

Research Topic for the ParisTech/CSC PhD Program
(one page maximum)

***Field (cf. List of fields below):** Chemistry, Physical Chemistry and Chemical Engineering,
& Energy, Processes

Subfield: (Chemistry, Materials)

Title: Cophotolysis of water and carbon dioxide on doped TiO₂ based aerogels for the production of solar fuels.

ParisTech School: MINES ParisTech

Advisor(s) Name: BEAUGER Christian

Advisor(s) Email: Christian.beauger@mines-paristech.fr

(Lab, website): <http://www.persee.mines-paristech.fr/Accueil/Presentation/>

Short description of possible research topics for a PhD:

In the context of the scheduled scarcity of fossil energy resources and increasing carbon dioxide emissions, it becomes imperative to make alternative fuels available such as hydrogen or synthetic hydrocarbons. Today mainly produced from fossil carbon resources (by methane steam reforming and Fischer Tropsch process, for example), they will play a major role in the future energy mix only if they can be produced from viable processes from energetic, economic and environmental points of view. CO₂ retroconversion and water photodissociation could separately fulfill this role. The proposed topic is based on the combination of these two processes to produce hydrogen and carbon monoxide, or eventually methanol, from photodissociation of carbon dioxide and water at the same time. The process will benefit from the efficiency of TiO₂ based aerogels to harvest UV radiation in order to dissociate water. Such materials will be modified by doping to increase their range of light absorption and efficiency. They will also be tested for CO₂ retroconversion and cophotolysis of water and carbon dioxide. The work will build on the developments of the group in the field of photolysis of water on the one hand and the synthesis of aerogels on the other hand. It will include both materials and processes developments. It will consist in assessing the ability of the materials developed in the study to produce H₂ and/or CO from H₂O and/or CO₂ (preparation and characterization of TiO₂ aerogels, doping, theoretical and experimental study of the new process).

Required background of the student:

Good knowledge in materials science, chemical synthesis and characterization, solid physics. Knowledge in photochemistry would be appreciated.

A list of 5(max.) representative publications of the group: (Related to the research topic)

- BEAUGER et al., **Microporous and Mesoporous Materials**, 232 (2016) 109-118
- D'ELIA et al., **International Journal of Hydrogen Energy** 36 (2011) 14360-14373
- SUZUKI et al., **Journal of Nanoscience and Nanotechnology**, 9(256) (2008) 260, 2009
- SUZUKI et al., **NANO: Brief Reports and Reviews**, 3(5) (2008) 373-379