276f The Role of Curvature Dependent Free Energy in the Behavior of Polymer Vesicles and Composite Droplets

Kurt A. Smith, Anna C. Balazs, David M. Jasnow, and Mihail Mihailescu

Equilibrium conformations of multicomponent systems are typically assumed to depend on the interfacial tensions between the various phases. However it has been shown theoretically [1] that in polymer blends and additional molecular weight dependent curvature term contributes to the free energy. This suggests a new route for control of multi-phase morphologies. We show how the molecular weight dependence alters the typical relations (namely Young's Law and the Neumann Triangle) that determine contact angles. We use a phase field model to address the dynamical behavior of multicomponent systems with the expanded free energy. In particular we consider a vesicle consisting of two immiscible homopolymers, one forming an outer membrane and the other constituting an internal core. This morphology is relevant both in industrial polymer materials and as a synthetic version of a cell. One of the cell's most crucial functions is phagocytosis, where the membrane restructures to engulf a large extracellular “target” and then recloses as this species is ingested. Through simulations we examine the response of the vesicle when it contacts a foreign object and the role of the molecular weight of each phase in this process.

[1] H. Tang and K. F. Freed, J. Chem. Phys., 94, 1572 (1991).