Master thesis Research Fellow

"Understanding of intrinsic instability and synthesis of new hybrid lead halide 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 solar cells and perovskite. We are capitalizing on important knowledge in stability and degradation mechanisms in dye-sensitized solar cells and transposition to perovskite solar cells.

Scientific Project :

Lead halide perovskites **[1]** are structures which recently emerged as a robust alternative to silicon photovoltaic displays. The most recent achievements raised the technology to above 22 % power conversion efficiency. **[2]** One advantage of this technology stems from its solution process, richer chemistry and atypical opto-electronic properties allowing to get rid of high vacuum / high temperature procedures penalizing the cost and LCA indicators of silicon and more generally (III-V) (II-VI) technologies. So far two main drawbacks are impeding on the credibility of the technology: *(i)* the content of lead in the absorber and *(ii)* its lack of chemical/thermal stability of the absorber itself, the hole-transporting material and the way this latter is doped (ie. LiTFSI).

The objective of this master internship is to investigate the synthesis of new lead halide perovskite structures. Indeed, PSC show a lack of stability *versus* moisture, heat and UV-light. In the purpose of improving the stability, one solution is to prevent moisture to enter in the cell by increasing hydrophobicity of the device. **[3]** Nevertheless, all the modification in PSC should be respectful of the good conversion efficiency showed in literature by this Perovskite solar cell technology.

Furthermore, this work will be also a good opportunity to set up a bench stress test for PSC *versus* humidity and heat condition in the laboratory. The candidate will also be in charge of the complete characterizations of the materials.

This work has the potentials to pave the way towards deciphering degradation phenomena in perovskite solar cells while also has the potentialities to significantly enhance the device life-in time.

Recent publications related to the topic :

[1] Shiqiang Luo and Walid A. Daoud, J. Mater. Chem. A, **2015**, *3*, 8992-9010; Bayrammurad Saparov and David B. Mitzi, Chem. Rev. **2016**, *116*, 4558-4596
[2] NREL chart, http://www.nrel.gov/ncpv/images/efficiency_ chart.jpg, Accessed 24.10.2016.
[3] Dongqin Bi , Peng Gao , Rosario Scopelliti , Emad Oveisi , Jingshan Luo , Michael Grätzel , Anders Hagfeldt , and Mohammad Khaja Nazeeruddin, Adv. Mater. **2016**, *28*, 2910-2915; Zhaoning Song, Antonio Abate, Suneth C. Watthage, Geethika K. Liyanage, Adam B. Phillips, Ullrich Steiner, Michael Graetzel, and Michael J. Heben, Adv. Energy Mater. **2016**, 1600846

Techniques used :

The candidate will characterize in depth the properties of these new perovskites by measuring the (J-V) characteristics under illumination, quantum efficiency and uses additional tools to measure the electron transfer properties such as electrochemical impedance spectroscopy (EIS), Intensity-modulated photocurrent/photovoltage spectroscopies (IMPS/IMVS), ps-Time-Correlated Single Photon Counting (TCSPC) and pump-probe ns-Transient Absorption Spectrometry.

Candidate profile:

The student has to be in Master II in chemistry, materials chemistry or electrochemistry 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 one recommendation letters) to:
Dr. Sébastien Gottis: sebastien.gottis@u-picardie.fr
Dr. Frédéric Sauvage: frederic.sauvage@u-picardie.fr