

## Open Master Internship position

### Title: “Preparation/characterization of activated carbon for CO<sub>2</sub> gas adsorption and separation”

#### Keywords

CO<sub>2</sub> capture, adsorbents, activated carbon, gas, regeneration

#### Objectives

The main aim of this project is to synthesize efficient porous carbon materials for CO<sub>2</sub> separation. Other objectives are: (i) to increase the knowledge in science applicable CO<sub>2</sub> separation technology by adsorption and; (ii) to provide methods and guidelines for the preparation/modification of these materials.

#### Position and tasks

CATALPA is a 4 years PEPR research project, funded by the French “National Research Agency” (“ANR”) program”. The CATALPA project entitled « CO<sub>2</sub> cAPtUre At Low or decarbonized energy PenAlty », involves 5 academic partners, and one industrial collaborators (IFPEN). The EDYTEM laboratories is one partner for the Work Package WP 1: “Innovative separative media for low-carbon footprint CO<sub>2</sub> capture processes”.

The work of internship dedicated to WP1 will consist in preparing appropriate activated carbon with ultra-micropores (pore diameters < 0.7 nm) and a surface chemistry enriched in electron donors (N, S, F, etc) able to selectively physisorb/desorb of CO<sub>2</sub> from a gas mixture also containing CH<sub>4</sub> and/or N<sub>2</sub> and other minority components over a large pressure range (up to 20-30 bar).

Activated carbons and activated carbons-graphene oxide materials will be prepared by activating naturally N-rich or S-rich biomass (chitosan, keratine, etc..) or a synthetic precursor (including graphene oxide) by a thermochemical activation (using NH<sub>3</sub> as a doping agent and various activating agents such as steam, KOH, NaOH, etc.). The application of post-thermal treatments (800°C-1500°C) will allow to tailor the pore size distribution in order to enhance adsorption selectivity. Additionally, the preparation of activated carbons by loading with supported metal oxides and or the saturation of the activated carbons with solvents such as ionic liquids. Green chemistry principles will be followed as far as it is possible.

The elaborated activated carbons will be characterized to determine their textural properties (determination of the micro/meso/macro porosity) and also their surface chemistry properties (oxygenated and nitrogenated groups, composition by elemental analysis, ICP analysis of the ashes, and XPS). The textural characteristics (porosity) of the materials will be determined by adsorption-desorption of N<sub>2</sub> at -196°C, CO<sub>2</sub> at 0°C, Ar at -186°C and/or H<sub>2</sub> at -196°C, depending of the solid one gas or two gases will be used to obtain precise textural characterization and pore size distributions. Chemical and structural characterization will be also conducted including elemental analysis, FTIR, PXRD, SEM, and TGA. The adsorption isotherms for pure gases (CH<sub>4</sub>, CO<sub>2</sub>) and their mixtures will be determined and their adsorption enthalpies evaluated.



The Master student will work on the WP1 task of the CATALPA project on the site of EDYTEM laboratory at University Savoie Mont Blanc (Le Bourget du Lac site). The Master student researcher will have to present the results in progress meetings of the CATALPA project.

### **Link with Erasmus program**

Candidate funded by an Erasmus program may follow some courses/practical /projects of the Master of Green Chemistry and Eco-innovations of the University Savoie Mont Blanc.

(<https://www.univ-smb.fr/scem/formations/departement-de-chimie/master-chimie-verte-et-eco-innovations/>)

### **Period of the internship**

The position is open for a period of 6 months in 2025 or 2026.

### **Profile**

The candidate is a student in Master of Science or Engineer in materials science or chemistry or Environment. He/She possesses a background in materials chemistry or chemistry-physics or environmental chemistry. Good experience in the laboratory experimental work in chemical and analysis techniques is required. Knowledge in analytical chemistry will be positively considered.

The candidate is expected to produce independent and original research in the defined area, to be capable of working highly autonomous, to interact with the members of the group, to write progress reports, and to participate in dissemination activities such as progress meetings.

### **Required documents for the application**

- Short Curriculum Vitae and a covering letter showing your interest and especially addressing your professional project
- 1 Recommendation letter.
- Scores and rank in the last formation

The selected candidates will be first interviewed by videoconference.

### **Contacts**

**Laurent Duclaux** (Prof.), **Laurent.Duclaux @univ-smb.fr** +33 (0)479 758 805

**Laurence Reinert** (Assistant Prof.), **Laurence.Reinert @univ-smb.fr** +33 (0)479 758 122

### **Workplace**

EDYTEM, University Savoie Mont-Blanc, Le Bourget du Lac – Rhône-Alpes Auvergne – France

### **Employer**

#### **University Savoie Mont-Blanc**

With 14 000 students, a rich variety of multidisciplinary education and 19 research laboratories internationally renowned, the University Savoie Mont-Blanc is a human-sized institution which combines proximity with its territories and a wide perspective on Europe and the world.

The campus sites at Le Bourget-du-Lac offers particularly attractive living and studying conditions, at the center of an exceptional environment, between lakes and mountains.

The aim of the University Savoie Mont Blanc is, on the one hand to develop international projects, joint award qualifications, and programs delivered in English, and on the other hand, wherever



possible, to encourage mobility for students, lecturers and researchers as well as for administrative staff. Although present in 5 continents, with its 240 bilateral agreements, it has been able to take full advantage of its outstanding location on the borders of Switzerland and Italy to develop strong, special relationships with the higher education establishments of these two countries.

### **Laboratory Environment Dynamics and Territories of the Mountain (EDYTEM)**

With a truly interdisciplinary approach, EDYTEM looks at the environment in the widest sense (its climate, chemistry, biology and ecology as well as the social, economic and political aspects), studying archives, resources, changes and vulnerabilities and the players' terms of commitment. EDYTEM (Environnements, Dynamiques et Territoires de Montagne, UMR Université de Savoie Mont Blanc/CNRS 5204) and its « Matières » team are focused on green chemistry synthesis and biomass valorization processes, and particularly on the synthesis and characterization of porous activated carbon materials for environmental adsorption applications. Over the past decade more than 60 articles have been published in international scientific journal on porous carbon preparation and application, and more than 15 communications have been made in national and international research projects on carbon materials; more than 10 research contracts have been operated with private companies. More details are on the web site of "EDYTEM" (in French): <https://edytem.osug.fr/>