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Probing nano-rheology in thin polymer films

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In this talk I will summarize our recent work on using stepped films to uncover some of the physics relevant to polymer rheology on length scales comparable to the size of polymer molecules. The work presented will focus on the efforts of a larger collaboration (Elie Raphael's theory group in Paris and James Forrest's group in Waterloo). The simple geometry of a polymer film on a substrate with a step at the free surface is unfavourable due to the excess interface induced by the step. Laplace pressure will drive flow within the film which can be studied with optical and atomic force microscopies. Because of the excellent agreement between theory and experiment when we probe "bulk-like" properties, these studies provide an opportunity to study how such systems transition from the bulk to confined. Starting with some of the results of levelling experiments on simple stepped films as well as the levelling of polymer droplets on thin films, I will finish with a discussion on our more recent efforts to elucidate confinement effects.