

Synthesis and characterization of a new generation of thermoplastic elastomers with tailorable thermomechanical properties

UNIVERSITY: LILLE , Faculty of Sciences and Technologies

Laboratory: Unité Matériaux Et Transformations (UMET, UMR-CNRS 8207)

Scientific field: « Materials Science – Polymers Physics and Chemistry »

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Expected/obtained funding: 50% University – 50% Regional funding

ABSTRACT

Context et objectives :

The goal of this PhD thesis is to develop a new generation of recyclable thermoplastic elastomers (TPE) with controlled and tailorable thermomechanical properties. TPEs are materials widely used in fields such as transport (automotive, aeronautical rail, etc.), sports, textiles, etc., and these materials combine the features of common thermoplastic polymers (such as an easy processing), with the specific mechanical behavior of elastomers. As compared to rubbers, the main advantage of TPEs is that they can be recycled and that they exhibit a recoverable (elastic) deformation at large strains. Nevertheless, the currently used TPEs, due to their structure, exhibits some limitations regarding the range of accessible properties. Consequently, the objective of this project is to propose a new approach based on the use of functionalized block copolymers which can be covalently and reversibly crosslinked. Thus, beyond being controllable, the thermomechanical properties of these materials will be also evolutive and tailorable. In other words, the properties of the same material can be adapted in order to perfectly fit the needs of different applications. Another innovation is that the block copolymers will be formed through the assembly of homopolymers through supramolecular chemistry. The main advantage of this approach is that it offers a remarkable versatility regarding the assembly of blocks of different natures to form custom structures (diblocks: AB, triblocks: ABA, ABC or multiblocks: (AB)_n).

The different parts of this thesis project will be:

- the synthesis of the functional monomers and perfectly defined homopolymers.
- the assembly of the homopolymers to form the block copolymers.
- the in-depth physicochemical characterization of these polymers (molar masses, degree of functionalization, etc.)
- the elaboration of films from these copolymers and the characterization of their micro/nano structure.
- the evaluation of the cross-linking kinetics as a function of the stimuli parameters (temperature, etc.).
- The determination of the structure – reticulation degree – thermomechanical behavior relationships between of these new TPE.



Ecole Doctorale - 104

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Qualifications:

Applicants should have a Master Degree (or an equivalent degree) in the fields of macromolecular chemistry/synthesis and/or physico-chemistry of polymers. Strong knowledge regarding macromolecular synthesis are needed as well as, at least, knowledge regarding the thermomechanical behavior of polymers. The candidate should demonstrate a strong interest for experimental work. Due to the multidisciplinary nature of the subject, a facility for regular communication with several interlocutors is also required.

Planned recruitment date: 1st of October 2022

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