Contribution ID : **34** Type : **Oral**

Examining the structural and mechanical implications of surfactants on neutral polymer brushes through neutron reflectometry

Wednesday, 21 November 2018 10:25 (20)

Layers of densely-tethered polymers (polymer brushes) are of interest due to their potential applications as nano-actuators, biocompatible coatings, and switchable lubricating or antifouling surfaces. These applicable properties are dependant on the structure of the polymer interface, so it is important that the structural effects of common compounds and relevant environmental variables be understood. Neutron Reflectometry (NR) is the only technique capable of providing detailed structural resolution of solvated multi-component polymer brush systems due to its penetrating power and the possibility of isotopic substitution.

Here we present a Neutron Reflectometry study on the effects of surface-active molecules (surfactants) on two neutral polymer brushes, poly(ethylene oxide) (PEO) and Poly(N-isopropylacrylamide) (PNIPAM), focusing on small, single tail surfactants. PEO is a widely used biocompatible polymer with a range of medical and commercial applications, whilst PNIPAM is a well known thermoresponsive polymer, undergoing a swollen to collapsed transition over its critical solution temperature (CST) of 32˚C. We show that these two polymers exhibit similar yet distinct interactions with surfactants, with the observed differences having implications for the mechanism of brush-surfactant interaction. The presence of surfactants was found to raise the CST of PNIPAM; we show that this effect is dependent strongly on surfactant identity and concentration. As part of this work we have developed new modelling techniques for the analysis of NR data from polymer brush interfaces. These advancements will be explained in the context of the data at hand, and their applicability to other soft diffuse interfaces will be briefly discussed.

Topic

Soft Matter

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Session Classification : Topical Session 8: Soft Matter

Track Classification : Soft Matter