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Innovative approaches of film processing and interfacial structuration of $\text{CH}_3\text{NH}_3\text{PbI}_3$ and $\text{Cs}_2\text{AgBiBr}_6$ perovskite solar cells towards enhanced light absorption

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JPH 2023

Journées des Pérovskites Halogénées

Livret des résumés
/ Book of abstracts



du Mercredi 31 Mai au Vendredi 2 Juin 2023



Biarritz (France)





Résumés des oraux (dans l'ordre du programme)
/ Oral abstracts (as per the program)



Liste des 22 oraux (dans l'ordre du programme)

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- 01.** “Perovskite-based NIR photodetectors”
Loïc PAILLARDET – CEA Liten & STMicroelectronics
- 02.** “Redox-active substitutional doping of metal halide perovskites”
Zuzanna MOLENDĄ – IMS Bordeaux
- 03.** “Molecular engineering of hole transporting molecules for high efficient and enhanced thermal stability perovskite solar cell”
Thanh-Tuân BUI – LPPI
- 04.** “Structural and optoelectronics properties of gold based double perovskites semiconductors”
Géraud DELPORT – CNRS IPVF
- 05.** “Thermal and photo-degradation study of α -FAPbI₃-based perovskite using in situ characterization techniques”
Julie RUELLOU – LRCS
- 06.** “Colloidal Carbon Quantum Dots for More Stable Perovskite Solar Cells”
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- 07.** “Spectral fingerprint of quantum confinement in single CsPbBr₃ nanocrystals”
Mohamed-Raouf AMARA – LPENS
- 08.** “Electron's Spin Selectivity in Chiral Lead-Bromide Perovskites”
Alexandre ABHERVÉ – MOLTECH-Anjou
- 09.** “Excitons in highly anisotropic lead halide perovskite nanocrystals”
Maria CHAMARRO – INSP
- 010.** “Innovative approaches of film processing and interfacial structuration of CH₃NH₃PbI₃ and Cs₂AgBiBr₆ perovskite solar cells towards enhanced light absorption”
Anthony MAHO – ICMCB
- 011.** “Photo-physical Properties of Graphene Quantum Dots on Perovskite Substrates”
Hugo LEVY-FALK – ENS Paris-Saclay



- O12.** “Shedding light on the birth of hybrid perovskites: a correlative study by In-Situ TEM and synchrotron-based X-Ray scattering studies”
Charles SIDHOUM – IPCMS
- O13.** “Fabrication of green light-emitting diodes using CsPbBr₃ perovskite nanocrystals embedded in polymer matrices”
Quang-Huy DO – XLIM
- O14.** “ground-breaking PEROvskite technologies for advanced X-ray medical Imaging Systems”
Eric GROS-D’AILLON – CEA LETI
- O15.** “Influence of surface ligands on the electronic properties of AgBiI₄ rudorffites nanocrystals”
Ashanti BERGONZONI – INSA Rennes
- O16.** “Room temperature synthesis of green emitting lead-free perovskite inspired manganese halides”
Pierre MARTIN – Université Clermont Auvergne
- O17.** “Long-range and ballistic propagation at room temperature of 75% excitonic fraction polaritons in perovskite metasurface”
Hai Son NGUYEN – INSA Lyon & LuMIn
- O18.** “Deep-learning assisted identification of new hybrid perovskites from X-ray diffraction patterns”
Romain GAUTIER – IMN Jean Rouxel
- O19.** “Donor-Acceptor Pair Transitions in Halide Perovskite CH₃NH₃PbI₃ Single Crystals”
Thi Huyen Trang NGUYEN – UVSQ
- O20.** “Tight-binding modelling of layered halide perovskites”
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- O21.** “Detailed Analysis and Modelling of the Photocurrent Response of MAPb(Br_{1-x}Cl_x)₃ Single Crystals under X-rays”
Ferdinand Lédée – CEA LETI
- O22.** “Elaboration of new hybrid perovskite@graphite composites and mixed 2D/3D perovskites with enhanced stability for X-ray detection via a solvent-free mechanochemical approach”
Yihui CAI – ICPEES



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Journées Perovskites Halogénées

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Innovative approaches of film processing and interfacial structuration of $\text{CH}_3\text{NH}_3\text{PbI}_3$ and $\text{Cs}_2\text{AgBiBr}_6$ perovskite solar cells towards enhanced light absorption

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Type of communication: Oral

This contribution first covers the use of polystyrene beads as hard templating sacrificial agents for the design of inverse-opal electron-conducting TiO_2 [1] and of $\text{CH}_3\text{NH}_3\text{PbI}_3$ perovskite porous layers [2] through spin coating protocols, from which full solid-state architectures of perovskite solar cells are consecutively assembled. The positive effect of the porous structuration of the photoactive layers in comparison with dense, unstructured counterparts is demonstrated. Moreover, the specific impact of the pore dimensions on the morphological and optoelectronic properties of the structured layers is studied through structural (SEM, XRD), optical (UV-VIS-NIR, ellipsometry) and electronic/electrochemical analyses (I-V curves, EIS). The influence of the photon absorption intensity and lifetime on the charge recombination mechanisms within structured and unstructured active layers is further discussed. Ultimately, optimums of structural configurations are experimentally established in terms of light harvesting and of power conversion efficiency, in good correspondence with numerical studies [3,4]. Maximized light absorption is reached for 500 nm diameter pores structure, with photonic enhancement factors as high as 9% with inverse opal TiO_2 photoanodes and 16% with inverse opal perovskite layers, compared to unstructured compact benchmarks.

As other formulation of interest for solar cells, $\text{Cs}_2\text{AgBiBr}_6$ double perovskite is considered as a promising alternative, lead-free photovoltaic absorber due to its easy processability, high stability, and reduced toxicity. In this context, our recent works have shown that spray-coating could be used advantageously for depositing high quality $\text{Cs}_2\text{AgBiBr}_6$ double perovskite thin films [5]. Microstructural and optoelectronic properties of spray-coated layers are compared with spin-coated benchmarks, and consecutively assembled devices lead to 2.3% photoconversion efficiency with high open-circuit voltage of 1.09 V. Further optimization is considered through the design of combined layers of tetracene and Spiro-OMeTAD so to strengthen the perovskite - hole transport material interface [6].

References

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