ParisTech

RESEARCH TOPIC FOR THE PARISTECH/CSC PHD PROGRAM

Field: Chemistry, Physical Chemistry and Chemical Engineering, Life Science and Engineering for Agriculture, Food and the Environment

Subfield: Electrochemistry, Bio analytical chemistry

Title: Hydrogel Matrix Grafted electrochemical Aptasensors for the Detection of emerging pollutants

ParisTech School: Chimie ParisTech

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Lab website: https://iclehs.fr/research/seisad/

Short description of possible research topics for a PhD:

Driven by the growing concern about the release of the untreated emerging pollutants and the urgent demand of determining low level of these pollutants present in environment, novel biosensors dedicated to molecular recognition will be developed. The objective of the project is to design biosensors using a novel class of grafted polymers, surface-attached hydrogel thin films on conductive transducer as biocompatible matrix for biomolecule immobilization. From biomolecules, aptamers constitute an attractive alternative to antibodies due to their high affinity and their excellent specificity for a target or a family of selected targets. It is also possible to functionalize them with specific chemical functions and/or with tag to label the aptamers, for their further immobilization and/or for their analysis. The immobilization of the aptamer onto surface-attached hydrogel thin films by covalent attachment provides a biodegradable shelter, providing the aptamer excellent environments to preserve its active and functional structure while allowing the detection of pollutants. For improved sensitivity and higher stability of the sensor, a high density of immobilized aptamer is enabled. Within a constant miniaturization effort, we will tend towards the transposition of this work, towards microfluidic electrochemical biosensors on real samples due to their miniature, portable and low-cost systems as well as high through put and automation. The integration of electrochemical sensors into microfluidic formats with the incorporation of unique materials for detection will be explored in this project. The development of these systems would lead to significant advantages compared to the current analytic systems, in terms of simplicity, speediness, cost, and automation.

***Required background of the student*:** Physical chemistry, ideally background in basic electrochemistry

A list of representative publications of the group:

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- Quinton, D., Girard, A., Thi Kim, L. T., Raimbault, V., Griscom, L., Razan, F., Bedioui, F. (2011). On-chip multi-electrochemical sensor array platform for simultaneous screening of nitric oxide and peroxynitrite. Lab on a Chip, 11(7), 1342–1350
3- Griveau, S., & Bedioui, F. (2013). Electroanalytical methodologies for the detection of S-nitrosothiols in biological fluids. The Analyst, 138(18), 5173–81
4- Ramirez-Garcia, G., Martinez-Alfaro, M., Gutierrez-Granados, S., Alatorre-Ordaz, A., Griveau, S., & Bedioui, F. (2015). Electrochemical assessment of possible melatonin effect on nitric oxide production from kidneys of sub-acute lead treated rats. Electrochimica Acta, 166, 88–92
5- Slim, C., Ratajovà, 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