Master thesis Research Fellow

"Ensuring water stability of hybrid perovskite solar cells"

Context:

This Master thesis research fellow is a training position offer for student in Master II at the "Laboratoire de Réactivité et Chimie des Solides" CNRS UMR 7314 (www.lrcs.u-picardie.fr). "Photoelectrochemistry and photovoltaics" is the most recent thematic developed in the lab, including activities on dye-sensitized and perovskite solar cells. We are capitalizing on important knowledge in stability and degradation mechanisms in dye-sensitized solar cells and transposition to perovskite solar cells.

Scientific Project :

Perovskite structures have allowed the emergence of a whole new photovoltaic technology in recent years. This structure was first used in a solar cell in 2009 but only showed its interesting potential in 2012. Within a few years, Perovskite solar cells (PSC) achieved conversion efficiency up to 25%. Thanks to their inexpensive manufacturing process and an already high light conversion rate, PSCs may be one of the next major technologies that will be widely marketed. However, among many stability problems encountered by this type of cell, we wish to contribute to two important issues: (i) the lack of temperature and humidity stability of the absorber (ii) the lead content which leads to under humidity to degradation products, in particular PbI_2 and PbIOH which are soluble in water and therefore which can spread and pollute the environment.

Within this context, our focus is niche in the development of new organic composition including macromolecules and hydrophobic cation in the A-site which showed stability against light exposure and moisture. On the one hand, the objective of the master thesis will be to synthesize new hydrophobic ammonium salt and incorporate them into the Cesium-Formamidinium Perovskite layer. On the other hand, the Master student will modify polymers in order to create hydrophobic barrier. Both ammonium and polymers obtained would be incorporate into complete devices to rise efficiency greater than 21% and maintain perfectly stable materials under humidity thanks to the association of a simpler $FAPbI_3$ system as an absorber and the use of polymers.

The laboratory has all the tools and instruments for synthesizing materials and preparing perovskite solar cells. The new materials will be characterized in-depth by x-ray diffraction, transmission electron microscopy and UV-Visible absorption spectroscopy. The power conversion efficiency and spectral response of the devices will be measured from the (J-V) characteristics under illumination using class 3A solar simulator and by external quantum efficiency (EQE), respectively. The successful student will have access to all the laboratory instruments that will allow him to carry out the complete the study of the new materials. In addition, all of our students have access to microscopy platforms as well as a full panel of instruments to perform X-ray diffraction experiments under humidity and under illumination ex situ and in situ.

Recent publications related to the topic :

1 T. Miyasaka et al., Organometal halide perovskites as visible-light sensitizers for photovoltaic cells, J. Am. Chem. Soc., 2009, 131, 6050-6051
2 N.-G. Park et al., Material and Device Stability in Perovskite Solar Cells. ChemSusChem 2016, 9 (18), 2528–2540.
3 S.-H. Turren-Cruz, A. Hagfeldt, M. Saliba, Science, 2018, 362 (6413), 449-453
4 T. Xu et al., Nature, 2020, 578, 555–558

Candidate profile:

The student has to be in Master II in chemistry, organic chemistry or materials chemistry and should show a strong motivation for solar cells technology.

Duration : 6 months.

Location: Laboratoire de Réactivité et Chimie des Solides (CNRS UMR 7314) in Amiens, France

To apply, please send a CV, cover letter and two recommendation letters to:

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