Ecole Doctorale des Sciences Fondamentales

Title of the thesis: Synthesis by reactive sputtering of Bismuth-based photocatalysts for environment and solar fuel production.

Supervisor : BOUSQUET Angélique
Laboratory : ICCF
University : UCA
Email and Phone : angelique.bousquet@uca.fr 04.73.40.53.72
Possible co-supervisor : TOMASELLA Eric
Laboratory : ICCF
University : UCA

Summary :

Photocatalytic materials are more and more extended in environment (*pollutants photodegradation in water, in air…*) and energy domain (*production of new solar fuels*). Recently, Bismuth-based materials gained huge attention because of their advantages such as low toxicity, low solubility and corrosion resistance in aqueous medium. Large range of stoichiometry is explored with various cations (Bi_2O_3, $BiVO_4$, Bi_2WO_6, …) and anions (BiOF, BiOCl…). At ICCF, the MATEPP group (Materials and Plasma Processes) is working from several years on photocatalytic materials synthesized by reactive sputtering. This very versatile plasma process allows controlling the content of cations (by the choice of sputtered targets) and anions (by the injected reactive gases). Indeed, by tuning the O_2 and CF_4 gas during Bismuth target sputtering, we succeed to form Bismuth oxides and oxifluoride. To enlarge range of photocatalytic materials, we would now add a second target (Vanadium, Tungsten…) in Ar/O_2 atmosphere to reach more complex stoichiometries, such as $BiVO_4$ or Bi_2WO_6. These later present an optic absorption into visible domain; they are particularly interesting for pollutants photodegradation in water and H_2 generation by photolyse.

During its thesis, the PhD student will investigate the reactive sputtering process with two targets (Bi and V or W) in Ar/O_2 atmosphere, especially by optical emission spectroscopy and thanks to Berg model, in order to understand how to control the content of each elements (cations and anions). The PhD student will be in charge of thin films characterization thanks to numerous techniques available at ICCF (IR and Raman spectroscopies, XRD …), at UCA (XPS, electronic microscopies…), or in collaboration (Ion beam analysis at CEMHTI in Orléans). He will link this structural and microstructural characterization of materials with their optical (determined by ellipsometry and UV-visible absorption) and photocatalytical properties (photodegradation of methyl-orange into water and H_2 generation by photolyse).

Ideally, the candidate should have a Master degree in Materials Science or Material Chemistry. A first experience in plasma processes would be appreciated. She/he should be highly motivated and enjoy working in a team while demonstrating curiosity, autonomy, dynamism and rigor. The candidate should also have good communication skills in French and English (oral and written). The application form must contain a Curriculum Vitae, a motivation letter, a copy of the master diploma including rank and marks and eventual reference letters.