Development and Evaluation of Smart Adhesives to Improve the Recyclability of Plastic Packaging

Supervisors: Prof. Mathias Destarac (Ecolanka, University of Toulouse Campus) and Dr. Maëlenn Aufray (CIRIMAT-ENSIACET, Toulouse). Duration: Starting between January and March 2026, for 5 to 6 months. Profile: Master 2, Second or third-year engineering student.

Modern packaging often relies on multilayer plastic laminates (e.g., PET/PE/PA/Al) for high performance. However, these structures are not recyclable through existing mechanical or chemical recycling streams due to inseparable layers—98% are incinerated at end-of-life.

Debonding-on-demand adhesives are smart bonding materials designed to form strong, durable adhesion under normal conditions but can be easily and controllably separated when triggered by a specific stimulus. This “trigger” can be heat, light, electric current, magnetic field, pH change, or chemical agent, depending on the adhesive formulation. Such systems are particularly valuable in recycling, where reversible or selective disassembly enables easier reuse or material recovery.

One of the main objectives of this internship is to **develop a novel generation of demountable polymer adhesives for multilayer packaging**. In particular, the project will consist in :

-the development of smart adhesives for model materials to bind and peel off on demand.

- the study of the assembling of model materials incorporating these adhesives.

- delamination and recyclability tests under controlled lab conditions to evaluate the effectiveness of binder-triggered separation.

-the evaluation of the adhesion properties before and after the adhesive degradation.

Developed competences: Polymer synthesis, formulation and characterization. Adhesion.

Characterization techniques:

-Polymer and formulation characterization: Spectroscopy (FTIR, NMR), Size exclusion chromatography (SEC), rheology, DSC, TGA.

-Adherence strength: peel test measurements.

About Ecolanka: Ecolanka is a deep-tech startup developing first-in-class degradable monomers that provide common vinyl polymers with a controlled end-of-life. Our patented drop-in additives maintain material performance during use but enable recyclability or separation after disposal. Learn more about Ecolanka at ecolanka.co.

About CIRIMAT: **CIRIMAT** (Interuniversity Center for Research and Engineering of Materials) is a research laboratory dedicated to the study, design, and characterization of materials. It brings together multidisciplinary expertise in chemistry, physics, and engineering. Its research focuses on developing innovative materials for various industrial applications. **Mechanical tests on material strength and adhesion** will also be carried out to assess their performance. For more information about CIRIMAT: https://cirimat.fr/.

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