

Research Topic for the Arts et Métiers ParisTech - CSC PhD Program

Subfield: Polymer Science/Engineering, Applied Physics

ParisTech School: Arts et Métiers ParisTech

Title: Kinetics of rupture of thin polymer films: model experiments for understanding the instabilities in multilayer coextrusion

Advisor(s): Dr G. Miquelard-Garnier, guillaume.miquelardgarnier@lecnam.net, and Dr C. Sollogoub, cyrille.sollogoub@lecnam.net <http://pimm.paris.ensam.fr/en/user/156>

Short description of possible research topics for a PhD:

Unexpected behaviors of polymers confined at the nanometric scale (sizes similar to the radius of the macromolecules) has led to a renewed interest for the development of new technologies allowing structuration of the blends down to the nanoscale.

Multilayer coextrusion consists in forcing the polymer flows to create materials composed of thousands of alternating layers with nanometric thicknesses of different polymers. However, when brought down to this nanometric scales, instabilities can develop during the process, breaking the continuity of the layers and altering the final properties.

The goal of this PhD will be to identify and understand the complex physical phenomena (role of interfacial tension, shearing etc), leading to these instabilities, by working on model experiments. This work will be done in collaboration with colleagues from the ESPCI and Université Paris-Saclay. Arkema is also involved in the project.

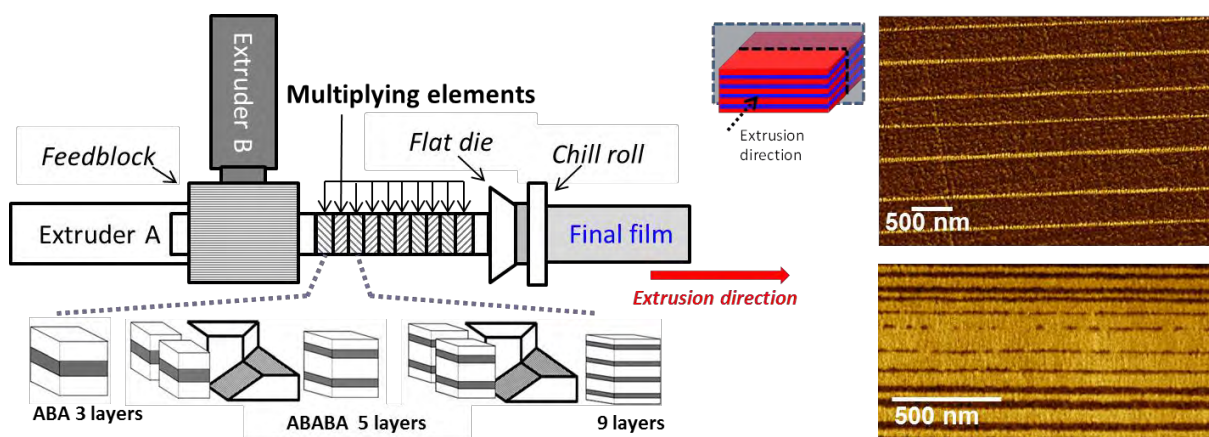


Figure 1: schematic of the multilayer coextrusion process (left). PS/PMMA nanolayer films (total of 2049 layers) observed by AFM (right). In the top image, continuous layers with thicknesses on the order of 50 nm for the PMMA are observed (yellow lines). In the bottom one, PS layers (brown) below typically 30 nm are broken.

Required background of the student: Polymer Science or Chemical Engineering or Physics of Fluids

2-3 representative publications of the group:

- Roland S. *, Miquelard-Garnier G. *et al*, *Materials Today Communications*, 2016, 6, 37-43
- Li X., McKenna G.B., Miquelard-Garnier G. * *et al*, *Polymer*, 2014, 55, 248-257
- Miquelard-Garnier G. * *et al*, *Polymer*, 2013, 54(16), 4290-4297

FOR APPLICATION, PLEASE CONTACT ADVISOR(S) BY EMAIL WITH COPY TO:
ali.siadat@ensam.eu AND yvon.velot@ensam.eu