

M2 Master Internship Proposal
SIMM laboratory (ESPCI) and i-CleHS institute (Chimie ParisTech)

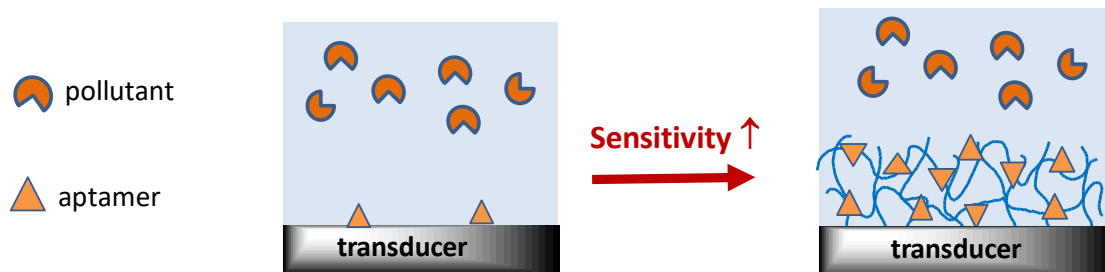
Innovative hydrogel-based electrochemical biosensors for the detection of environmental pollutants

The presence of exogenous chemical species such as pharmaceutical pollutants in ecosystems directly affects the health of living beings. Though they are present in trace amounts, their toxicity results from their accumulation. The need to detect and determine the concentration of these compounds is therefore a major issue. Current means of detection and quantification require cumbersome and expensive analytical techniques such as HPLC chromatography.

The objective here is to develop innovative-portable electrochemical biosensors for the sensitive and selective detection of pollutants and molecules that are damaging to the environment or health.

A key step in the design of electrochemical biosensor is the immobilization on the detection electrode of bio-receptors (aptamers, enzymes) for the molecular recognition of the target. The objective of this internship is to investigate the use of polymer hydrogel layers that can be shaped as an intermediate bonding layer of bio-receptors for their controlled immobilization. These hydrogels have the advantages of biocompatibility, adaptivity (the polymer matrix can be easily functionalized) and flexibility (the size and thickness of the hydrogel can be finely adjustable).

After fixation on the electrode, the films will be functionalized by a bio-receptor, in the presence or not of conductive nanoparticles, for the optimization of the density of immobilized receptors. The analytical performance of the designed sensor will be evaluated, using a model target. The downstream development of this project will concern the transposition to miniaturized systems and the multi-detection of several targets simultaneously.



The internship will be carried out at the SIMM laboratory of ESPCI and the i-CLeHS institute of Chimie ParisTech. The intern will be directly supervised by Jie Sun (PhD student).

References:

- 1- Kassahun, G.; Griveau, S.; Juillard, S.; Champavert, J.; Ringuedé, A.; Bresson, B.; Tran, Y.; Bedioui, F.; Slim, C. Poly(acrylic acid) hydrogel matrix based impedimetric aptasensor for the detection of diclofenac. *Langmuir* 36 (2020) 827–836.
- 2- Slim, C., Ratajová, E., Griveau, S., Kanoufi, F., Ferraro, D., Perréard, C., Bedioui, F. (2015). Two-step local functionalization of fluoropolymer Dyneon THV microfluidic materials by scanning electrochemical microscopy combined to click reaction. *Electrochemistry Communications*, 60, 5–8.
- 3- Chollet, B.; Li, M.; Martwong, E.; Bresson, B.; Fretigny, C.; Tabeling, P.; Tran, Y. Multiscale surface-attached hydrogel thin films with tailored architecture. *ACS Appl. Mat. Interfaces* 2016, 8, 11729-11738 (front cover).

Techniques/methods in use:

Surface modification and lithography, Spin-coating, AFM, IR-ATR, Cyclic Voltammetry CV, Electrochemical Impedance Spectroscopy EIS

Required background of the student:

Physico-chemistry of polymers

Physical chemistry, ideally background in basic electrochemistry

Location of the internship:

SIMM - ESPCI Paris. 10, rue Vauquelin. 75005 Paris.

i-CLeHS - Chimie ParisTech. 11, rue Pierre et Marie Curie. 75005 Paris

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