65: Fabrication and characterisation of a hybrid perovskite solar cell

Dmitry ALDAKOV and Mathilde BOUCHARD

INAC/UMR 5819 SPrAM (CEA-CNRS-UJF)/LEMOH, CEA Grenoble

The photovoltaic technology based on hybrid perovskite materials as light absorbers has emerged 5 years ago and extremely rapidly overpassed the silicon one in terms of both efficiency (for amorphous silicon) and cost and keeps developing. In other words, it conceals a huge potential for the efficient large scale integration. First introduced in 2012, the efficiency of solar cells using thin films of metalorganic Pb-containing perovskites as light absorbers has risen from 10 to 20% in just 2 years, which makes them perfectly on par with well-known thin-film technologies such as α-Si/micromorph-Si, CdTe or CIGS.

The concept of perovskite solar cells was originally inspired by well-known dye-sensitized cells, where upon light absorption the organic dyes adsorbed on mesoporous TiO_2 material injects charges to opposite electrodes. An important advantage of commonly used hybrid methylammonium lead(II)-trihalide MAPbX3 (X = I in most cases) perovskite material is their extremely high charge mobility, which allows to increase the perovskite film thickness to absorb a maximum of light and possibility to fabricate all-solid state cells, which are much more interesting for practical applications.

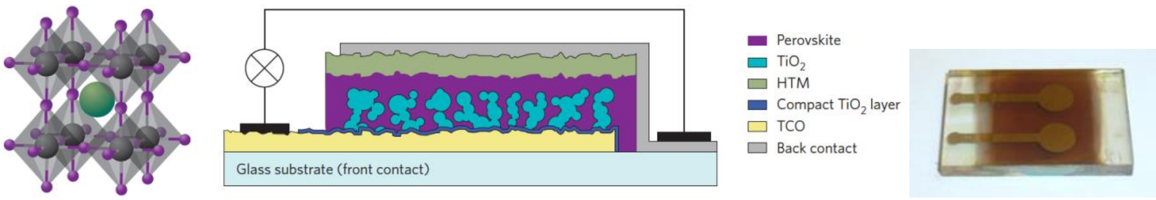

Figure 1. Structure of a 3D perovskite material (left), solar cell configuration (center) and picture of a final cell (right)

The sudden emergence of perovskite solar cells and their facile solution-based fabrication method offer a unique opportunity to give a hands-on experience in mainstream photovoltaics. The lab training proposes to perform the complete cycle of fabrication of perovskite cells starting from wet materials deposition all the way to their characterization. We will start by the deposition of TiO_2 mesoporous material on specially patterned FTO slides. The perovskite material will then be deposited from solution by spin-coating using a two-step sequential method (deposition of lead precursor first followed by MA precursor), filling the nanopores of TiO_2, and after rapid annealing perovskite forms a thin 200-300 nm 3D polycrystalline film *in situ*. The cell will be completed by the deposition from solution of a classical doped hole transporting material, spiro-OMeTAD, and finally gold electrodes will be evaporated on top using a specially designed mask.

Even though the perovskite materials are relatively robust and stable against the structural defects, they are sensitive to the ambient humidity, so most of the deposition work will be performed in a glovebox. At the end of training we will measure the efficiency of the obtained cells using solar simulator available in the lab and discuss the effect of a photovoltaic mask on the photocurrent and voltage.

Profile: Students interested by new technologies for renewable energies with chemistry and materials science background.

References:

Record : Jeon, N. J.; Noh, J. H.; Yang, W. S.; Kim, Y. C.; Ryu, S.; Seo, J.; Seok, S. *Nature* **2015**, 517, 476.

Review : Kazim, S.; Nazeeruddin, M. K.; Grätzel, M.; Ahmad, S. *Angew. Chem. Int. Ed.* **2014**, *53*, 2812–2824.