixed and ball-milled with the desired stoichiometric ratio. The mixtures were calcined in air atmosphere at 720oC for 2 hours and ball-milled again. The powders were pressed uniaxially by using 200 MPa and sintered in a closed alumina crucible at 950oC for 2 hours. Structural properties were analyzed from X-ray diffraction technique and Raman spectroscopy. Dielectric response has been analyzed from the temperature dependence of the complex dielectric permittivity, in a wide frequency range, by using a HP4194A impedance analyzer.

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Conference 13 – Theme 1

Materials in photovoltaics based on perovskites 3D

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ABSTRACT:

We present an overview on inorganic and hybrid organic / inorganic perovskites based on lead halide and derived materials (alloys) that constitute an innovative family of absorber materials for photovoltaic systems. We show that these perovskites and derivatives have exceptional optical, electrical and structural properties with high absorption of light facilitating the extraction of electric current. Perovskite solar cells based on these materials combine a high efficiency of cells with a great ease of preparation and synthesis at very low costs via simple deposition techniques. In this article we also discuss the operating principle of perovskite-based solar cells, charge transport materials and associated architectures. Simple fabrication techniques and issues with stability and hysteresis are also discussed.

Keywords: solar cells, perovskites 3d, perovskite solar cells (pscs), photovoltaics

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Conference 14 – Theme 1

Comparison of Structural, Optical, and Morphological Properties of ZnO, NiO, and TiO_2 Thin Films for High-Performance Photovoltaic Applications

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ABSTRACT:

Transparent conducting oxide (TCO) thin films, such as zinc oxide (ZnO), nickel oxide (NiO), and titanium dioxide (TiO_2), are essential for photovoltaic devices due to their high optical transparency and significant electrical conductivity. This study compares their structural, optical, and morphological properties to identify the most suitable materials for high-performance photovoltaic applications. ZnO, NiO, and TiO_2 layers were deposited by spray pyrolysis. Zinc oxide was prepared by dissolving 8.25 g of zinc acetate ($Zn(CH_3COO)_2$, $2H_2O$) in 50 mL of ethanol, to which 2 mL of diethanolamine was added as a stabilizer. The titanium oxide solution was obtained by dissolving 1.80 mL of titanium isopropoxide (IV) ($Ti[OCH(CH_3)_2]_4$) in 10 mL of ethanol. Nickel (II) nitrate hexahydrate [$Ni(NO_3)_2$, $6H_2O$] was used as the precursor for preparing the nickel oxide solution. For this, 1.45 g of the precursor was dissolved in 50 mL of distilled water. X-ray diffraction analysis of the ZnO, NiO, and TiO_2 thin films shows that ZnO and TiO_2 have better crystallinity than NiO, with crystallite sizes of 27.5 nm, 27.16 nm, and 20.3 nm, respectively. TiO_2 exhibits the lowest lattice strain, followed by ZnO and NiO, indicating better structural quality for the first two materials. The UV-Visible transmittances are approximately 81%, 80%, and 76% for ZnO, TiO_2, and NiO, respectively. The band gaps are 3.26 eV for ZnO, 3.2 eV for NiO, and 3.34 eV for TiO_2. ZnO has a more homogeneous crystal distribution than TiO_2, while NiO shows some surface defects. ZnO and TiO_2 are identified as more promising materials than NiO for TCO applications in photovoltaic devices due to their superior structural quality and optical properties.

Keywords: photovoltaic, zinc oxide, nickel oxide, titanium dioxide, zinc oxide, electrical conductivity

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Conference 15 – Theme 2

Fluorine-doped zinc oxide nanoparticles deposition by sol-gel route and surface morphology analysis

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ABSTRACT:

In this work, we present a solution-based deposition and characterization of the as-grown fluorine doped nanoparticles (FZO) onto glass substrates.
Methods: A series of sol-gel via spin-coating deposition protocols was designed to prepare fluorine doped nanoparticles (FZO) in the following proportions of fluorine dopant content: 1%F, 3%F, 5%F and 7%F. Characterization techniques used in this work were X-ray diffraction (XRD), scanning electron microscopy (SEM) and Raman Spectroscopy. X-ray diffraction results showed polycrystalline wurtzite phase with c-axis orientation. The mean crystallite size of the samples varies between 32-49 nm and the nanoparticles thickness varies in the range 80-350 nm. Scanning Electron Microscopy (SEM) revealed spherical shape and uniform surface consisting of nano-sized polycrystalline grains. Two peaks were observed in the Raman spectra at 82 cm-1 and 433 cm-1 for all the as-grown nanoparticles. Four kinds of fluorine doped nanoparticles (FZO) were designed and experimentally synthesized based on fluorine content. The properties investigated in this study depend on the fluorine dopant content. Additional measurements may therefore be required to investigate the characteristics of FZO nanoparticles. This work also provides guidelines for sample preparation in materials science.

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Conference 16 – Theme 2

Evaluation of the energy performances of a photovoltaic solar refrigerator with cold storage

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ABSTRACT:

The design of autonomous, high-performance refrigeration systems is part of a global context marked by the challenges of climate change, through the need to reduce greenhouse gas emissions and access to energy in rural areas. Solar photovoltaic refrigerators represent a promising alternative for meeting these challenges, particularly in regions where electricity supplies are limited or intermittent. In many developing regions, the lack of reliable access to electricity makes it difficult to preserve food and medicines, increasing losses and compromising public health. The effect of internal cold storage on the energy consumption of a solar photovoltaic refrigerator The energy supplied by the photovoltaic generator and that consumed by the motor compressor were measured by were measured by 2 recording multimeters positioned respectively at the inlet and outlet of the electrochemical battery. The maximum energy consumption of the motor-compressor was reduced from 59 Ah.d-1 to 34 Ah.d-1, so a 42% reduction in the electrical energy consumption of the solar refrigerator (25 Ah.d-1). The cold battery inserted in the refrigeration enclosure has made it possible not only to reduce heat loss considerably but also the energy consumption of the motor compressor.

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Conference 17 – Theme 3

Polar domains reordering in liquid crystals doped ferroic materials

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ABSTRACT:

The dielectric properties of ferroelectric liquid crystal having large spontaneous polarization, short pitch and high purity, have been studied in the frequency range of 5Hz-1MHz in smectic C* on different thicknesses cell in planar alignment. The first experiments have clearly shown Goldstone and Soft mode relaxations far from SmC*-SmA phase transition. In addition, the macroscopic polarization and the optically observed density of dechiralization lines are measured versus bias field. Dielectric permittivity, polarization and optic measurements show the same complex hysteresis behavior that we discuss in connection with a possible onset of ferrielectricity in the dechiraization lines lattice. The influence of the ionic effects on the dielectric behavior have been performed. These investigations don't exhibit neither change of the helical structure, nor modifications of Goldstone mode. But they reveal the existence of possible depolarization effect induced by the ions generated. However, the inclusion of ferroic nanomaterials in the matrix of liquid crystals have appeared as a highly promising approach to developing advanced, highly electro-optical materials which is important for improving the performance of digital display devices. Our scientific and technological challenges in the fast-growing field of liquid crystal nanoscience will allow us to overcome a few difficulties. The focus of this work is to provide a broad overview of the current technology, properties and impacts of ferroic materials on the polar domains of ferroelectric liquid crystals.

Keywords: Ferroelectric liquid crystal, Ferroic material, Polarization, Phase transition, Polar domain, depolarization field.

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Research Interest*: Ferroelectric liquid crystal, Nano material, Electrocaloric effect

Conference 18 – Theme 3

Application of organic semiconductor materials for the realization of solar cells

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ABSTRACT:

This work focuses on the development of photovoltaic solar cells based on a stack of organic electron donor and acceptor layers. The deposition of a transparent upper electrode remains one of the technological obstacles of these devices. We analyze in detail the vacuum deposition of the different thin layers that constitute the solar cell. A reliable and reproducible procedure is proposed. The properties of the thin layers and the interface of the films are studied in detail. The realization of solar cells based on CuPc / C60 has made it possible to highlight the excellent properties and present better yields of the photovoltaic devices. Finally, the realization of the solar cells validates our technology. A particular effort has focused on the optimization of the organic thin layers deposited under the transparent conductive oxide (ITO).

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Conference 19 – Theme 2

The challenges of eco-responsible energy production and storage

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ABSTRACT:

Excessive consumerism based on fossil fuels (oil) will lead us into an ecological dead end where biodiversity will disappear. To do this, we will have to become aware of how to produce, store and use energy, while respecting our environment. Ecological planning must therefore be done in a global manner, by considering long-term projects with a global and coherent operation.

Knowing that the development of peoples is based on energy control, Africa and Africans must play their part, by launching large-scale projects for a peaceful future and energy autonomy from the West; because we are full of clean energy sources: solar (photovoltaic and thermal), nuclear, biomass, wind, hydroelectric, hydrogen-based, etc.

My conference will take stock of all these forms of energy production and the scientific basis of the operating mechanism of these systems, concluding on the electrocaloric cooling of the systems. The electrocaloric effect constitutes an alternative to technically replace the heat transfer gases (pollutants) present in current cooling systems. The materials studied will also be used in electrostatic energy storage devices.

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Research Interest*: ferrielectricity, ferroelectrics, photovoltaic

Conference 20 – Theme 3

Investigation of structural, electronic, and optical properties of the ferroelectric phase of lithium niobate using a DFT+U approach

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ABSTRACT:

Lithium niobate (LiNbO3) is a ferroelectric oxide material with electro-optical, linear and nonlinear optical, piezoelectric, and photorefractive properties. This impressive number of properties makes it a material of choice for applications in optoelectronics and photonics; this is why it is sometimes compared to silicon for electronics. At its Curie temperature Tc, which is about 1210°C, the structure of LiNbO3 undergoes a transformation from the paraelectric phase (stable for T>Tc) to the ferroelectric phase (stable for T<Tc). At room temperature, this material has a wide energy band gap with a value of 3.78 eV. The aim of this work is to investigate the structural and electronic properties of LiNbO3 using first-principles calculations based on functional density theory with Hubbard-U corrections (DFT+U). We used ultrasoft pseudopotentials and both OLYP and HCTH exchange-correlation functionals, which are both implemented in Quantum Espresso. We found that for both functionals, the calculated values of the crystal parameters show good agreement with the experimental values (showing a deviation of less than 2%). The calculated electronic band structure indicate that LiNbO3 is an indirect semiconductor. Yet, the calculated value of the energy band gap presents a good agreement with the measured one when HCTH+U functional is used. Furthermore, the optical magnitudes such as reflectivity, refractive index, and absorption coefficient as a function of incident light wavelength have also been discussed. The reliability of this method allowed us to say that the DFT+U approach is satisfactory for calculating structural and optoelectronic properties.

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Conference 21 – Theme 3

Magnetic bimetallic recoverable Fe3O4@TiO2 nanocomposite-based photocatalyst

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ABSTRACT:

TiO_2 nanoparticles (NPs) have been used for decades as photocatalyst for the removal of organic dye contaminants in wastewater due to non-toxicity, low cost and availability, excellent chemical and thermal stability, high catalytic activity, and excellent carrier properties. However, the TiO2 NPs have some drawbacks that restrict their real field uses as photocatalysts for wastewater treatment, including agglomeration, difficult separation and recovery of TiO2 NPs, require only UV light irradiation. To separate and recovery TiO2 NPs and enhance the photocatalytic activity in the visible region for direct solar energy irradiation. Magnetic bimetallic recoverable Fe3O4@TiO2 nanocomposite was prepared by mixing the Fe3O4 NPs with titanium precursor followed by chemical reduction, and the performance characteristics as photocatalyst were evaluated by XRD, DLS, UV-visible, FE-SEM, HR-TEM, XPS and VSM analyses. XRD, FE-SEM (EDAX and mapping) and HR-TEM analyses confirm the structure of as-prepared Fe3O4 and TiO2 nanoparticles and bimetallic recoverable Fe3O4@TiO2 photocatalyst. FE-SEM and HR-TEM images indicate that the photocatalyst particles are tightly connected in aggregate and spherical shape. The average particle sizes of 41, 250 and 391 nm for TiO2 NPs, Fe3O4 NPs and Fe3O4@TiO2 nanocomposite, respectively, were determined by DLS. The magnetic measurement (VSM) shows that the recoverable Fe3O4@TiO2 photocatalyst exhibit a super ferromagnetic behavior and characterized by a wide band absorption in the visible region 350 to 530 nm in contrast of TiO2 NPs in the UV region by UV-visible analysis. Successfully prepared recoverable Fe3O4@TiO2 photocatalyst that can benefit of direct solar energy irradiation, separate under a modest magnetic field and re-used.

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Conference 22 – Theme 2

The Ferroelectrics Nanoparticles effect on the physical properties of ferroelectric liquid crystals in confined geometry.

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ABSTRACT:

The last few decades have seen prolific scientific research into nanoparticle technology and digital signage. This research is focused on understanding the nanoparticle behaviour to improve the physical properties of liquid crystal displays (LCDs). This revolution is being accompanied by the mastery of the internal structures of ferroelectric nematics and smectics. Due to these remarkable properties of nanoparticles, some researchers have decided to investigate the possibility of combining liquid crystals with nanoparticles. Theoretical studies on ferroelectric FLC liquid crystal mixtures doped with nanoparticles reveal a variation of some properties compared with pure FLCs in the neighbourhood of the phase transition.

Due to the helical structure in these materials, which induces a non-null average polarisation, we used a theoretical method based on the modified Landau phase transition theory to investigate the dynamics of the molecules.

This theory clearly shows that the insertion of nanoparticles into a cell of FLCs will not affect the arrangement of the molecules, i.e. the tilt, but will reduce the spontaneous polarisation of the system, improve the response time and considerably reduce the rotational viscosity of the system.

It is therefore an essential technique for predicting and understanding the behaviour of an FLC doped with ferroelectric nanoparticles, the results of which will be verified experimentally very soon.

Keywords: Ferroelectric, liquid crystal, nanoparticules, spontaneous polarisation, response time, rotational viscosity, tilt.

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Conference 23 – Theme 1

Analysis of Optoelectronic Properties and Aging of MA1-XFAXPbBr3 Perovskites for the Improvement of High-Efficiency Solar Cells

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ABSTRACT:

In a world increasingly focused on renewable energy to combat climate change, solar energy plays a crucial role. Research on thin-film absorbers, one of the key components of solar cells, is paramount. This study analyzes the optoelectronic properties and aging of formamidinium (FA)-doped MAPbBr3 perovskites (MA1-XFAXPbBr3). For the preparation of the perovskite solution, methylammonium bromide (MABr) and lead dibromide (PbBr2) were dissolved in 0.5 mL of DMSO, and formamidinium bromide (FABr) was added to the DMSO solution containing MABr to obtain 1 mL of perovskite solution. The MABr mass was varied from 0% to 10% in 2% increments for the FABr. The different MA1-xFAxPbBr3 samples were then deposited on a rotating substrate using the one-step spin-coating method, with substrates spun at 5000 rpm for 50 seconds. Ether was used as the anti-solvent, and the samples were annealed at 100°C for 30 minutes on a hot plate. The thin films of MA1-xFAxPbBr3 perovskites, fabricated by spin-coating, exhibit a preferential crystallographic orientation along the (001) plane with two major peaks at 15° and 30°, with no impurities detected. The peak intensity and grain size vary with FA doping. The films with 6% FA show the best morphology, being homogeneous and well-covered, while the highest absorbance is observed for the 10% FA samples. After four weeks, the films with 4% FA demonstrate the best structural stability. FA doping significantly influences the crystallinity, absorbance, and stability of perovskites, offering prospects for improving solar cell performance.

Keywords: Solar cells, thin films, perovskites, MA1-XFAXPbBr3, Degradation.

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Research Interest*: Thin films for photovoltaic applications

Conference 24 – Theme 3

Changes in temperatures of phase transformations in ferroelectric multilayers with differences in the cell sizes of the conjugated layers

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ABSTRACT:

Three-layer ferroelectric structures barium titanate - strontium titanate and lead titanate - strontium titanate was studied experimentally and theoretically. It was experimentally shown that in the ferroelectric multilayer with barium titanate the temperature range of existence of the polar state is significantly (by several hundred degrees) extended to the high-temperature region compared to the single crystal and barium titanate films. The type of phase transition in the said multilayer changes radically (from the second to the first) in the considered multilayers. This is supported by the absence of temperature hysteresis of the Curie point and the law of two for the inverse permittivity. Key factor in the observed changes in the specified structures compared to single crystals and barium titanate films is the mechanical deformations that change the structure of the layers of the multilayers arised due to the difference in the sizes of the unit cells of the crystalline layers. In the structure under consideration the barium titanate layer is characterized by a negative misfit deformation (relative difference in cell sizes). In this case, as a result of the action of the specified deformations, a spontaneous polarization vector arises perpendicular to the plane of the layers in the barium titanate layers of the multilayers under consideration.

According to the obtained experimental data, in the case of a multilayer with a lead titanate layer, due to the absence of structural differences in the conjugated layers, the Curie point and the type of transition practically do not change in comparison with a homogeneous lead titanate.

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Conference 25 – Theme 3

Assessment of the environmental performance of agricultural biomass for electricity generation in Côte d'Ivoire

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ABSTRACT:

Faced with the worrying consequences of climate change, the gradual switch from fossil fuels to renewable energy sources is becoming imperative in electricity production. Côte d'Ivoire, a predominantly agricultural country, is considering the use of agricultural residues as a viable energy solution. This study aims to assess the environmental performance of agricultural biomass by calculating the impact of producing electricity from crop residues such as rice, coffee and cocoa. To do this, a life cycle analysis was carried out to determine the global warming potential associated with the various stages: collection, transport and combustion of the residues required to produce 1 kWh of electricity. The results show that producing electricity from biomass generates greenhouse gas emissions, thereby contributing to global warming. Emissions range from 270.55 to 432.30 g CO2 equivalent per kWh. Of the residues studied, coffee hulls make the smallest contribution to global warming, while rice straw is responsible for the highest emissions. However, these emissions are still lower than those generated by fossil fuels. Agricultural biomass is therefore proving to be a promising energy alternative. Its use not only makes it possible to make the most of agricultural residues, but also to reduce overall greenhouse gas emissions. Thus, the transition to agricultural biomass sources is an effective strategy for mitigating the environmental impact of the electricity sector, while supporting sustainable development in Côte d'Ivoire.

Keywords: Biomass, Agricultural residues, Life cycle assessment, Greenhouse gases, Climate change

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Research Interest*: Energie, Environnement et development durable

Conference 26 – Theme 3

Enhancement of Natural Dye-Sensitized Solar Cell Efficiency through TiO2 Hombikat UV100 and TiO2 P25 Photoanode Optimization

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ABSTRACT:

Engineering new photoanode materials is a significant challenge in the field of natural dye-sensitized solar cells (DSSC-N) to substantially improve their efficiency. The present study utilizes the Doctor Blade technique to develop novel photoanode materials, basing on mixtures in different proportions, of TiO_2 Hombikat UV100 and TiO_2 P25, two nano-metric powders with different grain sizes. Typically, adding a small amount of 10 nm sized powder to a predominantly 25 nm sized powder paste can fill the voids between larger grains, significantly altering the properties of the resulting mesoporous layer. The fabricated films were studied by X-ray diffraction revealing a dominant anatase phase in the structure, corroborated by Raman spectroscopy. For current-voltage (I-V) measurements, the device is connected to a two-channel Keithley 2602B instrument. The incident light source is a solar simulator (Osila Sheffield 54 7W UK, model No: 02009A1), calibrated to emit a total integrated power of 1000 W/m² across the wavelength range of 350 nm to 1000 nm. By optical measurements we estimate the bandgap energy (Eg) of the photoanodes that almost varies through the samples around 3 eV. The assembled solar cells demonstrate a significant efficiency of 4.87 % in the TiO_2 Hombikat UV100/TiO_2 P25 sample with the proportion 50-50 % (HP50) blended photoanode. This sample device exhibits a fill factor of 50.41 %, an open circuit voltage (V_{oc}) of 0.65 V, and a current density of 14.75 mA/cm² for an active surface area of 0.19 cm². HP50 constitute a highly efficient DSSC-N and photoanodes, with lower open-circuit voltage in this series while HP40 develop a V_{oc} of 0.73 V and HP30 a V_{oc} of 0.70 V. These advancements represent a significant step forward in the development of efficient and sustainable photovoltaic technologies, paving the way for further optimization and broader utilization of TiO_2-based materials to enhance the performance and viability of dye-sensitized solar cells.

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Conference 27 – Theme 3

Magnetoelectric effect and internal friction in ferrimagnetic – ferroelectric composites

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ABSTRACT:

Over a range of resonant frequencies of the 1st harmonic of longitudinal oscillations along the sample length at a strength of the DC magnetic field H1 = 0 – 220 Oe, volume fraction of PbZr0.53Ti0.47O3 ferroelectric in a composite v = 0.40 – 0.67, and temperature T = 293 – 393 K, we experimentally studied the converse magnetoelectric (ME) effect and internal friction in two-layer composites made by co-sintering Mn0.4Zn0.6Fe2O4 ferrimagnetic and PbZr0.53Ti0.47O3 ferroelectric powders (Mn0.4Zn0.6Fe2O4 − PbZr0.53Ti0.47O3 composites) as well as by gluing Mn0.4Zn0.6Fe2O4 and PbZr0.53Ti0.47O3 ceramic plates (Mn0.4Zn0.6Fe2O4 − PbZr0.53Ti0.47O3 + Epoxy composites). As it follows from our experiments, Mn0.4Zn0.6Fe2O4 − PbZr0.53Ti0.47O3 samples due to the direct transmission of piezoelectric strain show larger values of transverse ME coefficient α31 in comparison with Mn0.4Zn0.6Fe2O4 − PbZr0.53Ti0.47O3 + Epoxy samples. This fact means that the glueless layered composites, where the mutual doping occurs, have more suitable ME properties for application than the layered composites with an adhesive interlayer. α31 increases with H1, passes through a maximum depending on v, and decreases as T rises. The ME coefficient α31 have the inverse correlation with the internal friction Q-1 at resonant frequencies. Depending on H1, v, and T, variations of α31 are discussed using the theoretical model of effective parameters of a heterogeneous medium, while variations of Q-1 are explained by the interaction of ferroelectric domain boundaries with crystal-lattice defects. The inverse correlation between α31 and Q-1 enables us to use Q-1 as one of the indicators of the efficiency of ME interaction in composites.

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Research Interest: Magnetoelectric composites

This work was supported by the Russian Science Foundation under Grant No. 24-12-20010.

Conference 28 – Theme 1

Estimating and mapping solar irradiance and photovoltaic cell production potential in Côte d'Ivoire

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ABSTRACT:

The issue of climate change is a plague that affects all socio-economic layers. It is responsible for extreme precipitation by extending (reducing) dry (wet) periods during the rainy season (Yapo et al., 2019; 2020), and it leads to an increase in average temperatures, hot nights, and warm days (IPCC, 2021). However, this change is primarily due to greenhouse gas (GHG) emissions in the atmosphere. Fossil fuels, the main sources of greenhouse gas emissions, account for over 70% of global energy production (IEA, 2018). To mitigate this phenomenon by reducing GHG emissions, it is essential to resort to renewable energies, particularly solar energy. Using the HelioClim-3 database from the Meteosat-2 satellite, which has a resolution of 3 to 5 km, we spatialized the solar resource in Côte d'Ivoire. We also employed the formula from Jerez et al. (2015) to determine the production potential of monocrystalline photovoltaic cells in Côte d'Ivoire. This study identifies the Denguélé district in northwestern Côte d'Ivoire as the region with the highest solar resource and photovoltaic cell production potential. Additionally, the months of February and March show significant solar energy potential. Solar irradiance in Côte d'Ivoire ranges from 334.86 W/m² to 468.35 W/m², with production potential varying between 25% and 46%.

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Research Interest*: Improvement of climate services dedicated to renewable energy in Côte d'Ivoire.

Conference 29 – Theme 1

Study of the Degradation and Optoelectronic Properties of MAPbX3 and Mixed Halide Perovskite Thin Films for Enhancing Solar Cell Performance

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ABSTRACT:

Bromine-based films show predominant peaks at 15° and 30°, $MAPbCl_3$ at 26.62°, and $MAPbI_3$ at 14.22°. The surfaces of the layers are well-covered and dense, without voids or cracks. However, $MAPbCl_3$ has smaller grains than MAPbBr3 and MAPbI3, which have similar grain sizes. The bandgaps of the fabricated layers range from 1.35 eV to 2.43 eV. The degradation mechanism of $MAPbX_3$ and mixed halide perovskites was studied after four weeks in an ambient environment. SEM images show advanced surface degradation with a color change. The $MAPbI_3$, $MAPbCl_3$, and $MAPbI_2Cl$ layers are more degraded, while the bromine-based films ($MAPbBr_3$, $MAPbBr_2Cl$, and $MAPbBr_2I$) undergo less advanced degradation. Bromine-based perovskites are more promising for durable optoelectronic applications.

Keywords: Solar Cells, Thin Films, Perovskites, Mixed Halides, Degradation technologies

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Conference 30 – Theme 2

Energy entrepreneurship and funding opportunities in French speaking Africa

Eugène SAINT-GREGOIRE

ABSTRACT:

He leverages an extensive network of investors, to help businesses secure the capital they need to grow and scale, both in France and across Africa. This session will explore energy entrepreneurship and the funding opportunities available in French speaking Africa, specifically tailored to scientists, researchers, and PhD students. The focus is on how innovative business models can address Africa's pressing energy access issues while leveraging the continent's rich renewable energy resources. We shall present an overview on the importance of energy access, opportunities on renewable energy, lean startup approach for energy entrepreneurs, funding and investment landscape in Francophone Africa, how to engage with policy and regulators for support as well as corporates and finally some success stories and case studies. This session aims to inspire and equip scientists with the entrepreneurial tools needed to develop energy solutions that can address Africa's energy challenges while creating sustainable businesses. By combining scientific expertise with business innovation, participants will be empowered to transform ideas into impactful ventures.

ESG is a fundraising advisor and lawyer at Dama Advisory and Dama & Co Avocat with expertise in equity, grants and debt financing for technology and energy companies.

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Conference 31 – Theme 2

Design of a Remotely Controllable Multifunctional Hybrid Dryer for Agricultural Conservation

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ABSTRACT:

The preservation of agricultural products and the minimization of their packaging constitute a major challenge for the agricultural sector in Benin. Adequate drying devices, necessary to reduce moisture content and avoid microbial deterioration, are often expensive and not available locally. To develop a multifunctional hybrid dryer, “MADE IN AFRICA”, capable of efficiently and hygienically drying agricultural products at the right temperature, while being remotely controllable to facilitate its use by local farmers. The proposed dryer integrates a dashboard for direct interaction with the user, providing real-time information on drying conditions and remaining time. It is also equipped with a mobile application with a database allowing remote control and selection of products to be dried. Tests were carried out on various agricultural products to assess drying efficiency and ease of use. The tests show that the hybrid dryer offers a significant reduction in the humidity of agricultural products, with controlled drying conditions and a reduction in costs compared to imported devices. The mobile application facilitated remote control and monitoring, thus increasing efficiency and convenience for users. The multifunctional hybrid dryer “MADE IN AFRICA” represents an innovative and economically viable solution for the preservation of agricultural products in Africa. It addresses local drying challenges, reduces import costs, and improves post-harvest management through its remote control and programmable features.

Keywords: dryer, solar, controllable, agricultural, application.

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