Ecole Doctorale des Sciences Fondamentales

Title of the thesis: New nano-materials: application to the photodegradation of pollutants and generation of H_2

Supervisor : Pierre BONNET
Laboratory : ICCF, MI group
University : UCA
Email and Phone : Pierre.M.BONNET@uca.fr +33 04 73 40 76 48
Possible co-supervisor : Marcello BRIGANTE
Laboratory : ICCF, Photochemistry group
University : UCA
Email and Phone : Marcello.BRIGANTE@uca.fr +33 04 73 40 55 14

Summary :

The current environmental context makes urgent the reduction of pollutants and generation of new clean energy technologies. In this contest, the development of new photocatalysts is an important issue. In the literature, the photocatalytic properties of pollutants degradation and production of H_2 using materials such as TiO_2, ZnO, g-C_3N_4 or Bi_2O_3 have been improved by the controlled addition of fluorine in their structures. Thus, the addition of fluorine leads to modulating the absorption threshold of the material, allows a better separation of the photogenerated charges, improves the stability of the compound but also impacts the nanostructure improving the rate of pollutants degradation and the amount of H_2 produced.

The objective of the PdD work is to obtain and develop new fluorinated and nanostructured photo-active materials for the photogeneration of energy (H_2 by water-splitting, etc.) and depollution (*via* advanced oxidation processes). During this thesis, we plan to develop the fluorination of the photo-active material by methods allowing fine control of the fluorine introduced (in quantity, nature of the bond, stability, etc.) and to understand the influence of the fluorination on the structure of the material and its electronic properties. At the same time, the PhD student will evaluate the photodegradation performance of pollutants by the obtained materials, first on model molecules (Bisphenol A and caffeine) to understand the mechanisms of photodegradation. Then, we plan to use the most efficient materials on real waters doped with mixtures of recalcitrant pollutants (estrogens, polychlorophenols, etc.).

Particular attention will be paid to the role of fluorine and the photochemical mechanisms (fluorine bound to the material *vs* fluorine in solution) involved during the degradation of the targeted compounds. Finally, the H_2 generation performances of the materials obtained will be tested and correlated with the structure of the fluorinated materials.

This work, which emerges in the "Materials" and "Environment" axes of the ICCF, will be based on the recognized skills and expertise of the "Fluorination and Fluorinated Materials" and "Photochemistry, Reactivity and Environment" groups of the ICCF.
The PhD student will benefit the analytical and scientific facilities related to the fluorine chemistry as well as the platforms for advanced characterization of materials and evaluation of photochemical performance of the ICCF.

The candidate will have obtained a diploma in an engineering school or in a master's degree in the fields of Materials Chemistry and/or Physical Chemistry. An M2 level internship in at least one of these areas would be an advantage.