FOR APPLICATION, PLEASE CONTACT ADVISOR(S) BY EMAIL WITH COPY TO:
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Research Topic for the ParisTech/CSC PhD Program

Field (cf. List of fields below): Materials Science, Mechanics, Fluids

Subfield: Polymer Science (ideally, more physics and engineering than chemistry oriented)

Title: *Dewetting dynamics of a polymer thin film embedded in an immiscible polymer matrix*

ParisTech School: ENSAM

Advisor(s) Name: G. Miquelard-Garnier & C. Sollogoub
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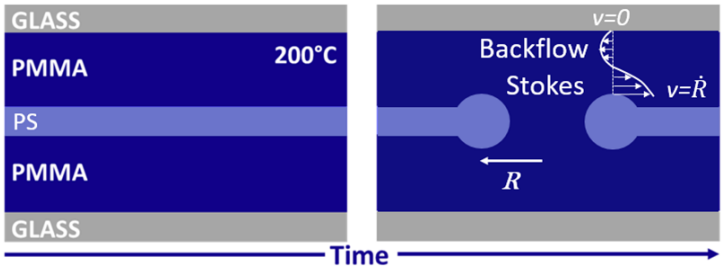
Short description of possible research topics for a PhD: When a glassy thin polymer film is placed on top of a substrate with which it has no affinity and heated above its glass transition temperature, it will spontaneously dewet. Both nucleation mechanisms and dewetting kinetics have been widely studied over the last 25 years.
We recently developed in the lab an experiment where the thin film is actually embedded in two thicker layers of an immiscible matrix. We showed that the dynamics is different from the simpler case described previously. Notably, the viscous dissipation occurs in the surrounding matrix and extends over distances several order of magnitude higher than the film thickness.
In the proposed research we would like to further explore this system under many aspects, such as the asymmetric case where the outer layers have different thicknesses. The role of the interfacial tension will also be thoroughly characterized with the use of well-defined copolymers placed at the interfaces. Finally, the finite-size effect which plays a role in the viscous dissipation balancing the capillary forces in our model will be investigated.
This study shall lead to a better knowledge of the dewetting dynamics of polymeric multilayer systems, which is of interest for applications in both thermoplastics processing but also for microfluidics. This work is part of an-going and successful collaboration with academic and industrial partners.



Schematic of the experiment illustrating the proposed dewetting mechanism

Required background of the student: Polymer Science or Soft Matter Physics or Fluid Mechanics

A list of 5(max.) representative publications of the group:
[1] Y. Zhu, A. Bironeau, F. Restagno, C. Sollogoub, G. Miquelard-Garnier, *Polymer*, **2016**, 90, 156
[2] M. Chebil, J.D. McGraw, T. Salez, C. Sollogoub, G. Miquelard-Garnier, *Soft Matter*, **2018**, 14, 6256
[3] A. Bironeau, T. Salez, G. Miquelard-Garnier, C. Sollogoub, *Macromolecules*, **2017**, 50, 4064
[4] G. Miquelard-Garnier, S. Roland, *European Polymer Journal*, **2016**, 84, 111
[5] J. Feng, Z. Zhang, A. Bironeau, A. Guinault, G. Miquelard-Garnier, C. Sollogoub, A. Olah, E. Baer, *Polymer*, **2018**, 143, 19