

Master 2 / Engineer internship proposal 6 months – Starting in October 2026

Hybrid biomaterials for the treatment of prostate cancer by combination therapy

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Keywords	polyesters, polysaccharides, nanoparticles, hydrogels, API formulation
Skills acquired by the student at the end of the internship	Synthesis of copolymers, formulation of nanoparticles and hydrogels, encapsulation/release of therapeutic active agents

Project description

A growing interest in nanoparticle-hydrogel hybrids and their applications for asset delivery is witnessed. Hydrogels are typically used to protect and modulate the release of nanoparticles while nanoparticles are used as cargo for active pharmaceutical ingredients (API). Despite the expected therapeutic benefits of combination therapies, little research is aimed at obtaining **hybrid drug delivery systems (HDDS) based on amphiphilic copolymers with inverse and complementary structures** that ensure stable and homogeneous dispersion of nanoparticles within the hydrogel network, and **increased retention** of NPs within the gel. Another important area of development is to ensure that these HDDS are compatible with **subcutaneous injection** to obtain the release of the API into the systemic circulation from the hydrogel and to avoid the gastric tract.

This approach has been validated within our group as part of a thesis focused on breast cancer. This work demonstrated the relevance of degradable hybrid systems containing therapeutic antibodies delivered by the hydrogel while chemotherapeutic agents were loaded into the NPs (Figure 1).

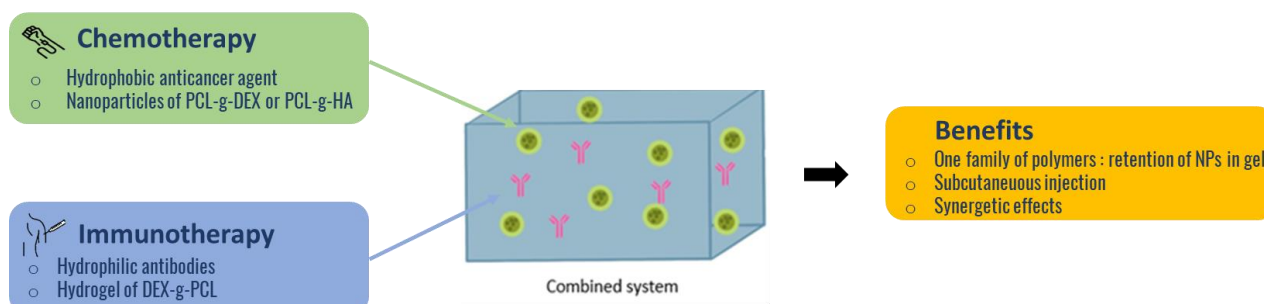


Figure 1: Representative diagram of the combined release systems (HDDS) targeted in the project

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MAX MOUSSERON INSTITUTE FOR BIOMOLECULES (IBMM)**

Director: Prof. Pascal DUMY

In the framework of this project, we wish to extend this approach to the treatment of prostate cancer in conjunction with the Cancer Research Institute of Montpellier (IRCM).

As part of your internship, your mission will be to synthesize polyester-polysaccharide copolymers that are precursors of NPs and/or hydrogels, to modify NPs in order to target prostate cancer cells, to characterize and formulate these NPs and to combine them with hydrogels to form HDDS. The formulation of two API with complementary and synergistic action mechanisms in two distinct populations of NPs will be carried out.

To do this, you will need to mobilize **knowledge of synthetic chemistry, physical chemistry and characterization of delivery systems**. This internship will be an opportunity to acquire/strengthen knowledge in the field of **macromolecular chemistry (ROP, click chemistry)**, the **formulation** of nano-objects and hydrogels, their **chemical and physico-chemical characterizations** (DLS, rheology), and **galenics** (encapsulation rates, releases).