Ph. D. Project: Design of Amino-acid inspired Functional Monomers for Molecularly Imprinted Polymers

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Context: Water pollution is a major source of concern. Indeed, human activities have led to the release of various hazardous chemicals such as pesticides or endocrine disrupting compounds in wastewaters but also in rivers and ultimately in the oceans. In order to protect the biodiversity as well as public health, it is mandatory to develop systems able to recognize these molecules in water in order to quantify them and ultimately remove them (or at least to degrade them to less concerning molecules).

Researchers have taken advantage of different recognition systems such as antibodies, aptamers, synthetic analogues of antibodies named molecularly imprinted polymers (MIPs)[1]. These latter have the advantage of being cheaper to prepare in large quantities and display a higher robustness, inertness and resistance than their biological analogues. The preparation of a MIP consists in the polymerization of a functional monomer (a polymerizable group that displays weak interactions with the molecule of interest) in the presence of a template (the target of the recognition system). After cross-linking, the template molecule is removed which leads to a material that possesses cavities able to selectively recognize the template (Figure 1a). The library of functional monomers used by researchers is quite limited and we believe that designing new functional monomers could improve the efficiency of MIPs through an improvement of sensitivity, specificity, water compatibility.

Objectives: In this research project, we plan to take advantage of the diversity of interactions that could arise between template molecules and aminoacids. To do so, we envision in a first step to graft vinyl functionalities on a library of aminoacids in order to obtain polymerizable aminoacids (figure 1b)2. Once polymerized, these modified aminoacids could interact with templates through hydrogen bonds thanks to the carboxylic acid and amine functionalities but also through hydrophobic interactions such as □-□ stacking or cation-□ stacking. The second step would be to screen the best conditions to form MIPs with the new monomers (stoichiometry, solvent, cross-linker, initiator, temperature, time) and to characterize the newly obtained MIPs. Then, the third step would be to evaluate their ability to work as MIPs through binding experiments before testing their applicability in analytical biochips (this part of the project will be a collaboration with BAE lab in Perpignan)[3,4].

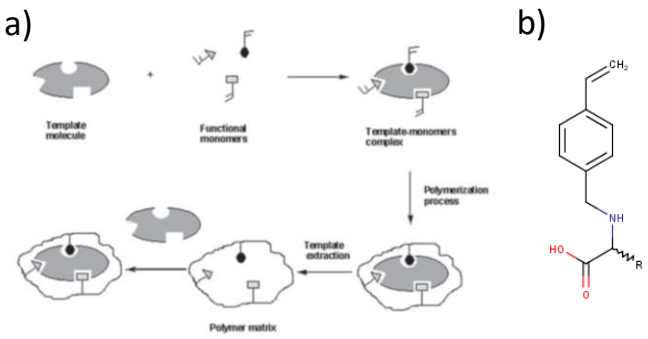

Figure 1: a) Formation of a MIP around a template molecule. b) Target functional monomer. R designates amino-acids side-chains.

Requirement: This multidisciplinary project requires skills in synthetic chemistry, polymer chemistry, physical chemistry. We are looking for a motivated and creative candidate with experience in either of these three fields and willing to extend his knowledge to the other two.

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[3] Bedwell, T. S., & Whitcombe, M. J. (2016). Analytical applications of MIPs in diagnostic assays: future perspectives. *Analytical and Bioanalytical Chemistry*, *408*(7), 1735–1751.

[4] Ekomo, V. M., Branger, C., Bikanga, R., Florea, A. M., Istamboulie, G., Calas-Blanchard, C., Brisset, H. (2018). Detection of Bisphenol A in aqueous medium by screen printed carbon electrodes incorporating electrochemical molecularly imprinted polymers. *Biosensors and Bioelectronics*, *112*, 156–161.