527g Thermodynamics and Dynamics of Diblock Copolymers

B. J. Reynolds, M. L. Ruegg, N.P. Balsara, and Clayton J. Radke

The efficacy of diblock copolymers for stabilizing interfaces between immiscible polymers depends on both thermodynamic and dynamic factors. We study the equilibrium and dynamic concentration profiles of an AB diblock co-polymer (i.e., the surfactant) at an A polymer/ B polymer interface. We create thin polymer films containing two surfactant-bearing polymeric interfaces and follow the transient concentration profiles of the diblock copolymer by dynamic secondary-ion mass spectroscopy (SIMS). For well-equilibrated films, the measured concentration profiles and the adsorption isotherms are in good agreement with self-consistent field theory (SCFT), where all necessary parameters were determined independently from SANS and gel-permeation-chromatography measurements. For the nonequilibrated films, transport of the diblock copolymer depends on the two binary Fickian diffusion coefficients and on the depth of the thermodynamic potential wells that hold the surfactant molecules at the interface. Diffusion coefficients of our system were measured in independent SIMS experiments. We again find excellent agreement between the measured transport rates of the AB surfactant across the film interfaces and those calculated using a SCFT free-energy profile and diffusion in a potential field. Fascinatingly, no kinetic barriers to adsorption/desorption are found. For the first time, surfactant adsorption dynamics at a polymer/polymer interface is addressed