Equipe d'accueil / *Hosting Team : Equipe Soft Polymer Networks*
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Période de stage / *Internship period*: janvier-juillet 2017
Gratification / *Salary : ~546 Euros/mois*
Possibilité de continuer en thèse : *Oui avec financement projet ERC*

Mechanoluminescence to detect molecular fracture in filled elastomers

Background

Unfilled simple networks of elastomers have very poor mechanical properties. They are generally either stiff and brittle, or soft and extensible depending on the amount of crosslinker[1]. In practice elastomers are almost always filled with nanoparticles which increase both their stiffness and resistance to fracture. Yet the detailed mechanisms by which the presence of filler delays crack propagation are unknown. Organic chemists have recently developed new molecules that emit light when a specific chemical bond breaks. If these molecules are incorporated in a material they can reveal whether the bond breaks or not during a macroscopic test of fracture or simple extension. Such molecules can be incorporated in the network of a well-chosen transparent filled elastomer at different positions such as in the bulk, or at the interface between filler and silica nanoparticle. As the material is deformed or broken, light emission informs on molecular mechanisms of damage[2,3].

Subject of the internship

The objective of this internship is to synthesize, and characterize mechanically, new types of model filled acrylic elastomers with different particle-matrix chemistries and to incorporate chemoluminescent molecules to detect molecular fracture. This is a completely new approach to an old problem and we expect to shed some light on the effect of changing the particle/matrix interaction on the spatial distribution of molecular fracture ahead of a crack.
Preliminary experiments have been carried out on multiple networks (unfilled) and show that the dioxetane molecule can be incorporated in the material and provide spatially and time resolved detailed information on the molecular fracture process[2]. To complete the molecular fracture detection, several characterizations of the mechanical properties will be carried out such as viscoelastic properties in small and large strain, hysteresis due to damage and fracture toughness tests.
This internship is an opportunity to have a good insight in the physical chemistry of the materials. Indeed the internship will combine the synthesis and the mechanical characterization of innovative elastomers and the advanced optical techniques to detect fracture.

Qualité requises

Stage idéalement ciblé pour un master physico-chimie des matériaux ou SMNO

Références

1. Creton, C. and M. Ciccotti, (2016) "Fracture and Adhesion of Soft Materials. A review" Reports On Progress In Physics, **79**(4): p. 046601.
1. Ducrot, E., Y. Chen, M. Bulters, R. P. Sijbesma and C. Creton (2014). "Toughening Elastomers with Sacrificial Bonds and Watching them Break." Science **344**(6180): 186-189.
2. Gostl, R. and R.P. Sijbesma (2016) "[small pi]-extended anthracenes as sensitive probes for mechanical stress". Chemical Science. **7**(1): 370-375.