

2019-2020

Internship proposal (Master or final project engineering school) at LMGP Lab.

## Study of the deposition condition of Vanadium oxide thin films as hole selective contact layer for improved solar cells

### Abstract

For the improvement of the solar cell efficiencies, the internship focuses on the study of the deposition by CVD of vanadium oxide thin films in order to optimize the extraction of holes toward the electrode by creating an efficient hole selective contact layer.

### Context

The high efficiency of a solar cell does not rely solely on the intrinsic efficiency of the PN junction but on a whole set of steps in which the extraction of charges towards the electrodes has an important place. To improve this extraction the conductivity of the absorber's excess holes and electrons have to be optimized in the device regions in close proximity to the external metal electrodes. More precisely, in these device regions the conductivity of the carrier species that shall be blocked must be as small as possible. As for the other species, for which the contact is intended to be selective, the local conductivity must be sufficiently high to guarantee a loss less carrier transport into the external electrodes.

### Project description

Within this context, the internship focuses on the study of the deposition of VO<sub>x</sub> thin films by metal-organic chemical vapor deposition (MOCVD). The optimization of the growth conditions will be performed by a detailed characterization study using a wide range of standard physicochemical analysis techniques (X-ray diffraction; scanning and transmission electron microscopy; energy and wavelength-dispersive X-ray microanalysis, Fourier-transform infra-red and Raman spectroscopies).

The functionality as a selective hole contact layer will be analyzed by integrating the developed layer in different structures of solar cells: on the one hand based on crystalline Si cells in collaboration with CEA-LITEN-INES (Le Bourget du lac) as part of an ANR project and on the other hand in organic cells in collaboration with LEPMI. The electrical characterizations under solar illumination will then determine the effectiveness of the different devices in order to optimize the deposition conditions.

**Scientific environment** The candidate will work within the LMGP, Materials and Physical Engineering Laboratory, in the FunSurf group. More over the internship work will be developed within a French research project (ANR oxygene) in collaboration with five partners (CEA-INES, IMEP, INL, LGEEP, Ion Beam Service).

Located in the heart of an exceptional scientific environment, the LMGP offers the applicant a rewarding place to work. LMGP Web Site: <http://www.lmgp.grenoble-inp.fr/>

### Profile & requested skills

The candidate is a high school, engineering school and / or Master student whose training focuses primarily on materials science. Aptitude for teamwork, good spoken and written English will be appreciated. We are looking for dynamic students, motivated and interested in pursuing with a PhD.

**Subject could be continued with a PhD thesis** : possibly

**Internship allowance**: Internship allowance will be provided (approx. 550 € /month).

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