

## The laboratories

The laboratory of **Chemistry of colloids, polymers & complex assemblies** (Softmat) is dedicated to research into the chemistry of soft matter. Thanks to an expertise in polymer synthesis, physical chemistry and analytical chemistry, Softmat designs new smart polymer architectures and assess their structure/properties relationship. This research has a wide range of applications in life sciences, materials sciences, green chemistry, environmental sciences, meeting the scientific and societal challenges of our time. The **Toulouse Biotechnology Institute** (TBI) is a world-class research unit supported by INSA, CNRS and INRAE. TBI combines fundamental and applied research in the field of biotechnology, operating at the interface of fundamental research in biology, engineering of enzymes and processes. The institute develops innovative solutions to address the challenges of the bioeconomy and ecological transition.

Supervisors : Mathias Destarac and Louise Breloy (Softmat), Cédric Montanier and Isabelle André (TBI)

## The thesis project

Global plastic production has reached unprecedented levels, yet only about 9% is recycled, with the rest incinerated or accumulating in the environment. Current recycling methods face significant limitations, often leading to material degradation or having a substantial environmental footprint. Recently, **enzymatic recycling** has emerged as a promising and more eco-friendly alternative. It relies on biocatalysts capable of selectively degrading specific plastics under mild and sustainable conditions, such as aqueous media and moderate temperatures. These advances have been driven by remarkable progress in enzyme identification and engineering—resulting in highly efficient enzymes for polymers like polyesters—as well as a deeper understanding of how polymer chemistry and structure affect recycling efficiency. However, enzymatic recycling still faces numerous challenges at the interface of polymer physico-chemistry and biocatalysis, which currently limits its application to a narrow range of polymers.

This project aims to shed light on **polymer-enzyme interactions** by focusing on an original class of **controlled-structure polymers**, specifically designed for enzymatic degradation. The project will involve polymer synthesis, enzyme production and modeling, the advanced analysis of degradation products and the thorough exploration and optimization of operating conditions.

## The applicant

The candidate will hold a **Master's degree (M2) or equivalent in Chemistry** with a strong background in polymer chemistry and a **genuine interest in the interface between chemistry and biology** (specifically enzymology and enzyme modeling). As this PhD project is a joint collaboration between the Softmat and TBI laboratories (located within a 10-minute walk of each other in Toulouse), high scientific curiosity and the ability to adapt to different research environments are essential. Proficiency in standard chemical characterization techniques, such as NMR and Mass Spectrometry (MS), is expected. Previous experience in the following areas would be highly valued: radical polymerization, HPLC analysis, bacterial culture, enzyme production, or molecular modeling. Beyond technical expertise, **excellent communication skills** and the ability to engage effectively with multidisciplinary teams are crucial for this interdisciplinary project.

**Application through the CNRS portal only:**

<https://emploi.cnrs.fr/Offres/Doctorant/UMR5623-LOUBRE-001/Default.aspx>

