

Materials chemistry

Institut de Science des Matériaux de Mulhouse (IS2M)
Université de Haute-Alsace - CNRS - Mulhouse, FRANCE

Functionalization of carbon monoliths with hierarchical porosity by plasma polymerization

Keywords: nanoporosity, carbon materials, surface chemistry, plasma polymerization, adsorption

Research topic:

Porous carbonaceous materials are present in many fields of application such as catalysis (catalyst support), water /gas depollution, gas storage / separation and energy storage. They have the advantage, with a relatively low cost, to be easily prepared from biosourced precursors and in monolithic form. To improve the performances of these bulk porous materials and to extend their field of application, a functionalization of their internal surface is often carried out but its control is made difficult by problems of diffusion of the reactive species in the tortuosity of the material. Plasma polymerization has rarely been investigated to functionalize such materials but could be a relevant process to achieve such a purpose while being compatible with an eco-design approach. It is supposed to lead to the deposition of a thin film of functional polymer (typically a few tens of nanometers thick). This green process, operating in gas phase, so without any solvent; enables a fast surface modification step and allows to bring very varied functional groups to the surface of the material (hydrophilic, hydrophobic groups...). However, the functionalization limitations of this process, in particular on the surface of porous and electrically conductive bulk carbonaceous materials, are still not known.

Preliminary works have been carried out at the Institute of Materials Science of Mulhouse (IS2M) in collaboration between the Carbon and Hybrid Materials (CMH) axis and the Functional Polymers Engineering (IPF) axis, specialized in the field of porous carbons and plasma polymerization respectively. It has paved the way of the potentialities of this functionalization technique applied to bulk carbon porous monoliths but in-depth studies are now needed to fully control and understand the plasma process within such materials.

Objectives of the PhD:

Three scientific challenges will be addressed during this PhD work: i) **the synthesis of porous carbon monoliths** with controlled porosities (size and organisation) and different degrees of graphitization, ii) the **development of a methodology** to assess the plasma polymerization mechanisms within porous and conductive bulk materials and, iii) the **investigation of the potential applications** of those functionalized materials based on adsorption/absorption phenomena.

The candidate:

Applicants should have a Master or Engineer degree (or equivalent) in a relevant chemistry or materials science discipline. Interest and enthusiasm for surface chemistry is essential while theoretical and experimental skills in materials synthesis, surface functionalization and characterization will be an advantage. The applicants should show initiative and seriousness to work in team. They should have good organization and communication skills.

LOCATION:

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GRANT INFORMATION:

Duration:

Three years full-time
Starting from Oct. 2023

Funding:

Grant from the Université de
Haute-Alsace

HOW TO APPLY?

Applications including a CV,
a cover letter and a copy of
grades (last 2 years) should
be sent electronically to
Julien Parmentier
as soon as possible and
preferably before March 25th
2023.