Master thesis Research Fellow

"Hydrophobic-based lead "perovskite" : the first truly stable composition in liquids, study of its application in perovskite-liquid solar cells and photocatalysis"

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 perovskite (eg. $CH_3NH_3PbI_3$), **[1]** which was unveiled firstly in 2009 as sensitizers for photovoltaics, has rapidly emerged as a robust alternative or as a pair to silicon photovoltaic technology. These materials combine outstanding opto-electronic properties in terms of high absorption coefficient, high yield and long-lived charge separation owing to only 30 meV exciton binding energy and finally are compatible to solution process, thus making this field with unprecedented developments in PV, photocatalysis, X-ray or photon detectors and imaging, LEDs etc… . Today, light-to-electrical power conversion efficiency are reaching 22.1% **[2],** a value lying in the standards of silicon PV. Nowadays, most of research are dedicated to 3D perovskite because of their high efficiencies despite they remains poorly stable under light, moisture and thermal stress. A new pathway with 2D Ruddlesden-Popper hybride halide "perovskites" showed up promising stability and properties.**[3]**

Within this context, we recently developed a new 2D "perovskite" composition including hydrophobic cation in the A-site which showed for the first time robustness against light exposure, stable not only in water media but also in corrosive electrolytes including iodine/iodide species. The objective of this master internship is thus to continue the development of such new kind of promising compositions while taking advantage of their high stability to include them as an absorber in a first liquid-perovskite solar cells, in dye-sensitized solar cells and for photocatalysis (ie. water splitting). One particular emphasis of this work would be dedicated to prompt this development in device and to explore different composition to optimize the bandgap value for the application.

Recent publications related to the topic :

[1] Akihiro Kojima, Kenjiro Teshima, Yasuo Shirai and Tsutomu Miyasaka, *J. Am. Chem. Soc.*, **2009**, *131* (17), 6050–6051; 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] Constantinos C. Stoumpos, Duyen H. Cao, Daniel J. Clark, Joshua Young, James M. Rondinelli, Joon I. Jang, Joseph T. Hupp, and Mercouri G. Kanatzidis, *Chem. Mater.*, **2016**, *28* (8), 2852–2867

Techniques used :

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 dynamic of charge carriers transport vs. recombination will be asset by electrochemical impedance spectroscopy under illumination and/or by intensity modulated photovoltage and photocurrent (IMVS-IMPS). Ultra-fast charge transfer components, namely injection of electrons into TiO_2 and holes into the hole transporting material or electrolyte, will be determined by ps-Time-Correlated Single Photon Counting (TCSPC) and pump-probe ps-Transient Absorption Spectroscopy.

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:

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