ParisTech

RESEARCH TOPIC FOR THE PARISTECH/CSC PHD PROGRAM

Field: Chemistry, Physical Chemistry and Chemical Engineering

Subfield: Chemistry

Title: 2D/3D Perovskites for Stable and High-Efficiency Solar Cells

ParisTech School: Chimie ParisTech | PSL

Advisor(s) Name: Thierry PAUPORTÉ
Advisor(s) Email: thierry.pauporte@chimieparistech.psl.eu
Research group/Lab: Institut de Rechreche de ChimieParis (UMR8247)
Lab location: 11 rue P. et M. Curie 75005 Paris
Website : www.pauportegroup.com

Short description of possible research topics for a PhD:

Recently, hybrid halogen perovskites (PVKs) have emerged as fascinating materials and highly versatile semiconductors. These compounds can be prepared as 2D (two-) and 3D (three-dimensional) materials, and their composition can be varied over a quite large extend. This ensures the possible fine tuning of their optoelectronic properties. Their superior properties make them especially attractive for an application to photovoltaic (PV) solar cells. If their PV power conversion efficiency is now reaching impressive values, these devices still suffer from a problem of stability.
The host group, which is leader in France on perovskite solar cells (PSCs) research, has discovered recently precursor solution chemistries that allow the preparation of highly stable 2D/3D perovskite layers. Moreover the power conversion efficiency achieved with these perovskites is very promising.
The aim of the PhD will be to get further insights into the preparation 2D/3D PVK with special stoichiometry and additive. The student will investigate the role of the additives and the effect of the composition on the layers morphological, structural, optical and electronic properties. PV cells based on these new materials will be prepared and characterized by various techniques (*J-V* curves, impedance spectroscopy, spectral response…). The objective will be to better understand the effect of chemistry and composition on the devices stability and high performances.

Required background of the student:
Material science, Chemistry, if possible: Physics of semiconductors, Photovoltaics.

A list of 5 representative publications of the group:
1- T. Zhu, D. Zheng, J. Liu, L. Coolen, Th. Pauporté, Electrical Response of High Efficiency and Stable Solar Cells Based on MACl Mediated Grown $FA_{0.94}MA_{0.06}PbI_3$ Perovskite. ACS Appl. Mater. Interfaces 12 (2020) 37197–37207.
2- T. Zhu, D. Zheng, M.-N. Rager, Th. Pauporté, Actual Organic Cations Composition Determination in Perovskite Thin Films. Application to Formamidinium Lead Iodide Stabilization for High Efficiency Solar Cell. Solar RRL 2020, 2000348.
3- T. Zhu, J. Su, F. Labat, I. Ciofini, Th. Pauporté, Interfacial Engineering through Chloride-Functionalized Self-Assembled Monolayer for High Efficiency Perovskite Solar Cells. ACS Appl. Mater Interfaces, 12 (2020) 744-752.
4- A. Leblanc, N. Mercier, M. Allain, J. Dittmer, T. Pauporté, V. Fernandez, F . Boucher, M. Kepenekian, C. Katan, Enhanced Stability and Band Gap Tuning of α-$[HC(NH_2)_2]PbI_3$ Hybrid Perovskite by Large Cation Integration. ACS Appl. Mater. Interfaces, 11 (2019) 20743-20751.
5- D. Pitarch-Tena, T.T. Ngo, M. Vallés-Pelarda, Th. Pauporté, I. Mora-Seró, Impedance Spectroscopy Measurements in Perovskite Solar Cells. Device Stability During the Measurement and Noise Reduction. ACS Energy Lett., 3 (2018) 1044–1048.