On the route of high efficiency in organolead halide Perovskite Solar Cells

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Photovoltaic cells use semiconductors to convert sunlight into electrical current and are regarded as a key technology for a renewable energy supply. Since the first report of the dye-sensitized solar cell (DSSC) in 1991 by Gratzel et al, these DSSC cells have been considered as one of the most promising next generation photovoltaic technologies due mainly do their low cost. Therefore, a tremendous number of research papers have spouted during last two decades. As a consequence of the DSSC-related research efforts, the beginning efficiency of around 8% was improved to over 12% using liquid electrolytes. More recently, this activity took a major leap in late 2012 when a halide perovskite, CH3NH3PbI3, emerged as a light harvester with efficiencies of about 15% (in late 2013).

Therefore, the aim of this work is to focus in improving the characteristics of the solid state perovskite based DSSC solar cell in the route of 20% efficiency, by using both novel chemical and physical approaches. For the chemical approach, an original meso structuration will be used to improve and control the porosity of the discontinuous TiO2 active layer. This consists of using a self-assembling, at the anode surface, of polymer beads or microfibers spherical particles. This will give rise to large spherical pores that allow the perovskite infiltration and, therefore, a good connectivity with TiO2 particles and efficient charge collection. For the physical approach, a physical vapor deposition technique, like sputtering, will be used to grow the TiO2 hole blocking layer, or other alternative transparent conducting oxides, like ZnO and SnO2. This will allow a fine control of all the structural characteristics and mainly the interface with the perovskite nanoparticles with the hope to increase the charge collection and, therefore, the efficiency of the device.

The project will be done in collaboration with several partners from Strasbourg: the group of Rehspringer of the IPCMS for his expertise in solution deposition techniques, in particular sol-gel and spin-coating, which are of particular importance for this project; the group of Holl from ICS for his expertise in polymer colloid synthesis and film formation mechanisms, including structural control of assemblies of polymer particles through drying; the group MaCEPV from ICUBE will bring his expertise in device realisation and characterisation and also in the characterisation of the charge carrier dynamics.

We are looking for a bright candidate with strong personal motivation. A solid scientific background and interest in materials Science is desirable. Personal initiative and creativity within an efficient group workflow are welcome.