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Understanding micro-friction in polymers
L.C.A. van Breemen, L.E. Govaert and H.E.H. Meijer

Introduction
Friction of polymers is a very common phenomenon in daily life and is responsible for huge energy losses. Processes governing friction are occurring in the thin surface layers of two moving bodies which are in contact. This leaves us with the following question: “Which intrinsic properties of a polymer contribute to friction and how, by knowing these properties, can we tailor polymers to minimize friction?”

Approach
Decouple the friction force ($F_f$) into a deformation ($F_d$) and adhesion ($F_a$) related component according to Bowden and Tabor’s law of friction [1].

$$F_f = F_a + F_d = \tau_{eff} A_{rz} + \sigma_{bulk} A_{rx}$$

Current status
Numerical
to adequately predict the response of a polymer we need to accurately describe its intrinsic deformation (figure 3).

To accomplish this, we extend our single-mode model to a multi-mode model [2], according to

$$\sigma = \sigma_{s,x}^h + \sigma_{s,x}^d + \sigma_r$$

where

$$\sigma_{s,x} = \kappa_x (J - 1) I + G_x B_{c,x}^d$$

and

$$\sigma_r = G_r B_d$$

Experimental
The focus will be on the initial step of a scratch experiment, which is indentation. This needs to be understood before we can continue to a more complex loading mechanism such as scratching.

Outlook
The ultimate goal is to compare FEM-simulations with scratch experiments and isolate the deformation contribution to the friction force.

References: