ITI HiFunMat Master Internship Proposal

☒ M 1 ☒ M 2

Synthesis of thermoresponsive polymers for light-triggered drug release

Internship supervisor

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Laboratory	Institut Charles Sadron, UPR22
Collaboration with a HiFunMat member (*please indicate their name*)	☐ No ☒ Yes : Jacques Lalevée (IS2M UMR7361, Mulhouse)

Student profile looked for

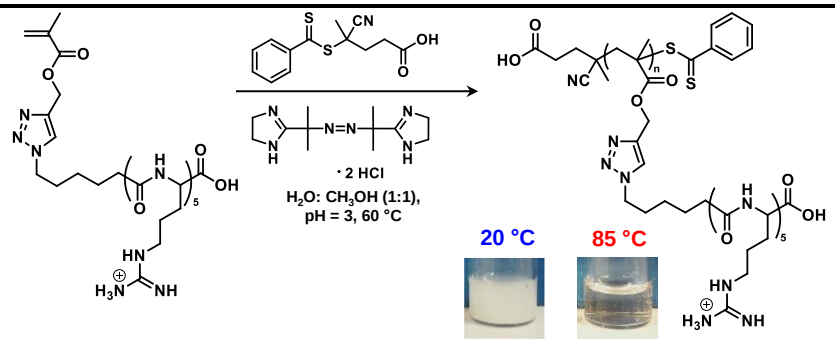
Master program (*more than one box can be ticked)*	☐ Material science and engineering ☒ Chemistry ☐ Physics
Other indications if necessary	Molecular chemist with interest in gaining experience in polymer syntheses.

Internship description

Cancers, first leading cause of death worldwide, are usually treated by combining local and general treatments for better efficiency. For example, a surgery can be performed first to remove the tumor and some nearby tissues followed by a chemotherapy to eliminate the remaining cancer cells and prevent from a cancer recurrency. The main limitations of chemotherapy are the potential low therapeutic efficiency due to some resistance mechanism to the drug used and the appearance of side effects that could be due to the non-specificity of the anticancer drug. The development of strategies to deliver the anticancer drug at the tumor sites only remains a key challenge to lower the potential side effects of the drug while eliminating efficiently and definitely the cancer cells.

One strategy is to use polymers as carriers of the anticancer drug promoting its prolonged circulation in the blood stream and thus accumulation at the tumor site. To prevent the leakage of the drug during its circulation, different approaches have been considered like drug conjugation on the polymer or use of stimuli-responsive polymers. In the latter case, endogenic (*e.g.* redox, pH, enzymes) and exogenic (*e.g.* light, temperature, ultrasounds) stimuli have been considered for the development of drug delivery systems.

We recently demonstrated the synthesis of poly(methacrylate-*g*-oligoarginine)s by RAFT polymerization of methacrylate-*g*-oligoarginine under reversible addition-fragmentation chain transfer (RAFT) polymerization. These polymers exhibited a thermoresponsive behavior induced by the stacking of the guanidinium groups present on the side chain of the polymer.



The objective of this internship relies on the development of a photosensitive RAFT chain transfer agent that will be used to (photo)polymerize methacrylate-*g*-oligoarginine. The introduction of a near-infrared (NIR) dye on the polymer will offer the ability upon NIR irradiations to induce locally the increase of the temperature and thus the disassembly of the polymer. As proof-of-concept, a model molecule will be encapsulated in the nanoobjects formed by the polymer and its release upon NIR irradiations will be monitored.