ESPCI PARIS
ÉCOLE SUPÉRIEURE DE PHYSIQUE ET DE CHIMIE INDUSTRIELLES DE LA VILLE DE PARIS

PSL RESEARCH UNIVERSITY PARIS

PhD Project - CIFRE - ESPCI/Michelin
Adhesion and fracture of non vulcanized elastomers

Research project

Michelin develops some novel elastomers to reduce the rolling resistance of future tires. The chemical nature of these elastomers induces important modifications in the rheological properties of the material in the non vulcanized condition, which makes their processing very delicate. In particular, depending on the specific formulation, Michelin observes two limiting behaviors: an important adhesion on the cylinder lamination tools for the softer materials and an extensive fracturing process for the hardest materials (c.f. figure). The optimal window of processing parameters between these limiting behaviors is very narrow for these novel elastomers. The nonlinear behavior of the material is likely to be responsible for these effects, and this problem is clearly related to the difficult and unsolved issue of fracture in soft viscoelastic materials, which is a main domain of expertise of the SIMM laboratory.

The aim of this PhD thesis is to approach these two problems in a systematic way by coupling mechanical measurements with local optical observations in order to identify the nature of the strain localization mechanisms that lead to fracture or enhanced adhesion. Michelin will provide the model materials with and without mineral fillers and the PhD student at the SIMM laboratory will be in charge of developing custom mechanical tests coupled with optical observation techniques. The adhesion mechanisms will first be investigated through peeling and tack tests on functionalized glass surfaces and fracture by tensile tests on prenotched specimens. A custom small scale cylinder lamination tool will then be developed to model the behavior in the processing conditions.

Academic tutors

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