

Institut de Chimie de Clermont-Ferrand

ICCF - UMR 6296



PhD offer

Development of an efficient BiVO₄-based photoanode to be integrated in a photoelectrochemical cell (PEC)

Description of the subject:

This thesis is part of a collaboration between the Institute of Chemistry of Clermont-Ferrand (ICCF - Inorganic Materials team) and the Pascal Institute (Process Engineering, Energetics and Biosystems axis - GEPEB) of the Clermont Auvergne University. The project in which it is involved aims to convert sufficiently energetic solar photons to produce, via photo-catalytic processes (artificial photosynthesis), gaseous energy carriers such as hydrogen.

To achieve energy efficiencies that meet the specifications of solar energy ($\geq 10\%$), it is necessary to develop high-performance photoelectrochemical cells (PECs). These require the use of an appropriate photoanode made of a material with a reasonable cost, high photo-catalytic activity and a small gap. It is within this framework that this thesis is set. Indeed, the main objective of the recruited PhD student will be the elaboration of a photo-anode with controlled morphology made of a semiconductor material belonging to the bismuth vanadate family (BiVO₄). This material, which is initially pure, can then be doped with rare-earth ions in order to modify the structural and optical properties of the photoanode and thus improve the efficiency of the PEC in which it will be used. The effect of nano/microstructure of BiVO₄ coatings deposited on a conductive substrate (ITO glass type) on their electrochemical behavior will be particularly studied, taking as a reference an unstructured BiVO₄ coating. In order to elaborate these coatings, several synthesis processes will be used such as the sol-gel process or the solvothermal synthesis. The influence of the synthesis and processing parameters on the topography of the coatings and on their structural, optical and electrochemical properties will be studied. The use of electrophoresis will also be evaluated, in collaboration with a Mexican researcher.

The various coatings developed will be characterized by X-ray diffraction, infrared and Raman spectroscopies, scanning electron microscopy and atomic force microscopy, as well as by profilometry to determine their thickness. Their specific surface, which is an important parameter for evaluating the efficiency of the photoanode, will be determined by porosimetry or GISAXS. In parallel to the characterizations carried out at the ICCF, electrochemical measurements (hydrogen photoproduction test) will be carried out at the PI in order to evaluate the efficiency of the photoanode within a PEC.

Profile sought: Holder of an M2 Research degree or Engineer in materials chemistry with previous experience in the synthesis of inorganic materials by similar methods (liquid route) and skills in materials characterization. Curious, dynamic candidates who are attracted by multidisciplinary subjects.

How to apply:

Detailed CV, grades obtained during the Master/engineering school, letter of motivation and letter(s) of recommendation. Any incomplete application will not be considered.

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