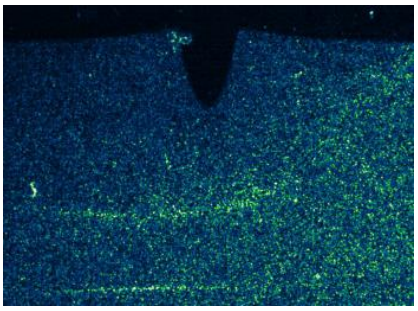
PhD position

Spontaneous and driven dynamics of model vitrimers

Laboratoire Charles Coulomb, Centre National de Recherche Scientifique (CNRS) & University of Montpellier, Montpellier, France.
Foundation for Research & Technology - Hellas (FO.R.T.H.) & University of Crete, Heraklion, Greece.

This PhD project is part of the European Doctoral Network 'ReBond', which involves eight Universities, five industrial partners et 15 PhD students. By combining the expertise of the different partners in synthesis, advanced characterization, linear and nonlinear dynamics, mechanical properties, modelling, and plastic product development and processing, we shall uncover the underpinning relationships among processing and performance of vitrimer-based recycled plastics and elastomers. Vitrimers consist of dynamic covalent networks, which can change their topology by thermally activated bond-exchange reactions. At high temperature, they flow like viscoelastic liquids, while at low temperature they behave like classical thermoset polymers. In the framework of 'ReBond', **the specific objectives of this PhD are to rationalize the spontaneous and driven microscopic dynamics of vitrimers at different temperatures**.



Speckle pattern whose temporal fluctuations reflect the local microscopic dynamics of an elastomer submitted to a continuous extension. The dark triangle on the top of the image is a notch of length ~1 mm, where damage accumulates. Credit: Nick Orr, L2C, Montpellier

We will use a non-conventional laser-based, spatially-resolved dynamic light scattering apparatus coupled to a traction machine to investigate the origin of vitrimer deformation at the nano- to micron-scale, for both small deformations (linear regime) and approaching mechanical failure. By selecting different deformation protocols, the interplay between the spontaneous vitrimer exchange dynamics and the sample dynamics induced by the deformation will be probed.
We will use model vitrimer samples provided by chemists from the 'Re-bond' consortium, with whom we will work in close collaboration. The microscopic dynamics measurements will be conducted in Laboratoire Charles Coulomb, Montpellier, France (with Laurence Ramos and Luca Cipelletti) and will be complemented by detailed measurements of the sample's mechanical and rheological properties at the same conditions in FORTH, Heraklion, Greece (with Dimitris Vlassopoulos), to link microscopic and macroscopic responses.

The successful candidate will gain significant knowledge in polymer dynamics as well as in scattering techniques. We are seeking a highly motivated PhD student with an excellent CV. The applicant must have a master's degree in physics, materials science, or engineering. Good knowledge of polymer/soft matter physics will be seriously considered. Additional knowledge in rheology or mechanics and/or scattering techniques is an additional asset.

Due to EU mobility rules, the candidate must not have spent more than 12 months in France in the last 3 years.

Applications should be sent by email (a single pdf file containing a detailed CV, a transcript of marks obtained during the Master, a motivation letter, and the names of two referees) to: rebond-manager@uclouvain.be

Starting dates: between December 2023 and March 2024. A slightly delayed recruitment may be discussed for outstanding candidates.
Project duration: 24 Months at CNRS (Montpellier, France) and 12 Months at University of Crete, Greece