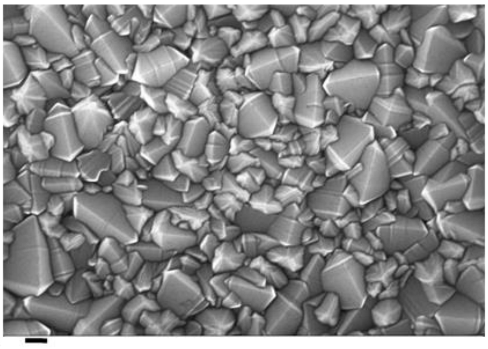
2013-2014

Proposition de stage (Master 2R ou projet de fin d'études) au LMGP

Study of efficient transparent electrodes with varying haziness for energy applications

Project description: More and more research work nowadays focuses on the study of materials for applications in the fields of energy (solar cells) and optoelectronics (LEDs). The transparent electrodes play a very important role in many applications requiring the use of transparent and conductive thin films such as solar cells, flat panel displays, transparent heaters or LEDs. Until now, these electrodes are mainly made of oxide thin films known as the so-called transparent conducting oxides (TCOs). The indium tin oxide (ITO), the fluorine-doped tin oxide (FTO) and aluminium-doped zinc oxide (AZO) are currently the most encountered TCOs in laboratory researches and in industries as well. While ITO exhibits good electro-optical properties, it suffers from indium scarcity and should be replaced in industry.

The Scanning Electron Microscopy picture on the right hand side reports the top view of the microstructure of a thin polycrystalline FTO layer fabricated at LMGP by aerosol-assisted chemical vapor deposition. Such layers simultaneously exhibit good electrical conduction properties (to collect or to inject charge carriers at device interfaces) and high transparency due to its large fundamental band-gap energy (around 3.6 eV). The Laboratory of Materials and Engineering Physics (LMGP) has extensive experiences in the deposition of FTO thin films on large surface areas (100 cm^2) with state-of-the-art properties. In contrast to flat-panel displays, obtaining a large amount of scattered light into the device (i.e. the concept of "light trapping") is of particular interest for solar cells to improve the light absorption and thus to achieve higher photo-conversion efficiencies.



Light scattering is the process in which the trajectory of an electromagnetic wave is made to deviate from its initial straight path. A very promising route concerns the combination of oxide nanoparticles and FTO layers to fabricate nano-composites which maintain reasonably good electrical and optical properties while exhibiting excellent high haziness. Haziness is the ratio between scattered transmitted light divided by total transmitted light: the two pictures visually tell normal FTO from hazy FTO. The diffuse component of the light transmitted through these layers is increased when the oxide nanoparticle density in the fabricated nano-composite is increased. Solar cells fabricated using hazy FTO are expected to show higher efficiencies compared to those using normal FTOs.

The aim of the training will be to test new oxide nanoparticles for the fabrication of diffuse FTO with various haziness, to characterize and better understand the properties of the nano-composite as well as to optimize them. Strong efforts will be devoted to their integration in solar cells through national and international collaboration.

Reference: G. Giusti, V. Consonni, E. Puyoo, D. Bellet, ACS Applied Materials & Interfaces 6 (2014) 14096
Laboratory website: http://www.lmgp.grenoble-inp.fr/
Profile: Looking for a highly motivated student interested to work in an inter-disciplinary project. Interpersonal skills, dynamism, rigor and teamwork abilities are strongly appreciated. Candidates can be fluent in English or in French
Subject could be continued **with a PhD thesis** : Yes
Stipend: an internship stipend will be provided (554€/month).
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