Study of polymer pseudo-brushes by Rheo-NR

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Polymeric fluids constitute a class of materials with remarkable physical properties, especially when subject to shear. They have several industrial applications, from e.g., production of plastics to functional coatings and lubrication. Understanding their rheology is both fascinating from the perspective of fundamental science and useful for technological development. When considering melts and semi-dilute solutions of high molecular weight polymers, the rheological properties are mostly independent of chemistry. Rather, they are defined by the chain length and the topological interactions between chains, and can thus be generalized. For example, in flowing through capillaries, entanglements of the chains and adsorption at the walls cause the stick-slip defect, a phenomenon whose molecular origin has been described theoretically [1] but not directly observed experimentally. Neutron reflectometry (NR) is a technique capable of characterizing buried interfaces in terms of layer thickness, roughness and composition, the latter thanks to the scattering contrast between deuterated and hydrogenous species. Combining *in situ* rheology and NR, it is possible to define the density profile of a polymer adsorbed on a solid substrate and study how it changes under shear. In previous work [2], we applied rheo-NR to study a polymer brush grafted to a substrate and in contact with a solution of the same polymer. We observed a collapse of the brush under shear, which is in line with molecular dynamics simulations and theory. In this presentation we investigate a Guiselin, or pseudo-, brush [3,4], in which the polymer chains are physisorbed on a substrate as this is a more realistic model for polymer flow at solid walls. The pseudo-brush is composed of deuterated polystyrene, and is immersed in a solution of hydrogenous polystyrene, to differentiate the contributions to the scattering signal via the isotopic contrast of the chains. Results suggest that, interestingly, chains from the pseudo-brush under shear exchange with those in solution rather than simply desorbing from the surface.

Keywords:
Polymer brush, Rheology, Neutron Reflectometry

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