Effect of Molecular Architecture on the Wetting Properties of Polymers

EMMANOUIL GLYNOS, BRADLEY FRIEBERG, PETER GREEN, University of Michigan, Ann Arbor —

We show that the wetting properties of star-shaped polystyrene (PS) macromolecules possessing sufficiently high functionality, f higher than 4, differ significantly from their linear analogues of otherwise identical chemical structure. The equilibrium contact angles of macroscopic droplets composed of star-shaped macromolecules on silicon oxide substrate, are as much as one order of magnitude smaller than their linear analogues, provided that f is equal to or greater than 8 and the degree of polymerization per arm length, Narm, is sufficiently small. The corresponding line tensions of the star polymers are as much as two orders of magnitude smaller. The dewetting characteristics of the linear and star polymers also differ. Linear PS chains dewet leaving an adsorbed layer of nanoscopic dimensions; this layer is also structurally unstable and breaks up into nano-droplets, leaving a precursor layer at the boundary of the macroscopic droplets. The thickness of this layer is consistent with expectations based on the shape of the effective interface potential. The corresponding nanoscopic layer of star-shaped polymers, of sufficiently large f and sufficiently small Narm, remains structurally stable. These effects are discussed in terms of the role of molecular architecture and entropic effects on the structure and dynamics of macromolecules at interfaces.

1This work was support by the National Science Foundation, Division of Materials Research, Polymers Program 0906425.

Emmanouil Glynos
University of Michigan, Ann Arbor

Date submitted: 17 Nov 2011

Electronic form version 1.4