PhD Proposal

Coarse-grained dissipative dynamics for complex polymer – polymer interface

To maintain its leadership in the tire business, MICHELIN is dedicating a great amount of resources to understand the physical and chemical mechanisms that drive the industrial performance and the quality of its products under various usage conditions. A tire is a composite that integrates a large variety of materials: textiles, metallic cables, elastomers, mineral fillers etc.). Mastering the various interfaces is key for the guarantee of tires' performances at the industrial processing stage and during the drastic condition of the usage phase. The work proposed here is dedicated to treat the problem of the adhesion between two elastomer-based nanocomposites. This question represents a challenge from both an academic point of view in the field of polymer physics and rheology and at an industrial level for industrial and product performances.

The adhesion level of a polymer - polymer interface depends on various parameters linked to material properties (microstructure and macrostructure) and contact kinematic. These parameters are highly coupled and the quantification of these couplings is a complicated task.

The first objective of this PhD is to develop coarse-grain potentials from realistic atomic simulations of elastomers with industrial complexity. These potentials will allow the construction of realistic free polymer surfaces in equilibrium at the mesoscale that may be put in contact. The model will afterward be confronted to the classical results for cured and uncured polymer – polymer interfaces and their characteristic modes of fracture: from the low rate modes of a confined fluid to viscoelastic fracture modes at larger speeds.

The candidate will be integrated to the SIMATLAB join laboratory between the Thermodynamic group at the Institute of Chemistry of Clermont-Ferrand and Michelin Research Center.

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