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Master thesis proposal

SIMM - ESPCI Paris PSL
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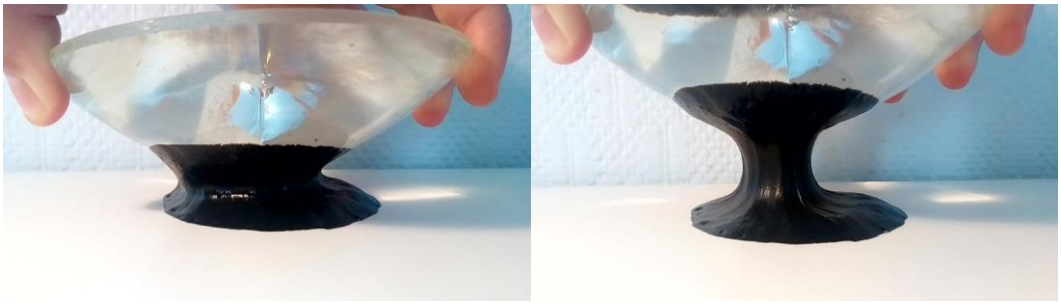
Title: Life and death of a stretched soft fibril

Keywords: Soft matter, adhesion, rheology

Scientific description: Viscoelastic puttys (like SillyPutty) present very non-linear behaviors ranging from brittle fracture to fluid flow under some changes in the rapidity of application of the loading. Although they are very soft, these puttys are substantially incompressible, which leads to important internal flows when submitted to large strains. We will tackle the behavior of a putty squashed between two stiff solids, like a sphere and a plane, in order to establish a good adhesive contact between the two. When the sphere is rapidly separated from the plane, the putty can either react in a brittle elastic way leading to interfacial debonding from one of the solids with little or no visible deformation. But if we separate the sphere slowly enough, the putty will progressively get strained into a long fibril, that can be stretched considerably before debonding or even flow indefinitely, so that debonding becomes impossible.



The nature of that transition, still poorly understood, is probably hiding into the spectacular changes in shape of the regions close to the triple lines that delimit the contact region between the putty and the substrate. In particular, the strong changes in the apparent contact angle lead to important modifications in the local stress concentration, which is the central mechanism leading the interfacial debonding. Through a series of simple, but well-conceived, experiences and modeling we plan to study the physics of debonding of viscoelastic pastes from rigid substrates in these transition conditions, by separating the role of the non-linearities that come from the strong shape changes from those that originate from the non-linear rheology of viscoelastic puttys[1].

1) C. Creton and M. Ciccotti, Fracture and adhesion of soft materials : a review, Rep. Prog. Phys., 79, Art N. 046601.

Techniques/methods in use: Mechanical testing, image analysis, fracture mechanics.
Applicant skills: Soft matter science, polymer physics, rheology, mechanics.
Industrial partnership: N (specify the company)
Internship supervisor(s) (name, email, phone, webmail): Matteo CICCOTTI, matteo.ciccotti@espci.fr, 0140794419, http:/ciccotti.espci.fr
Internship location: ESPCI Paris PSL, SIMM Laboratory
Possibility for a Doctoral thesis: Y (application for funding underway)