



The University of Western Ontario

A JOINT PRESENTATION of the Departments of Physics & Astronomy and Applied Mathematics

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“Confined Self-Assembly of Block Copolymers”

ABSTRACT

Spontaneous formation of ordered structures from amphiphilic molecules has attracted tremendous attentions in the last decades. Among the many different amphiphilic systems, block copolymers with their rich phase behaviour and ordering transitions have become a paradigm for the study of structural self-assembly. For the simplest case of diblock copolymers, which are linear polymers composed of two different sub-chains (A and B blocks), a variety of ordered bulk phases, including lamellae, hexagonally-packed cylinders, body-centered-cubic spheres and a bicontinuous network structure called gyroid, are observed. In a physically confined environment, structural frustration, confinement-induced entropy loss and surface interactions can strongly influence the molecular organization. In particular, it is possible that confinement can lead to unusual morphologies which are not accessible in the bulk, thus providing opportunities to engineer novel structures. Confined self-assembly of block copolymers is studied using a combination of Monte Carlo simulations and self-consistent field theory. For confined asymmetric diblock copolymers, a rich variety of novel morphologies, ranging from helices to toroids to complex networks, is predicted. The formation of these structures depends strongly on the geometric shape and dimension of the confinements. The combination of theoretical studies with experiments demonstrates that confined self-assembly of amphiphilic molecules provides a robust method to produce nanoscopic structures which are not accessible in the bulk phases.

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