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The Internal structure of a NIPAM brush layer

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The internal structure of a thermoresponsive poly(N-isopropylacrylamide) (PNIPAM) brush coating has been investigated via neutron reflectometry and small angle neutron scattering (SANS).[1] PNIPAM is a thermoresponsive polymer with an entropically driven lower critical solution temperature (LCST). Below the LCST, the polymer will hydrogen bond with H2O, solubilising the chains. Above the LCST, the entropic penalty from solubilising the hydrophobic regions of the polymer becomes too great, and PNIPAM becomes insoluble. When tethered to a surface in the polymer brush regime, the brush layer is swollen at low temperatures and collapsed above the LCST. Furthermore, this abrupt LCST broadens into a temperature transition range spanning 10-20 ℃.[2]
We have examined the influence of molecular weight, ionic strength and salt identity on the temperature induced swelling/collapse transition of PNIPAM brushes using ellipsometry, QCM-D, AFM, contact angle measurements and DLS.[1-2] These techniques provided a detailed understanding of bulk and surface properties of the PNIPAM systems investigated. The use of neutrons to interrogate these systems, however, has enabled subtle variation in the brush volume fraction profile normal to the substrate to be elucidated (Fig. 1). This highlights any variations related to surface curvature, brush thickness, surface confinement, ionic strength and salt identity.

[1] T. J. Murdoch, B. A. Humphreys, et. al., Macromolecules 2016, 49, 6050-6060.
[2] (a) B. A. Humphreys, et al., JCIS 2018, 516, 153-161; (b) B. A. Humphreys, et. al., PCCP 2016, 18, 6037-6046; (c) T. J. Murdoch, B. A. Humphreys, et. al., JCIS 2018, 526, 429-450.

Topic

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