Journées Nano-Est

1er & 2 Octobre 2025

Nancy

Institut Jean Lamour
Mines Nancy
Campus Artem

Booklet

Program & Abstracts

PROGRAM

Wednesday 1st october

13h30: Arrival of participants

13h50: Welcome Speech and Presentation of C'Nano

14h00: Conference by Emmanuelle LACAZE, INSP, *« Highly Distorted Liquid Crystals For Creation Of Topological Defects, Confinement And Assembly Of Nanoparticles »*

14h40-16h00: Oral Presentations

- **Mourad OUDICH**, IJL, *« Gigahertz Topological Phononics In Integrated Waveguide Arrays: Visualization, Protection, And Control »*
- **Benjamin BOGLIO**, ISIS/ICS, *« Chiral Fabry Pérot Cavities from Silver Nanowire Mirrors »*
- **Mathieu BASTIDE**, IS2M, *« Graphene Field Effect Transistors with Edge Contacts: Fabrication and Electrostatic Characterization via Kelvin Probe Force Microscopy »*
- **Ghaya BAABOURA**, LCAE/ICMPE/Leesu**,** *« Toward a New Antibacterial Agent: PEGylated Magnetic Cu-Based Bimetallic Nanoalloys »*

16h00 : Presentation of the 2024 FRMNGE Young Researcher Award Winner, Aurélie HOURLIER-FARGETTE, ICS, *«Self-assembly Of Architected Polymeric Foams From Liquid Templates »*

16h30-17h15: Coffee Break / Poster Session

17h15: Platforms Visits at IJL

18h00: Cocktail / Poster Session

19h00: End of the day

PROGRAM

Thursday 2nd october

8h50: Welcome Speech and Presentation of FRMNGE

9h00: Conference by Nicolas MARTIN, FEMTO-ST, *« Anisotropic Behaviors In GLAD Architectured Thin Films »*

9h40-10h20: Oral Presentations

- **Gaël HEYSEN**, MATIM, *« ZnO Thin Films For Water Depollution Using The Pechini Method »*
- **Stéphane KOUASSI**, ITheMM, *« Synthesis of Copper Oxides by Phase-Shifted Pulsed Sonoelectrochemistry and Sol-gel »*

10h20-10h45 Coffee Break / Poster Session

10h45: Platform Visits at IJL

12h00-13h30 Lunch

13h30: Conference by Guillaume SCHULL, IPCMS, *« Atomically-controlled Fluorescence And Photochemistry »*

14h10-14h50: Oral Presentations

- **Ludovic LÉPÉE**, IPCMS, *« Design Of New Luminescent Hybrid Materials Based On Layered Oxides »*
- **Kevin Dawson ANGO NSA**, LCP-A2MC/IJL, *« Infrared Plasmon Resonance of Doped Silicon Nanocristals by Spectroscopic Ellipsometry »*

14h50: Presentation of the 2023 FRMNGE Young Researcher Award Winner, Jon GORCHON, IJL, *« Manipulating Magnets at Terahertz Speeds »*

15h20-15h50 Coffee Break / Poster Session

15h50-16h10: Oral Presentation

- **Benoît BRAGANTINI**, IMoPA, *« Multidisciplinary Approach To Characterize Biofabricated And Natural Lipid-based Nanoparticles »*

16h10: Presentation of the 2024 FRMNGE Young Researcher Award Winner, Alexandre NOMINÉ, IJL, *« Sustainable by Design Approaches to Nanomaterials »*

17h00: End of the days

Guest Lectures

Journées Nano-Est 1er & 2 Octobre 2025
Nancy
Institut Jean Lamour / Mines Nancy
Campus Artem

Highly Distorted Liquid Crystals for the Creation of Topological Defects, Confinement and Assembly of Nanoparticles

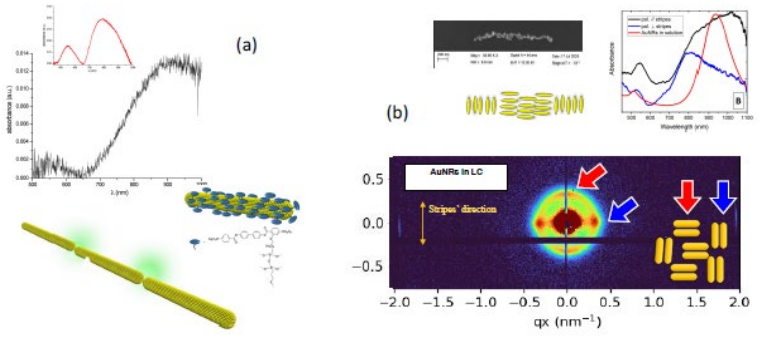
Emmanuelle LACAZE*[1]

[1] *Institut des NanoSciences de Paris, CNRS, Sorbonne Université, Paris, France*

**Correspondance : emmanuelle.lacaze@insp.jussieu.fr*

The study of composites liquid crystal/nanoparticles starts to be a mature thematics in the field of liquid crystal research. It is known that nanoparticles get easily trapped inside liquid crystal topological defect cores, allowing for nanoparticle confinement into specific localizations and allowing for nanoparticle assemblies templated by the defect geometry. We work on these composites liquid crystal/nanoparticles in order to to understand the general principles that govern the interaction between nano-objects and topological defects and use this knowledge for formulating original materials with a specific focus on otical properties of the composites.

I will firstly show that it is possible to build highly distorted thin liquid crystal smectic films that present different kinds of coexisting topological defects. Using X-ray diffraction we are able to reveal the corresponding structure of the distorted smectic layers and the nature of the three kinds of coexisting topological defects, disclinations, dislocations and topological grain boundaries [1, 2, 3]. These defects are strictly oriented by the substrate allowing to use them as templates for the creation of highly anisotropic assemblies of nanoparticles.
By varying size, shape and concentration of nanoparticles, I will show how to precisely study the interactions between nanoparticle and defects responsible for the observed nanoparticle organization within the defects [4, 5]. We are now able to precisely select the defect nature between the three possible ones for the confinement of nanoparticles. Depending on the defects, the nanoparticle assemblies are different but always of controlled orientation as shown in the figure below for gold nanorod with their related light absorption controlled by light polarization. This finally leads to modulated optical properties of the nanoparticles, controlled by light polarization [4, 5] but also by temperature when we take advantage of the liquid crystal phase transition to create or annihilate the defects [6].



(a) Optical properties of gold nanorods confined in the dislocations that form end-to-end chains of strongly anisotropic properties (in black absorption for polarization parallel to the defects and in red for the solution)
(b) Combined Optical properties (in red for solution, respectively in black and blue for parallel and perpendicular polarization), SEM and X-ray diffraction that demonstrate formation of coexisting perpendicular assemblies of nanorods for large diameter and large concentration now confined in the disclinations, with again light absorption controlled by polarization

References

[1] B. Zappone and E. Lacaze, Liquid Crystal Review (2022) ; [2] J. de D. Niyonzima et al, Phys Rev Lett., 124, 018101 (2025) ; [3] L. Musarec et al., Surf. And Interf., 63, 106294 (2025) ; [4] S.P. Do et al., Nano Lett. 20 1598 (2020) ; [5] H. Jeridi et al., Soft Matt. 18 4792 (2022) ; [6] H. Jeridi et al., Appl. Phys. Lett.123 203101(2023)

Journées Nano-Est 1er & 2 Octobre 2025
Nancy
Institut Jean Lamour / Mines Nancy
Campus Artem

Anisotropic Behaviors in GLAD Architectured Thin Films

Nicolas MARTIN*[1]

[1] *Institut FEMTO-ST, 15B, Avenue des montboucons, 25030 BESANCON Cedex France*

**Correspondance : nicolas.martin@femto-st.fr*

https://sites.google.com/site/sitenicolasmartin/

Structuring of thin solid films at the micro- and nano-scale is presently one of the most exciting challenges of materials science. There is a vast number of available deposition methods and in use today. However, all methods exhibit some drawbacks and involve compromises with respect to the process specifics, substrates, as-deposited film properties and so on. Among these methods, the GLancing Angle Deposition (GLAD) is a quite recent strategy, which was successfully developed to sputter-deposit thin films exhibiting original architectures. This strategy employs oblique angle deposition and controlled substrate motion to form an architecture composed of nanometer scaled columns of designed shape. It allows the fabrication of films with a carefully engineered structure at the sub-micron scale. Thus, very unusual shapes (zigzags, spirals, oriented columns and so on) through the film thickness can be produced, which provide new geometries of the film microstructure.

This presentation aims at illustrating how physical properties and anisotropic behaviors of metallic and ceramic thin films prepared by sputtering can be tuned by the GLAD method, especially by means of a co-deposition approach. Some behaviors of GLAD thin films will be discussed especially showing the correlations between the dimensions, designs and geometry of produced architectures, and the resulting properties. Last but not least, anisotropic behaviors focused on electronic transport, optical properties, elastic wave propagation among others, and potential applications of these structured thin films will be reviewed.

Journées Nano-Est 1er & 2 Octobre 2025
Nancy
Institut Jean Lamour / Mines Nancy
Campus Artem

Atomically-controlled Fluorescence and Photochemistry

Guillaume SCHULL*[1]

[1] *Université de Strasbourg, CNRS, IPCMS, UMR 7504, France*

**Correspondance : schull@unistra.fr*

Pushed to their limit, tip-enhanced photoluminescence and electroluminescence can be used to generate sub-molecularly resolved fluorescence maps of simple molecules adsorbed on thin insulating layers (Fig. 1). These techniques are in principle not suited to investigate molecular structures synthesized on-surface, as the direct molecule-metal contact quenches emission properties. In a recent work [1] we developed a strategy allowing us to transfer OSS graphene-nanoribbon from the metal surface to a decoupling NaCl layer and to study their atomic-scale fluorescence properties. An alternative approach would consist in synthesizing a targeted molec-ular structure directly on the insulating NaCl layer. Controlling chemical reaction on insulating surface is notoriously challenging. In this context, we recently reported [2] on the use of tip-enhanced light excitation to control, with sub-molecular precision, a basic chemical reaction for a molecule adsorbed on NaCl.

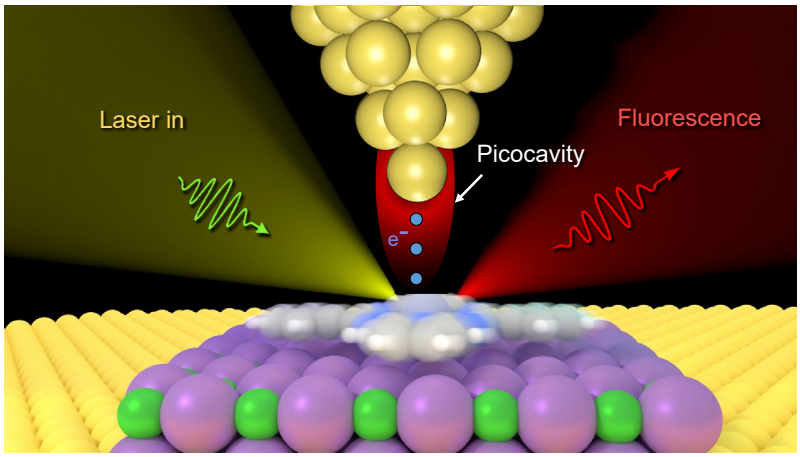


Figure 1: Figure: Tip-induced phototautomerization and enhanced photoluminescence of a free-based phthalocyanine molecule decoupled from Ag(111) by few layers of NaCl.

References
[1] Jiang S., Neuman T., Boeglin A., Scheurer F., Schull G. (2023). Topologically localized excitons in single graphene nanoribbons Science, 379, 1049. https://www.science.org/doi/10.1126/science.abq6948
[2] Roslawska A., Kaiser K., Romeo M., Devaux E., Scheurer F., Berciaud S., Neuman T., Schull G. (2024). Submolecular-scale control of phototautomerization. Nature Nanotech-nology, 19, 738 (2024). https://www.nature.com/articles/s41565-024-01622-4

FRMNGE Young Researcher Award

Journées Nano-Est 1er & 2 Octobre 2025
Nancy
Institut Jean Lamour / Mines Nancy
Campus Artem

Self-assembly of Architected Polymeric Foams From Liquid Templates

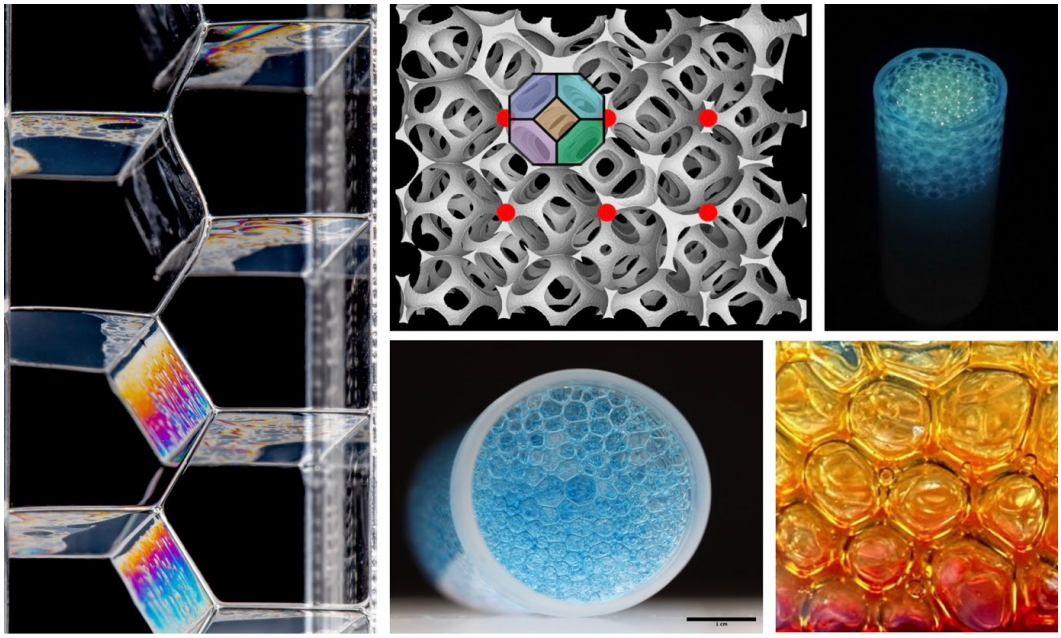
Aurélie HOURLIER-FARGETTE*[1]

[1] *Université de Strasbourg, CNRS, ICS, UPR22, France*

**Correspondance : aurelie.hourlier-fargette@ics-cnrs.unistra.fr*

From the assembly of objects at interfaces to the arrangement of bubbles into foams, capillarity has proven to be an efficient pathway for mechanical self-assembly. In that context, the interest for architected materials is raising a fundamental interesting question: can we convince bubbles to arrange themselves in unusual structures by guiding their assembly, thereby providing an alternative route to additive manufacturing? Despite their wide industrial use and the recent progress on “liquid foam templating” techniques, we still lack methods to explicitly control and customize the geometry and topology of liquid and solid foams.

To access novel architectures with interesting associated properties, we are studying how millimetric bubbles modify their organization by (i) exploring the mechanical self-assembly of bubbles and flexible intruders, leading to a modification of equilibrium structures in simple model foams, (ii) analyzing the arrangement of bubbles in arrays of rigid fibers, which results in the obtention of crystalline foams studied by X-ray tomography and (ii) extending the range of accessible formulations for model foams able to solidify in a controlled manner to reach architected solid foams, including systematic studies on polyurethane, hydrogel and silicone systems.



Journées Nano-Est 1er & 2 Octobre 2025
Nancy
Institut Jean Lamour / Mines Nancy
Campus Artem

Manipulating Magnets at Terahertz Speeds

Jon GORCHON*[1]

[1] *Institut Jean Lamour - Université de Lorraine - CNRS UMR 7198*

Campus Artem, 2 allée André Guinier 54011 NANCY Cedex France

**Correspondance : jon.gorchon@univ-lorraine.fr*

Group website: spin.ijl.cnrs.fr

The manipulation of magnetization is critical for many applications: sensors, isolators, modulators, new computing paradigms… In order to improve on these technologies and unlock new ones, speed of operation is capital. To address this, in our group we attempt to tackle a simple fundamental question: how fast can we control magnetization? To study this at the fastest timescales we use femtosecond laser pulses and terahertz waves, and try to combine different mechanisms such as heat and transfers of magnetization (angular momentum) to trigger magnetization dynamics in a host of magnetic systems. During the last 10 years, we have been able to demonstrate magnetic manipulation in a multitude of systems, at sub-nanosecond speeds, unveiling on the way surprising effects that could only take place at such ultrafast timescales. During this talk I will discuss some of these examples, and hopefully, will give you an overall view of the advancements and remaining challenges in the field.

Journées Nano-Est 1er & 2 Octobre 2025
Nancy
Institut Jean Lamour / Mines Nancy
Campus Artem

The Complex Equation of Critical Materials for Nanotechnologies

Alexandre NOMINÉ*[1,2,3]

[1] *Institut Jean Lamour, UMR CNRS-UL 7198, 54011 Nancy, France*

[2] *LORIA UMR CNRS-UL- INRIA 7503, 54506 Vandoeuvre-lès-Nancy*

[3] *Gaseous Electronics Department F6, Jožef Stefan Institute, Jamova cesta 39, SI-1000 Ljubljana, Slovenia*

**Correspondance : alexandre.nomine@univ-lorraine.fr*

Nanotechnologies have a decisive contribution to the twin transition. Indeed, the improvement of the solar cells performance of the battery storage capacity is a major challenge to met the objective of a Net Zero Carbon society. In the meantime, Nanotechnologies are creating the hardware (sensors, data storage systems, actuators etc…) needed for the digitalization of the society. Nowadays, there is a race for performance of these device to allow them to replace the older technologies and the research for new materials is very active. The emergence of nanotechnology is partly responsible for the extension of the palette of metals used by Humanity. A smartphone requires twice more elements than all life-forms on Earth do[1], [2].

Limiting the challenge of the Green and digital revolutions to the simple cost-performance paradigm would be somehow repeating the mistake of the Oil Age during which the resource was considered as infinite and the impact on the environment had been long time neglected. Making the twin transition successful requires to change the mindset of innovators (from lower TRL) to a binary trade-off (price-performance) towards multi-criteria decision making [3]. In this seminar, the different risks and impact associated with the massive increase in the metal extraction will be presented. Risk assessment at the level of devices will be presented and a multicriteria decision support system will be introduced showing the importance role and importance of the perception of the final user.

References

[1] W. Mertz, « The Essential Trace Elements », Science, vol. 213, no 4514, p. 1332-1338, sept. 1981, doi: 10.1126/science.7022654.
[2] A. H. King, « Our elemental footprint », Nat. Mater., vol. 18, no 5, Art. no 5, mai 2019, doi: 10.1038/s41563-019-0334-3.
[3] « The fine line between performance improvement and device practicality », Nat Commun, vol. 9, no 1, Art. no 1, déc. 2018, doi: 10.1038/s41467-018-07733-6.

Oral Presentations

Journées Nano-Est 1er & 2 Octobre 2025

Nancy
Institut Jean Lamour Campus
Artem, 2 allée André Guinier

First Name, Last Name: Mourad Oudich
Status (Researcher/Post-doc/PhD student 1st, 2nd, 3rd year): Researcher
Employer & Laboratory: Institut Jean Lamour, CNRS, Université de Lorraine
Supervisor(s):
City: Nancy
Email: Mourad.oudich@univ-lorraine.fr

Title: Gigahertz topological phononics in integrated waveguide arrays: visualization, protection, and control

Abstract

Manipulating acoustic waves at GHz frequencies is essential for both classical and quantum technologies. While topological phononics offers robust control over sound propagation, its practical implementation has largely been restricted to low frequencies and bulky structures. Here, we overcome these limitations by using micrometer-scale, unsuspended waveguides to tightly confine phonons and demonstrate integrated topological phononic circuits operating at 1.5 GHz. With a custom high-resolution scanning optical vibrometer, we directly image the spatial dynamics of topological edge states and robust Thouless pumping, in excellent agreement with theoretical predictions. We further realize a topological phononic Mach-Zehnder interferometer that enables rapid switching between transmission paths, achieving acoustic intensity modulation with a 3 dB bandwidth of 0.65 kHz. This work establishes a compact, reconfigurable, and scalable topological phononic platform at microwave frequencies, paving the way for advances in topological physics, microwave signal processing, and hybrid quantum systems[1].

[1]*X.-B. Xu, M. Oudich, et al. Nature Electronics (2025)*

Keywords : Gigahertz topological phononics, Thouless pumping, topological phononic Mach-Zehnder interferometer

Benjamin Boglio
PhD Student, 2nd year
Institut Scientifique d'Ingénieurie Supramoléculaire (ISIS) & Institut Charles Sadron (ICS)
Cyriaque Genet & Matthias Pauly
Strasbourg
Benjamin.boglio@etu.unistra.fr

Chiral Fabry-Pérot Cavities from Silver Nanowire Mirrors

Abstract

Optical cavities capable of confining chiral electromagnetic fields are promising platforms for enhanced chiral light–matter interactions, yet achieving strong chiral confinement within simple, tunable structures remains challenging. Here we demonstrate a versatile fabrication approach for creating chiral Fabry–Pérot cavities based on aligned silver nanowire layers deposited via grazing-incidence spraying. Using comprehensive Mueller matrix polarimetry and simulations of intracavity field profiles, we systematically characterise several cavity configurations and compare their far-field polarimetric signatures with their corresponding intracavity fields. Our results show that while the elements of the Mueller matrix can reliably measure the chiroptical responses of the investigated cavities, it does not allow for accurate prediction as to the chiral nature of the confined field, important for chiral light–matter coupling. These findings stress on the crucial distinction between far-field observations and intracavity chiral environments, guiding future cavity designs toward improved performance in fields such as chiral sensing, emission enhancement, and chiral polaritonics.

Keywords : Chirality, Polarimetry, Cavity

Journées Nano-Est 1er & 2 Octobre 2025

Nancy
Institut Jean Lamour Campus
Artem, 2 allée André Guinier

First Name, Last Name: Bastide Mathieu
Status (Researcher/Post-doc/PhD student 1st, 2nd, 3rd year): Post-doc
Employer & Laboratory: CNRS, IS2M
Supervisor(s): Céline Molinaro & Olivier Soppera
City: Mulhouse
Email: mathieu@e-bastide.net

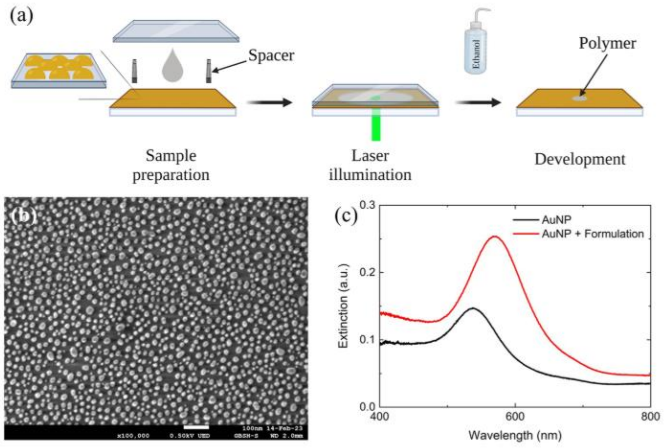
Plasmon-induced thermo-polymerization of PETA in presence of various initiators

Abstract

We have previously intoduce a novel thermopolymerization method utilizing gold nanoparticles (AuNPs) to determine the heat generated during plasmonic effects. [1,2] The system employs Pentaerythritol Triacrylate (PETA) as a monomer combined with a dialkoxyamine-based thermal initiator (DIAMS). Upon laser irradiation at 532 nm, the AuNPs generate heat that initiates the polymerization of PETA, enabling temperature mapping of the substrate.

The methodology involves depositing the thermopolymer formulation on a gold nanoparticle-coated substrate and exposing it to varying laser powers. Differential Scanning Calorimetry (DSC) and hot-plate tests confirm the polymerization threshold for each initiator. The thermopolymerization is visibly detectable as polymerized regions correlate with localized heating induced by AuNP irradiation. Importantly, the study validates the thermal pathway by excluding photopolymerization, owing to the transparency of the formulation in the irradiation spectrum.

This approach leverages collective heating effects from densely packed AuNPs, which amplify temperature distribution beyond individual nanoparticle scales. Experimental results demonstrate the precise control of polymer dot size and shape based on laser power and exposure duration. Moreover, this work highlights the self-sustaining nature of the exothermic polymerization reaction once initiated. This thermoplasmonic polymerization framework provides a rapid, marker-free method to probe heat generation in nano-thermoplasmonic applications. Its potential extends to fabricating metal-polymer nanocomposites and verifying temperature models in plasmonic systems.



References:

1 Molinaro, C., Khitous, A., & Soppera, O. (2024). Chemical Method Based on Thermally Activated Free Radical Polymerization to Determine the Temperature in Thermoplasmonics. ACS Applied Polymer Materials. https://doi.org/10.1021/acsapm.4c00525

Acknowledgement: This work is supported by Fondation de la Maison de la Chimie.

Keywords :
Thermoplasmonics, Gold Nanoparticles (AuNPs), Thermopolymerization, Thermal Initiators

Journées Nano-Est 1er & 2 Octobre 2025

Nancy
Institut Jean Lamour Campus
Artem, 2 allée André Guinier

First Name, Last Name: Ghaya Baaboura
Status (Researcher/Post-doc/PhD student 1st, 2nd, 3rd year): 2nd year
Employer & Laboratory: Laboratoire de chimie analytique et électrochimie (LCAE), Institut de chimie et des matériaux Paris Est (ICMPE), laboratoire eau environnement et système urbain (Leesu)
Supervisor(s): Karim Zehani, Hager Maghraoui, Tarek Ben Nasr, Noureddine Bousserrhine
City: Paris
Email: ghaya.baaboura@u-pec.fr

Title:

Toward a New Antibacterial Agent: PEGylated Magnetic Cu-Based Bimetallic Nanoalloys

Abstract

(Calibri 11 // max. 15 lines // Please do not exceed 1 page)

Magnetic nanoalloys have attracted considerable attention due to their potential in diverse fields such as catalysis, optoelectronics and energy related applications. However, their biomedical applications remain limited due to uncontrolled surface oxidation and toxicity. Copper is a valuable element for the design of nanomaterials with intrinsic antimicrobial properties. In this work, we report the synthesis of Cu-based magnetic bimetallic nanoalloys via a polyol-mediated chemical route. To enhance their biocompatibility, the nanoparticles were surface functionalized through PEGylation, resulting in enhanced colloidal stability in aqueous media. Special emphasis was placed on tuning their physicochemical properties to meet biomedical requirements. Structural properties were investigated using X-ray diffraction (XRD) combined with Rietveld refinement. Magnetic behavior was investigated via magnetization measurements as a function of magnetic field M(H) and temperature M(T). Morphological features, particle size distribution, and chemical composition were analyzed by scanning electron microscopy (SEM), transmission electron microscopy (TEM), and energy-dispersive X-ray (EDX) mapping. The colloidal stability of the PEGylated system was further assessed using optical techniques. Our findings underscore the potential of PEGylated Cu-based magnetic nanoalloys as a novel class of magnetic antibacterial agents, combining the benefits of magnetic response assessed intrinsic antimicrobial activity.

Keywords : 5 max. Magnetic nanoparticle, Nanoalloy, PEGyllation, Polyol synthesis, Antibacterial agent.

First Name, Last Name: **Gaël Heysen**
Status (Researcher/Post-doc/PhD student 1st, 2nd, 3rd year): **PhD student 2nd year**
Employer & Laboratory: **Université de Reims Champagne-Ardenne – Laboratoire MATIM**
Supervisor(s): **Pr Mickaël Gilliot (thesis director)**
City: **Reims**
Email: **gael.heysen@univ-reims.fr**

ZnO thin films for water depollution using the Pechini method

Water pollution by organic dyes from the textile industry is a major environmental problem, due to their persistence and toxicity. There is growing interest in wide-gap semiconductor materials such as zinc oxide (ZnO) for depollution by photocatalysis. Our work is part of this approach, with the aim of designing ZnO-based active films capable of effectively degrading organic pollutants in aqueous solution under UV or solar irradiation.

To achieve this, thin layers of ZnO are produced using a low-cost method that guarantees good material homogeneity. The synthesis is based on an original approach inspired by the Pechini process, which comprises four key steps: (1) chelation of Zn^{2+} ions by citric acid, (2) polymerization of the complexes formed, (3) formation of an organometallic gel by dehydration (4) dilution in a solvent suitable for spin-coating deposition.

The spin-coated films are then calcined to obtain the crystalline phase of ZnO. The films are characterized by structural, morphological and optical analyses. Photocatalytic performance is assessed by photodegradation of indigo carmine, used as a model dye, under controlled laboratory conditions. Particular attention is paid to the correlation between the properties of the films and their photocatalytic efficiency.

Keywords : Thin-film, Zinc Oxide, Photocatalysis, Water depollution, Pechini method

Journées Nano-Est 1er & 2 Octobre 2025

Nancy
Institut Jean Lamour Campus
Artem, 2 allée André Guinier

First Name, Last Name: Stephane KOUASSI
Status (Researcher/Post-doc/PhD student 1st, 2nd, 3rd year): PhD student 1st
Employer & Laboratory: Institute of Thermics, Mechanics, Materials (ITheMM), University of Reims Champagne-Ardenne (URCA)
Supervisor(s): Hicham Benhayoune, Valerie Mancier
City: Reims, France
Email: stephane.kouassi@univ-reims.fr

Synthesis of Copper Oxides by Phase-Shifted Pulsed Sonoelectrochemistry and Sol-gel

Abstract

Nanomaterials smaller than 100 nm are used for their special properties compared with bulk materials [1]. Their size improves optical, electronic and catalytic properties, as is the case for copper oxides [2]. This study therefore focuses on the synthesis of Cu_2O and CuO nanopowders using phase-shifted pulsed sonoelectrochemistry (SPD) and the sol-gel route. The main objective is to obtain these nanoscale oxides by controlling their size and morphology. SPD synthesis was carried out using a three-electrode potentiostat, comprising a titanium working electrode (sonotrode), a saturated mercury sulfate reference electrode and a copper counter-electrode. CuO was obtained in two stages: first, metallic copper was obtained via SPD, followed by heat treatment. X-ray diffraction analysis confirms the purity of the CuO obtained (Cu_2O nanopowder is currently being prepared using this technique). In addition, the sol-gel method was used to obtain separate Cu_2O and CuO nanopowders, with diffractograms showing cubic and monoclinic crystal structures respectively. In addition, the sol-gel method was used to obtain separate Cu_2O and CuO nanopowders, with diffractograms showing cubic and monoclinic crystal structures respectively. Scanning electron microscope observations (Figure 1) reveal significant differences in morphology: while nanoparticles of both types of oxide are of the same order of magnitude (average diameter around 30 nm), those of Cu_2O are essentially cubic in shape (Figure 1a), while those of CuO (Figure 1b) are more spherical. However, initial results obtained by differential centrifugal sedimentation for both oxides show a wider size distribution between 125 nm and 240 nm, probably due to particle agglomeration.

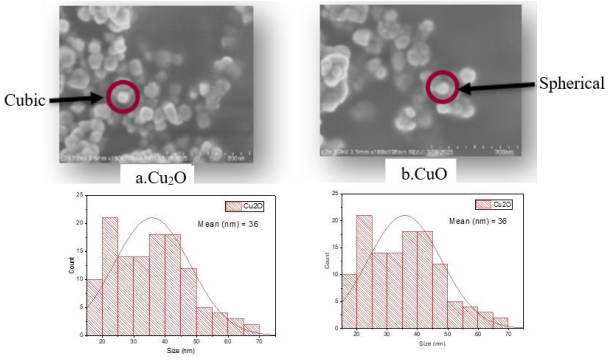


Figure 1: High-resolution scanning electron microscopy analysis of sol-gel copper oxides

[1] Dörner L., Cancellieri C., Rheingans B., Walter M., Kägi R., Schmutz P., Kovalenko M. V., Jeurgens L. P. H., 2019, *Scientific Reports*, *9*(1), 11758.
[2] Botsa S. M., Dharmasoth R., Basavaiah K., 2019, *Current Nanoscience* 15(2), 209-213.

Keywords: Sonoelectrochemistry; sol-gel; nanoparticles; copper oxides; antimicrobial and catalytic activities

Journées Nano-Est 1er & 2 Octobre 2025

Nancy
Institut Jean Lamour Campus
Artem, 2 allée André Guinier

First Name, Last Name: Ludovic Lépée
Status (Researcher/Post-doc/PhD student 1st, 2nd, 3rd year): PhD 2nd year
Employer & Laboratory: *Institut de Physique-Chimie des Matériaux de Strasbourg-IPCMS*
Supervisor(s): Pierre Rabu
City: Strasbourg
Email: ludovic.lepee@ipcms.unistra.fr

Title: Design of new luminescent hybrid materials based on layered oxides

L. Lépée*, C. Adamski, P. Chapel, A. d'Aléo, G. Rogez, P. Rabu*
Institut de Physique-Chimie des Matériaux de Strasbourg-IPCMS, DCMI, France
23 Rue de Loess, 67034 Strasbourg

Hybrid materials are a steadily growing field of research thanks to the ability they offer to combine the structural versatility and tunability of properties of organic compounds with the thermal stability and rigidity of inorganic structure. This synergy is especially valuable in luminescent materials: while organic molecules often provide high quantum yields and flexible molecular design for tuning excitation and emission characteristics, they typically lack stability and are susceptible to photobleaching. Incorporating them into inorganic hosts can not only mitigate these weaknesses but also enhance performance, offering better control over luminescence lifetimes and higher robustness under operating conditions.

This presentation reports on our project to control the photoluminescence properties of lamellar oxides by structural modification at the nanoscale using photo-active molecular species. Our approach involves two key steps: first, the insertion of simple alkylamine or alcohol chains as spacers, leading to pre-functionalized structures, followed in a second step by the incorporation of large chromophores into the Aurivillius $Bi_2SrTa_2O_9$. The chromophores are derived from 1,8-naphthalimide and (2)/(4)-bromo-1,8-naphthalimide, which exhibit Thermally Activated Delayed Fluorescence (TADF) properties, and functionalised by different anchoring groups. Another approach is to insert molecular species into Dion-Jacobson $RbLaNb_2O_7$ phases doped with Eu^{3+} and Tb^{3+} centers starting from their protonated forms ($H_2Bi_{0.1}Sr_{0.85}Ta_2O_7$, HBST, and $HLaNb_2O_7$(Tb or Eu), respectively). In that case, the funtionalisation is used to tune the intrinsic photoluminescence of the inorganic host.

I will describe the elaboration and structural characterisation of the obtained hybrid compounds. Then I will discuss their photophysical properties, notably the emission wavelength, quantum yield, lifetime and the various parameters that could tune their photophysical properties (insertion rate, co-insertion, nature of the chromophore, energy transfer mechanism). Such an approach remains largely unexplored in these layered oxides, offering novel insights aside other systems developed in the literature based on layered double hydroxides or clays.

Keywords : Photoluminescence, Insertion compounds, hybrid nanostructures, oxide functionalisation

Journées Nano-Est 1er & 2 Octobre 2025

Nancy
Institut Jean Lamour Campus
Artem, 2 allée André Guinier

First Name, Last Name: Kevin Dawson ANGO NSA
Status (Researcher/Post-doc/PhD student 1st, 2nd, 3rd year): 2
Employer & Laboratory: LCPA2MC and IJL
Supervisor(s): Aotmane EN NACIRI; Hervé Rinnert; Yann BATTIE; Michel VERGNAT
City: Metz
Email: kevin-dawson.ango-nsa@univ-lorraine.fr

Title: Infrared Plasmon Resonance of Doped Silicon Nanocristals by Spectroscopic Ellipsometry

Abstract

Localized surface plasmon resonance corresponds to collective oscillations of free charge carriers (electrons and holes) confined in a nanoparticle under the effect of an electromagnetic field. Noble metals such as gold (Au) and silver (Ag) have attracted a great deal of interest thanks to their high charge-carrier concentration, which gives rise to localized surface plasmon resonance in the visible range. However, production costs, the incompatibility of these nanostructures with CMOS technology, and the desire to reach the infrared spectral range with nano-sized structures have led researchers to look at other alternatives. Silicon nanocrystals (Si-NCs) hyperdoped with phosphorus or boron proved to be ideal candidates to overcome the limitations of noble metal nanostructures. They offer interesting applications in a number of fields. The aim of this study is to evaluate the effect of doping concentration on the plasmonic response of phosphorus-hyperdoped silicon nanocrystals (Si-NCs:P) using ellipsometry over a wide spectral range from ultraviolet to far infrared (250 – 35000 nm). We show that ellipsometric measurements provide informations on the concentration and mobility of free charge carriers as well as plasmonic properties of silicon quantum dot.

Keywords : Ellipsometry; Plasmon; Dispersion Law; Hyperdoped; Silicon Nanocristals .

Journées Nano-Est 1er & 2 Octobre 2025

Nancy
Institut Jean Lamour Campus
Artem, 2 allée André Guinier

First Name, Last Name: Benoît, Bragantini
Status (Researcher/Post-doc/PhD student 1st, 2nd, 3rd year): Research Engineer
Employer & Laboratory: Université de Lorraine & (1) Université de Lorraine, CNRS UMR 7365 IMoPA, Nancy (2) Université de Lorraine, Pôle scientifique BMS, SMP, Nancy
Supervisor(s): Does not apply
City: Nancy
Email: benoit.bragantini@univ-lorraine.fr

Multidisciplinary approach to characterize biofabricated and natural lipid-based nanoparticles

Benoït BRAGANTINI[1,2], Meriem KOUFANY[1], Arnaud BIANCHI[1,3], Franck CLEYMAND[4], Cyril JF KAHN[5], Elmira ARAB-TEHRANY[5]‡*, Émilie VELOT[1]‡*

[1] Université de Lorraine, CNRS UMR 7365 IMoPA, Nancy, France ; [2] Université de Lorraine, Pôle scientifique BMS, SMP, Nancy, France ; [3] Université de Lorraine, CNRS UMR 7360 LIEC, Nancy, France ; [4] Université de Lorraine, CNRS UMR 7198 IJL, Nancy, France ; [5] Université de Lorraine, LIBio, Nancy, France (‡ Equal authorship)

**Correspondance : elmira.arab-tehrany@univ-lorraine.fr; emilie.velot@univ-lorraine.fr*

Stem cells (SCs) secrete nanoscale extracellular vesicles (EVs) with a lipid bilayer similar to cell membranes. EVs have a higher potential for tissue regeneration than SCs. They are promising vectors for acellular therapies but their bioproduction remains complicated [1]. Nanoliposomes (NLPs) biofabricated with anti-inflammatory lipids derived from plant coproducts have a structure close to cell/EV membranes. They are also candidates for promoting tissue regeneration [2]. However, NLPs can be trapped by immune cells. Creating hybrid vesicles combining both EVs and NLPs would facilitate the encapsulation of target molecules in an innovative vector. Here we used a physicochemical, morphological and biological approach to characterize EVs derived from SCs and NLPs biofabricated from colza coproducts as a steppingstone toward the design of more complex hybrid vectors [3].

NLP and EV production was followed by zeta potential measurement and nanoparticle tracking analysis. Morphological analyses were performed with transmission electron microscopy (TEM) and cryoelectron microscopy (cryoEM). Biological EV markers were estimated by flow cytometry/nanoflow and western blot. Nanoparticle penetration in cells was assessed with spinning disk microscopy.

Nanoparticles exhibited a negatively charged surface with a decent stability. The production of synthetic vesicles was higher than natural ones. The mean hydrodynamic diameter for EVs was almost doubled compared to NLPs. TEM and cryoEM confirmed the size difference and showed a denser content in EVs, which is consistent since NLPs were formulated empty. Biological analyses evidenced that EVs carry specific markers, such as CD9. The imaging of stained vesicles confirmed their penetration in cells.

This multidisciplinary approach demonstrated good nanoparticle characterization and preservation. The EV/NLP ratio required for hybrid vesicle formation remains to be determined in future experiments.

[1] Silva AKA, et al.. Development of extracellular vesicle-based medicinal products: A position paper of the group "Extracellular Vesicle translatiOn to clinicaL perspectiVEs – EVOLVE France". Advanced Drug Delivery Reviews, 2021. (10.1016/j.addr.2021.114001). (hal-03412034).

[2] Velot É, et al.. Efficient TGF-β1 Delivery to Articular Chondrocytes In Vitro Using Agro-Based Liposomes. International Journal of Molecular Sciences, 2022. (10.3390/ijms23052864). (hal-03881099).

[3] Elkhoury K, et al.. Hybrid extracellular vesicles-liposome incorporated advanced bioink to deliver microRNA. Biofabrication, 2022. (10.1088/1758-5090/ac8621). (hal-03881164).

Keywords : stem cells, plant coproducts, lipid-based nanoparticle, nanoparticle characterization.

Posters

Journées Nano-Est 1er & 2 Octobre 2025

Nancy
Institut Jean Lamour Campus
Artem, 2 allée André Guinier

First Name, Last Name: Adrian Benedit-Cardenas
Status (Researcher/Post-doc/PhD student 1st, 2nd, 3rd year): Post-doc
Employer & Laboratory: Institut Jean Lamour
Supervisor(s): Olivier Copie; Karine Dumesnil
City: Nancy
Email: adrian-alberto.benedit-cardenas@univ-lorraine.fr

Epitaxial growth of (LaVO3)n/(PrVO3)m superlattices for emerging multiferroicity

Abstract

The increasing demand for faster digital technologies drives the development of advanced memory materials. Recent innovations have introduced hybrid memories that combine the advantages of electric and magnetic properties. Such advancements have fuelled the exploration of multiferroic materials that exhibit coupled magnetic and electric properties. In the last decade, a novel multiferroic material was theoretically predicted. This material is structured as a perovskite superlattice of rare earth oxides. At low temperatures, the superexchange interaction causes an antiferromagnetic behaviour that, at the same time, may be coupled with improper ferroelectric behaviour where the Jahn-Teller distortions and orbital ordering play a significant role.
This study presents the synthesis of superlattices containing repeated motifs of (LaVO3)n/(PrVO3)m, where n and m represent the number of unit cells for each compound per motif. Such a superlattice corresponds to the sequential stack of atomic planes of LaO/VO2, and PrO/VO2.
The (LaVO3)n/(PrVO3)m superlattices were deposited using Molecular Beam Epitaxy (MBE), with an ozone source acting as the oxygen provider. Growth evolution was followed by monitoring Reflection High-Energy Electron Diffraction (RHEED) intensity oscillations. Two distinct deposition strategies were employed to achieve the desired structures: the co-deposition and the atomic layer-by-layer (ALL) deposition
In the co-deposition approach, vanadium and rare earth atoms simultaneously arrive on the substrate, allowing the materials to self-arrange into the targeted structure. One RHEED oscillation confirms the deposition of one unit cell.
The ALL deposition approach involves sequential arrival of vanadium and rare earth atoms on the substrate. RHEED intensity increases during the arrival of rare earth atoms (formation of LaO or PrO planes) and decreases during vanadium deposition (formation of VO2 planes). The precise timing of the shutter openings is thus critical for achieving the correct doses for the LaO (or PrO) and VO2 planes. ALL is expected to allow for the formation of sharper interfaces inside the superlattice.
The successful synthesis of (LaVO3)n/(PrVO3)m superlattices was achieved. Satellite peaks observed in x-ray diffraction (XRD) Bragg-Brentano configuration diffractograms confirmed the formation of periodic superlattices for both co-deposition and ALL methods. XRD reciprocal space mapping and high-angle annular dark-field scanning transmission electron microscopy (HAADF-STEM) allowed the determination of the crystalline quality and the structural properties of the film. A comparison of the two synthesis strategies, in terms of epitaxial strain and interfaces sharpness is discussed.

Keywords : Growth; Epitaxy; Antiferromagnets

Journées Nano-Est 1er & 2 Octobre 2025

Nancy
Institut Jean Lamour Campus
Artem, 2 allée André Guinier

First Name, Last Name: Sébastien Boukhris
Status (Researcher/Post-doc/PhD student 1st, 2nd, 3rd year): PhD student 3rd year
Employer & Laboratory: Institut Charles Sadron
Supervisor(s): Doru Constantin
City: Strasbourg
Email: sebastien.boukhris@ics-cnrs.unistra.fr

In situ monitoring of the self-assembly of colloidal titanate ribbons

Abstract

Titanium dioxide (TiO2) is one of the most widely studied and used semiconductors for photocatalysis due to its stability, non-toxicity, abundance, wide availability, and low cost. Alongside its uses in environmental cleanup processes, TiO2 shows a high potential in water splitting, a process that generates hydrogen fuel by splitting water (H2O) into hydrogen (H2) and oxygen (O2) using solar energy. It has been notably postulated that lower dimensionality in titania, and especially 1D morphologies, helps in preventing e-h recombination, thus increasing the efficiency of the photocatalytic process [1]. In this context, we have previously reported a scalable, one-pot, near-ambient process to convert low-cost, earth-abundant, non-soluble titanium precursors, such as TiB2, TiC, TiN, into 1D lepidocrocite titanate nanofilaments (NFs), henceforth referred to as 1DL [2, 3]. In a recent study, we demonstrated that in the colloidal state, the NFs loosely associate into elongated ribbons, one lepidocrocite sheet thick. Upon trying, they reach a final state of an extended sheet, stacked three to about twenty high (***Figure 1***). The stack height and crystallinity vary together and are inversely correlated with the photocatalytic activity [4]. In this work, we are following in detail the evolution of the system from the colloidal state to the try state by studying via small and wide-angle x-ray scattering the drying kinetics of droplets in acoustic levitation.

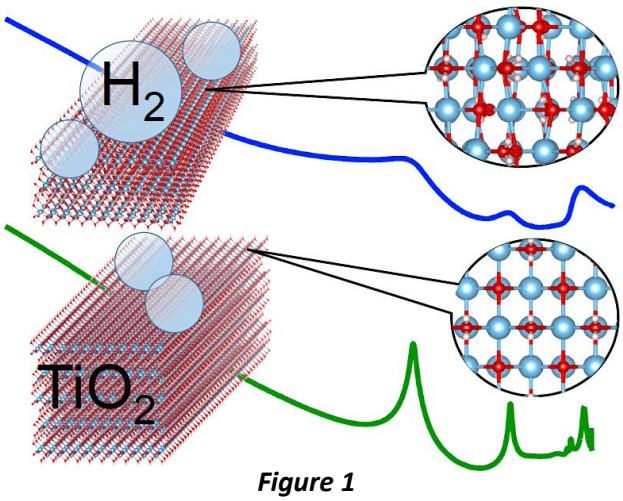


Figure 1

References

1. X. Wang, Z. Li, J. Shi, Y. Yu, Chemical Reviews 2014, 114, 19 9346.
2. H. O. Badr, V. Natu, S. Neatu, F. Neatu, A. Kuncser, A. M. Rostas, M. Racey, M. W. Barsoum, M. Florea, Matter 2023, 6, 9 2853.
3. H. O. Badr, F. Lagunas, D. E. Autrey, J. Cope, T. Kono, T. Torita, R. F. Klie, Y.-J. Hu, M. W. Barsoum, Matter 2023, 6, 1 128.
4. Boukhris, Sébastien & Iacoban, Alexandra & Ibrahim, Mohamed & Badr, Hussein O. & Kuncser, Andrei & Neatu, Stefan & Neaţu, Florentina & Barsoum, Michel & Florea, Mihaela & Constantin, Doru. Small Structures, 2025, 6, 2500017

Keywords : colloids, photocatalysis, self-assemblies, small and wide-angle X-ray scattering, titanate.

Journées Nano-Est 1er & 2 Octobre 2025

Nancy
Institut Jean Lamour Campus
Artem, 2 allée André Guinier

First Name, Last Name: Hélène DEHLINGER
Status: 2nd year PhD Student
Employer & Laboratory: NS3E laboratory at ISL
Supervisors: Dr. HDR Marc COMET & Dr. Cédric MARTIN
City: Saint-Louis
Email: helene.dehlinger@isl.eu

Stabilization of nanoparticles in suspension for the development of energetic materials

The design of energetic materials combining high performance and safety is a major challenge in pyrotechnics for both civil and defense applications. In this context, NanoStructured Thermites and Explosives (NSTEX), developed at NS3E laboratory, represent a promising class of hybrid composites. NSTEX are made of nanothermites, which are nanometric metal/oxide mixtures, with an explosive in submicron-sized powder prepared by the Spray Flash Evaporation (SFE) process[1][2]. These novel materials have tunable detonation properties.

A central challenge in preparing NSTEX arises from the dispersion of insoluble particles (*e.g.* Al, WO_3) in organic solvents such as acetone, as rapid sedimentation prevents homogeneous mixtures. To address this, various stabilization strategies have been investigated, including the use of energetic polymer additives. Polyvinyl nitrate (PVN), acting both as binder and energetic component, has shown improved dispersion of aluminum compared to conventional surfactants in acetone, with reduced sedimentation times.

The present work focuses on the synthesis of PVN from polyvinyl alcohol (PVA) through nitration[3][4], followed by detailed physico-chemical characterization. Particular attention is given to the role of PVN chain length and molecular weight in stabilizing aluminum nanoparticles suspensions, with sedimentation tests highlighting promising trends. These results provide the basis for the one-step formulation of NSTEX by Spray Flash Evaporation process.

[1] Thiruvengadathan, T. *et al.*, *Combustion and flame*, 158 (5), 964-978, **2011**.

[2] Comet, M. *et al.*, *Human factor and mechanical engineering for defense and safety*, 3 (1), 1, **2019**.

[3] Strecker, R. *et al.* Patent no. US3965081A, **1976**,

[4] Kazemi, A. *et al. Journal of Thermal Analysis and Calorimetry*, 119 (1), 613–618, **2015**.

Keywords: Energetic nanomaterials, Nanothermites, Energetic polymers, Nanoparticle dispersion, SFE process

Exploration of Graphene-based Magnetic and Metallic Rashba interfaces to increase Spin-to-Charge Current Conversion efficiency

F. Gonzáles[1,2], M. Yactayo[1,3], J. L. Ampuero[1], D. Melo[1], A. Anadón[1], J. Ghanbaja[1], M. Hilario[2], I. Arnay[4], A. Gudín[4], A. Guio[4], A. Manchon[5], A. Pezo[5], Paolo Perna[4], S. Petit-Watelot[1], and J.-Carlos Rojas-Sánchez[1]

[1]Université de Lorraine, CNRS, IJL, Nancy, France [2]Universidad Nacional de Ingenieria, Lima, Peru [3]Universidad Nacional Mayor de San Marcos, Lima, Peru [4]IMDEA Nanociencia, Madrid, Spain, [5]Universidad Marseille, France

The generation and detection of spin currents primarily occur in systems of ferromagnet/heavy metal (FM/HM) bilayers. It is expected that 2D systems, such as Rashba interfaces, exhibit better efficiency for spin-charge current interconversion due to Edelstein and Inverse Edelstein effect. Pristine graphene (Gr) has remarkable ability to acquire a sizable SOC through proximity effect.

Recent breaking results shows a record of spin-charge current conversion in the Fe(12 nm)/Gr/Pt(5 nm) heterostructure by spin pumping method at room temperature (Advanced Materials 2025). In this context, the proposed research will look to enhance the spin-to-charge current conversion by incorporating a 2D epitaxial graphene monolayer between different magnetic and non-magnetic layers, FM materials such as Fe, Co, and Ni as well as no-magnetic materials such as Pt and Ti. The samples are grown by our collaborator at IMDEA Nanosciencia. We explore experimentally the spin-charge current interconversion in our facilities at the Jean Lamour Institute in Nancy. Also perform thickness, and crystallographic dependence using both: spin pumping ferromagnetic resonance (SPFMR) and spin-torque ferromagnetic resonance (STFMR). The experimental results will be supported by ad-hoc theory based on DFT calculations.

Study in new devices of Fe(5 nm)/X/Pt(0.5 nm) where X= C(0.5 nm, Gr or nothing) show that Fe/C/Pt(0.5 nm) exhibit opposite sign for spin-charge interconversion than Pt. These open new perspectives to tune the sign and amplitude of the efficiency for such interconversion.

First Name, Last Name: Aicha IBRI
Status (Researcher/Post-doc/PhD student 1st, 2nd, 3rd year): 1st year PhD
Employer & Laboratory: Institute of Materials Science of Barcelona (ICMAB-CSIC) - University of Tunis El Manar
Supervisor(s): Carlos Frontera and Hager Magharoui Meherzi
City: Barcelona - Spain
Email: aicha.ibri@etudiant-fst.utm.tn - Aicha.Ibri@autonoma.cat

Structural, Morphological, and Optical Properties of $LaMO_3$ Perovskite Nanoparticles Synthesized via a Simple Chemical Route

Escalating pollution and the harmful impact of conventional synthesis routes highlight the need for sustainable and environmentally friendly alternatives in materials preparation. Green chemistry aims to reduce toxicity, energy consumption, and waste while enabling the development of functional materials. Perovskite oxide nanopowders are among the materials that have received (and are still receiving) great attention as they have proved to be astonishing multifunctional materials, known for their structural flexibility and tunable properties.

With the ultimate goal of exploring their capabilities in water purification, in this study, Lanthanum-based perovskite oxides nanoparticles, with the general formula $LaMO_3$, were synthesized using a simple non-toxic wet chemical co-precipitation method. Different B-site cations, M = Mn, Fe, Al, and Cr) were explored to evaluate their influence on the structural and optical behaviour. X-ray diffraction (XRD) were used to confirm the crystal structure and phase formation. Scanning electron microscopy (SEM) provided information on surface morphology and nanograin size. Energy-dispersive X-ray (EDX) analysis confirmed elemental composition. Optical properties were investigated using UV-Vis spectroscopy for band gap estimation, and photoluminescence (PL) spectroscopy to study charge recombination behavior. These results highlight the potential of the materials for future photocatalytic applications.

Keywords : Perovskite oxide, nanoparticles, green chemistry, Co-precipitation, Photocatalysis

First Name, Last Name: Pedro Leardin Silveira
Status (Researcher/Post-doc/PhD student 1st, 2nd, 3rd year): PhD Student 2nd year
Employer & Laboratory: LIBio – ENSAIA
Supervisor(s): Stéphane Desobry, Elmira Arab Tehrany
City: Nancy
Email: pedro.leardin-silveira@univ-lorraine.fr

Transcellular Transport Model for Nanoliposomes: A computational and experimental model

Nanoliposomes (NLs) have arisen as an auspicious drug delivery vector because of their biocompatible lipid compositions, thus serving as good candidates for the prevention and treatment of neurodegenerative disorders, such as Alzheimer`s and Parkinson`s. While evidence indicates NLs can cross the blood–brain barrier (BBB), the underlying transport mechanisms remain scarce. Furthermore, hydrogel-based microfluidic models, especially those utilizing GelMA, provide a manageable setting to mimic the BBB and study nanoparticle permeability dynamically.

In this study, the Zhang et al. (2020) transcellular transport model was adapted to a GelMA hydrogel-based BBB setting. Experimental parameters, including modulus (G), nanoparticle radius, and zeta potential, were integrated from in-house and existing literature data. Predictive plots for wrapping angle, penetration depth, and mechanical force were generated for various NL formulations. The model successfully simulated nanoparticle–GelMA BBB interactions, with surface charge and particle size identified as key determinants of translocation efficiency. GelMA hydrogels offer tunable matrix properties for modeling passive barriers prior to endothelial cell introduction. This modeling approach supports future in vitro validation and planned microfluidic experimentation in further steps of the project.

Keywords: Nanoliposome, Blood–Brain Barrier, Drug Delivery, Microfluidic Device, GelMA.

Journées Nano-Est 1er & 2 Octobre 2025

Nancy
Institut Jean Lamour Campus
Artem, 2 allée André Guinier

First Name, Last Name: Sher Mohd
Status (Researcher/Post-doc/PhD student 1st, 2nd, 3rd year): PhD student 3rd year
Employer & Laboratory: Université de Lorraine, LRGP.
Supervisor(s): Raphaël Schneider
City: Nancy (France)
Email: sher.mohd@univ-lorraine.fr

Title: Photoproduction of green hydrogen using Cu-based MOFs

Abstract
(Calibri 11 // max. 15 lines // Please do not exceed 1 page)

The need for energy is growing rapidly around the world but it must cope with the significant environmental pollution challenges and depleting resources simultaneously. Solar-driven hydrogen production has gained attention as an environmentally friendly approach to address global energy demands for sustainable and clean energy in combating climate change. Metal-Organic Frameworks (MOFs), with their customizable structures, high surface area, and exceptional light-harvesting capabilities, have emerged as advanced materials for this process. This research aims to synthesize photocatalytically active MOFs, specifically, copper 1,4-benzenedicarboxylate (CuBDC) as it is a promising MOF for photocatalytic H_2 production due to its efficient light absorption and catalytic potential. In this study, we investigate the enhancement of CuBDC's photocatalytic performance by doping with various metals cations to improve its hydrogen evolution reaction (HER) activity. Conventional CuBDC was tested for H_2 photoproduction and its performance is 2500 µmol g^{-1} h^{-1} of H_2. While Ni-doped CuBDC (5700 µmol g^{-1} h^{-1}) and Co-doped CuBDC (12000 µmol g^{-1} h^{-1}) showed significantly higher H_2 production than conventional CuBDC under visible light irradiation. This work highlights the advancements in doped CuBDC materials and provides insights into the future development of MOF-based photocatalysts for sustainable energy applications.

Keywords : 5 max. Hydrogen, MOFs, Photocatalyst, Energy

Journées Nano-Est 1er & 2 Octobre 2025

Nancy
Institut Jean Lamour Campus
Artem, 2 allée André Guinier

First Name, Last Name: Léo Petitdemange
Status (Researcher/Post-doc/PhD student 1st, 2nd, 3rd year): PhD student 2nd
Employer & Laboratory: Institut Jean Lamour
Supervisor(s): Daniel Lacour & Gregory Malinowski
City: Nancy
Email: leo.petitdemange@univ-lorraine.fr

Title: Magnetic textures generated by laser pulses

Abstract

In condensed matter physics, the study of magnetic textures bridges fundamental research and technological innovation, with potential applications in various fields such as computing, energy, and fundamental physics. These complex textures can be generated by laser pulses, fostering the emergence of ultra-fast, low-energy information storage systems. [1] Our study is inspired by the work of Zhang et al. [2] and is conducted on thin films with perpendicular anisotropy. Our magnetic characterization measurements show that by reducing the thickness of a CoFeGd thin film from 8.5 nm to 7 nm, the magnetization state transitions from a homogeneous to an inhomogeneous magnetic configuration in zero field. Before the transition, it is possible to prepare the system in a metastable state in zero field. The use of a femtosecond laser pulse can then provide enough localized energy to change the magnetic configuration and generate a texture. In this poster, we will present our results on CoFeGd thin films deposited on a monocrystalline Si/SiO substrate, fabricated by Physical Vapor Deposition under ultra-high vacuum at the Institut Jean Lamour. After a 30 fs laser pulse on this material, we observed the appearance of a magnetic texture, later imaged using a recent magnetic microscopy technique. [3]

[1] *Vakili, H. et al. J. Appl. Phys. 2021,130, 070908*
[2] Zhang, W. et al. ACS Appl. Mater. Interfaces 2023, 15, 4, 5608–5619
[3] Tetienne, J. P. PhD thesis. ENS de Cachan, 2014.

Keywords : Magnetic textures, Magnetic microscopy, Femtosecond laser, Simulations.

First Name, Last Name: Shubham, Shishodia
Status (Researcher/Post-doc/PhD student 1st, 2nd, 3rd year): PhD student 3rd year
Employer & Laboratory: CNRS-Laboratoire Réactions et Génie des Procédés & Institut Jean Lamour
Supervisor(s): Prof. Raphael Schneider, Dr. Thomas Gries
City: Nancy
Email: shubham.shishodia@univ-lorraine.fr

Compositional engineering of highly emissive and widely tunable I-III-VI based quantum dots (QDs) for photovoltaic applications

Abstract

In quantum dot sensitized solar cells (QDSSCs), replacing heavy metal based binary II-VI QDs such as Pb (S, Se or Te) or Cd (Se or Te) with I-III-VI counterparts is of high interest for environmental considerations while ensuring optimal device performance. Their ability to get assembled as nanocrystals on the surface of TiO_2 with tunable electronic properties through size, shape, and composition makes them worthy light-harvesting material in QDSSCs . In this context, it becomes imperative to extensively investigate the chemical pathways, composition and structure of Cu-In-Zn-Se QDs to achieve competitive photovoltaic characteristics [1]. The present study reports a robust, quick and inexpensive microwave assisted aqueous phase-based approach to produce Cd-free, bright, and highly emissive alloyed Cu-In-Zn-Se/ZnS QDs of small size (~ 2.2 nm). The prepared nanocrystals show widely tunable photoluminescence (PL) emission from 618 to 765 nm by varying feed molar ratio of precursors. Being in line with the systematic PL tunability, their energy gap could be enlarged from 1.73 to 2.12 eV. By leveraging the off-stochiometric effect on PL, QDs having Zn:Cu molar ratio of 1:2 recorded the longest mean decay PL lifetime of 0.63 μs with highest PLQY of 54%. Further, the purified QDs were characterized with UV-visible, PL spectroscopy, FT-IR in combination with XRD and HR-TEM analysis to investigate the role of cation deficiency on their structure. Different strategies were attempted to grow homogenous and crack-free thin films of QDs onto FTO substate to realize QDs-sensitized electrode. Dip coating of Cu-In-Zn-Se/ZnS QDs onto the magnetron sputtered TiO_2/FTO substrate resulted in the fabrication of desired QDs-sensitized electrode. Techniques like SEM, DRS and profilometry were extensively employed to monitor the thickness and surface of the fabricated electrode. Photoelectrochemical measurements on tailored QDs-sensitized electrode were conducted. Steady-state current response and dynamic response of the heterostructured QDs/TiO_2/FTO system to intermittent illumination was studied by chopped light chronoamperometry. Mott-Schottky analysis was utilized to understand their doping type and energy band alignment of QDs by measuring their flat-band potential. The presence of a small and tight semi-circular shape of Nyquist plot in comparison to unsensitized TiO_2 film electrode indicated an improved charge transfer with minimal interfacial effects. The study demonstrates high application prospect of Cu-In-Zn-Se/ZnS QDs sensitized TiO_2 thin film electrodes as potential heterostructures in QDSSCs.

[1]. Shishodia, S., Chouchene, B., Gries, T. and Schneider, R., 2023. Selected I-III-VI2 Semiconductors: Synthesis, Properties and Applications in Photovoltaic Cells. *Nanomaterials*, *13*(21), p.2889.

Keywords : Quantum dots, Optoelectronic properties, Thin films, Photovoltaics

Orbitronics: Quantification of inverse orbital Edelstein effect at Ni/Cu/MgO, CoPt/Ti/MgO and Ni/Ti/Au

M. Yactayo[1,2*], A. Pezo[5], J. L. Ampuero[1], Akilan K.[1], M.Tian[1,3], L. Badie[1], J. Quispe-Marcatoma[2], C. V. Landauro[2], S. Petit-Watelot[1] , Y. Xu[4] , M. Hehn[1], A. Fert[5] , and J. -C. Rojas-Sánchez[1]

[1]Université de Lorraine, CNRS, Institut Jean Lamour – CNRS:UMR7198, France ; [2]Universidad Nacional Mayor de San Marcos – Peru; [3]Southeast University, Nanjing, China; [4]MIIT Key Laboratory of Spintronics, School of Integrated Circuit Science and Engineering, Beihang University, China; [5]Laboratoire Albert Fert, CNRS, Thales, Université Paris-Saclay, France
*melissa-sonia.yactayo-yaranga@univ-lorraine.fr

There is a very active debate on the relaxation mechanism of orbital angular momentum (OAM) accumulation. Some experimental and theorical results point out a large orbital relaxation length [1-3]. Recent theories indicate that OAM accumulation relaxes in a few atomic layers [4-6], therefore the effect would be interfacial as experimentally shown for Zr [7].

In this work, we show the quantification of the interconversion efficiency through results based on spin/orbital pumping [8-10], and spin/orbital Seebeck effect [11]. This is via the so-called inverse Orbital Edelstein Effect (IOEE) [12], an effect for orbital similar to those already studied for spin at Rashba interfaces [9] or topological insulators surfaces [10]. We show IOEE conversion on //CoPt/Ti(t)/MgO(2)/Ta(2) and //Ni(10)/Ti(t)/Au(3). There is a weak effect independent of Ti thickness, which is ascribed as an interfacial conversion IOEE. These results are in agreement with magneto-thermal experiments, Fig 1ab, showing again no variation between 4 and 60 nm of Ti and in agreement with the absence of Orbital Hall Effect. Instead, the conversion is at the interfaces. This is in contrast to other experimental results on Ti [1,2]

We propose a double interconversion scenario at interfaces that reconcile the different results [13].

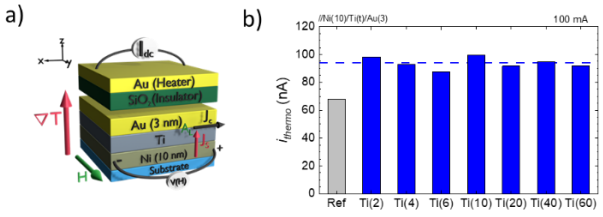


Figure 1. (a) Scheme of magneto-thermal experiment indicating the thermal gradient, DC magnetic field H, spin current J_s, the generated orbital accumulation A_L, and conversion in charge current J_c, which is detected by voltage as function of H. (b) total current produced i_{thermo}, including Anomalous Nernst Effect of Ni, as function of Ti thickness. There is not variation until 60 nm of Ti [13].

References

[1] YG. Choi, Nature volume 619, 52–56 (2023)
[2] H. Hayashi, Nat. Electronics 7, 646 (2024)
[3] I. Lyalin, Phys. Rev. Lett. 131, 156702, (2023)
[4] M. Rang and P.J. Kelly, PRB 109, 214427 (2024)
[5] T. Valet and R. Raimondi, PRB 111, L041118 (2025)
[6] A. Pezo et al arxiv.org/abs/2411.13319
[7] N. Kumar et. al. PRB 111, 094410 (2025)
[8] J.-C Rojas-Sánchez and A. Fert, Phys Rev. Appl., 11, 054049, (2019)
[9] J.-C Rojas-Sánchez; J Nat Commun, 4, 2944, (2013)
[10] J.-C Rojas-Sánchez; Phys. Rev. Lett., 116, 096602, (2016)
[11] V. Palin, et.al, Physical Review Materials 7, 104203 (2023)
[12] D. Go; J.S. Smith Phys. Rev. Lett, 121, 086602 (2018)
[13] M. Yactayo et al. *To be submitted*