

**« Development of chitosan based hydrogels for metallic extraction and drug delivery »  
« Développement d'hydrogels à base de chitosane pour l'extraction métallique et la délivrance de médicaments »**

Recently, Institut Lumière Matière (team FENNEC) has developed a new biopolymer based on chitosan functionalized by a cyclic chelate (DOTAGA) (M. Natuzzi *et al.*, *Sci. Rep.*, **2021**). This polymer presents the advantage to chelate metals that can be toxic in excess and to solubilize the polymer at physiological pH (FR2007997). Interestingly, it has been shown that this polymer can be included in hydrogels made of a mixture of chitosans. These hydrogels present the advantages to be easily implanted subcutaneously in animals. They can be processed as pellets or wires (FR2110474). They can also be used for drug delivery and first proofs of concepts have been performed with antibodies and different small drugs (EP22305120).

In this context, the PhD will take place in FENNEC team of ILM and will be performed in tight collaboration with MexBrain company, spin-off of FENNEC team for easier translation to the clinic. The goal of the PhD will be to optimize the hydrogels by varying their composition and shape in order to have good biodegradable properties and to present delivery of the drugs for weeks *in vivo*. Different types of drugs will be tested ranging from small organic molecules (~100 Da) to large antibodies (150 kDa). For the large biomolecules, they will be tagged by fluorophores to quantify their release *in vitro* and *in vivo*. The polymer can also be tagged by fluorophores or by gadolinium to follow its biodegradability *in vivo*.

During the PhD, the student will have the chance to participate to a large network of collaborations including at least:

- Dr Thomas Brichart (MexBrain company, Lyon). Industrial collaboration for scale-up and industrialization.
- Pr Laurent David (IMP, Lyon). Formation of hydrogels and their characterization.
- Pr Alexandre Detappe (ICANS, Strasbourg). Delivery of antibodies for immunotherapy.

The competences required for the PhD are basic skills in chemistry, in organic functionalization and in coordination chemistry. Interest and skills in biology are not mandatory but will be appreciated.

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