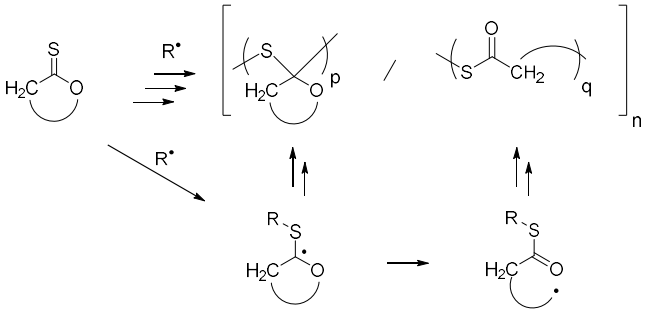
Thionolactones and derivatives for degradable vinyl polymers through radical copolymerization

Ph.D. position at SOFTMAT Laboratory, Toulouse (France) starting on September 1, 2024.
Supervisors : Prof. Mathias Destarac and Dr. Stéphane Mazières.

In today's chemical industry, nearly 50% worldwide production volumes of synthetic polymers are produced by radical polymerization of vinyl monomers. One of the main disadvantages of these polymers is their lack of degradability, as their monomer units are connected by very resistant C-C bonds. Because of this, plastic microparticles are now found all over the globe. In biomedical applications, controlled degradability is important to allow controlled drug release, reduce complications associated with the long term presence of a foreign material, and ensure renal clearance of high molecular weight polymers. Hence the challenge of bringing enhanced degradability to polymers derived from radical polymerization has never been that topical. Many strategies have been developed to introduce degradable functionalities into the backbone of vinyl polymers. Of these, the best known involve the use of radically polymerizable cyclic monomers such as cyclic ketene acetals (CKAs) and more recently thionolactones (TL)[1-3] and thionoglycolides (TG).[4] The latter two types of monomers were shown to polymerize according to coexisting mechanisms (Scheme 1), namely thiocarbonyl addition-radical ring-opening (TARO, forming thioester links) and 1,2-thiocarbonyl propagation mechanisms (forming thioketal links).



Scheme 1 : Synthesis of degradable vinyl polymers by free-radical polymerization of thionolactone monomers.

The objectives of the doctoral work are to (i) better understand the structure-reactivity of TL and TG monomers and deeper investigate the effect of polymerization conditions and (ii) submit polymers with predefined compositions and microstructures to different degradation strategies (chemical, enzymatic, biodegradation) and study their degradation pathways.

The candidate should hold a Master degree or equivalent with a profile in polymer chemistry, with a solid background in organic synthesis. A good level of English (spoken and written forms) is mandatory. If interested, please submit your application that should include your curriculum vitae, a cover letter describing your interest for this project, your transcripts of your Master degree, and the name and email address of two reference contacts to the offer UMR5623-MATDES-005 on the website of CNRS emploi (https://emploi.cnrs.fr/).

References : Ivanchenko, O. et al. [1] *Polym. Chem.* **2021**, *12*, 1931-1938 [2] *Polym. Chem.* **2022**, *13*, 5525-5529 [3] *Macromolecules* **2023**, *56*, *11*, 4163–4171 [4] *Polym. Chem.* **2022**, *13*, 6284-6292.