Interactions between polymer brushes in ionic liquids

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A polymer brush is formed when polymer chains are end-anchored on a solid surface at a sufficiently high density, adopting an extended conformation[1]. Many theoretical models[2] and measurements[3] have focussed on the properties of brush systems in different solvents. Further studies have investigated the properties of polyelectrolytic brushes in salt solutions[4]. However, a limitation of these studies arises as the concentration of salt in solution approaches saturation. One approach to circumvent this is to utilise ionic liquids to facilitate measurements from dilute to pure salt environments.

In this study, we have investigated the interactions between surfaces bearing poly([2-(methacryloyloxy)ethyl]dimethyl-(3-sulfopropyl)ammonium hydroxide) polymer brushes in mixtures of water and an ionic liquid, 1-hexyl-3-methylimidazolium bis(triflluoromethylsulfonyl)imide. Characterisation of the thickness of dry polymer layer grafted from mica was conducted using the 'bending mica' X-ray reflectivity technique[5], revealing a typical thickness of ~ 10 nm. Additionally, atomic force microscopy was conducted to investigate surface topography, indicating a relatively uniform surface coating with high coverage (*cf.* Figure 1). Finally, measurements of the normal and shear forces were conducted using a surface force apparatus, yielding first results on the forces mediated by polymer brushes in an ionic liquid – water mixture.



Figure 1 A: An X-ray reflectivity curve obtained for the polymer grafted from a mica substrate. B: An AFM image of the same sample.

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- [1] S. T. Milner, Science, 1991, 251, 905.
- [2] P.G. de Gennes, Journal de Physique, 1976, 37, 1445.
- [3] M. Chen, W. H. Briscoe, S. P. Armes *et al*, *Science*, 2009, **323**, 1698.
- [4] J. D. Willott, T. J. Murdock, B. A. Humphreys et al, Langmuir, 2014, 30, 1827.
- [5] W. H. Briscoe, M. Chen, I. E. Dunlop et al, Journal of Colloid and Interface Science, 2007, 306, 459.