

## Master 2 Internship Proposal

**Title: Development of electronically conducting ultraporous materials for energy storage**

### Internship supervisor

Name, first name	Biniek, Laure
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Laboratory	Institut Charles Sadron – Campus de Cronenbourg - Strasbourg
Collaboration with	<input type="checkbox"/> No <input checked="" type="checkbox"/> Yes : Sirine Zallouz (sirine.zallouz@ics-cnrs.unistra.fr)

### Student profile looked for

Master program ( <i>more than one box can be ticked</i> )	<input checked="" type="checkbox"/> Material science and engineering <input checked="" type="checkbox"/> Chemistry <input type="checkbox"/> Physics
Other indications if necessary	

### Internship description

Energy storage system such as supercapacitors are extensively used in many application such as transportation, military, aerospace,... [1] These systems could in theory deliver high energy storage densities coupled to fast charge and discharge capacities. Good performances require maximizing the interfacial area between the active material and the electrolyte. We aim at developing innovative electrically conducting networks with multiscale and ordered porosity to maximize the ion/electrode exposure area, and optimal ion diffusion to increase the performances of the supercapacitors.

Electrically conducting polymers (ECP) will be chosen based on their ability to store charge through  $p$ - or  $n$ -doping mechanisms, high pseudocapacitance, thermal stability, and capacity to form well-ordered structures. Porosity will be introduced using the ice-templated method. [2]. The structure of the network will be characterized by scanning electron microscopy, BET and mercury intrusion. The effect of the structure of the materials on the electrical and electrochemical properties will then be evaluated (4-probe resistivity and cyclic voltammetry methods, respectively).

The aim of this internship is to develop unidirectional and well-ordered macroporous ECP structures to be used as new electrodes of supercapacitors.

References:

[1] M. E. Şahin et al, *Energies* **2022**, 15(3), 674.

[2] Q. Weinbach, L. Biniek et al, *J. Mater. Chem.C* **2023**, 11, 7802-7816

### **Requirements & Application**

We are looking for motivated and creative team-worker master student interested in supercapacitors and willing to learn about polymer science, scanning electron microscopy, and electrical and electrochemical properties. The candidate is expected to be at ease with physical-chemistry of polymers and not afraid of multidisciplinary field.

Please address your application including a CV, a motivation letter and Master transcript of records to Laure Biniek and Sirine Zallouz, Institut Charles Sadron.

Possible starting date : Jan- February 2025

**\*Note that the lab is within a ZRR (Zone à Régime Restrictive)**