Nanorheology of thin polymer films

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The nanorheology of thin polymer films has recently received significant scientific attention due to the important effect confinement has on the mobility of the polymer molecules. The understanding of the viscous flow and stability of these films is important for technological applications, where ultra-thin polymer coatings are frequently used in, for example, nanolithography and nanoimprinting, as well as in the development of non-volatile computer memory devices. Here, we have studied the capillary-driven relaxation of small cylindrical holes in a viscous thin film to probe its nanorheological properties. By using atomic force microscopy, the relaxation of holes of various sizes was shown to consist of two different time regimes: an early regime where opposing sides of the hole do not interact, and a late regime where the hole is filling up. Analytical scaling arguments of the capillary levelling were made, and the derived scaling laws were shown to be in excellent agreement with experiments. Our system provides an interesting sample geometry with which to probe the nanorheological properties of thin polymer films.

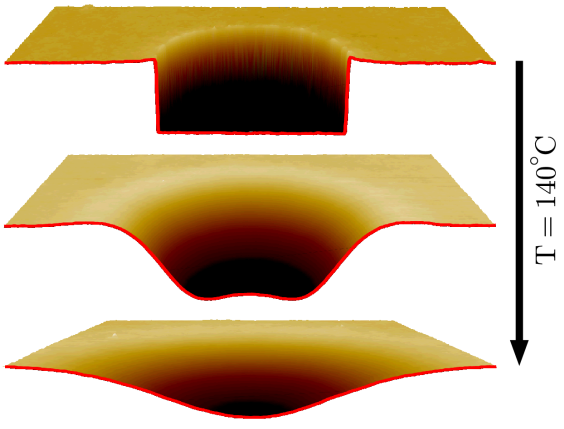

Figure 1. AFM surface topography images of the relaxation of a cylindrical hole (initial radius and depth 2.8 µm and 75 nm, respectively) in a polystyrene film heated above the glass transition

REFERENCES

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