

Phase Behavior and Phase Transitions in AB- and ABA-type Microphase-Separated Block Copolymers

Jin Kon Kim and Chang Dae Han

Abstract Currently held mean-field theories for microphase-separation in AB-type diblock and ABA-type triblock copolymers are reviewed and their limitations are highlighted. Numerical predictions, based on these theories, for the design of such block copolymers are also presented. It is emphasized that the use of a numerical algorithm leading to successful design and synthesis of block copolymers in terms of order–disorder transition temperature (T_{ODT}) is critically dependent upon the accuracy of the temperature-dependent interaction parameter. Specifically, the available temperature-dependent interaction parameters are often obtained using the molecular weights which are much lower than the molecular weights of the constituent blocks, in spite of the fact that the interaction parameters are molecular weight dependent. Two as yet unresolved issues, finite molecular weight effect and the phase behavior and phase transitions in highly asymmetric block copolymers, are discussed. These issues are fundamental enough to require a fresh look, particularly from a theoretical point of view, because the currently held mean-field theory cannot explain every conceivable phase behavior and phase transitions experimentally observed in block copolymers.

Keywords Block copolymer · Disordered micelles · Fluctuation effect · Order–disorder transition · Self-consistent mean-field theory

J.K. Kim (✉)

National Creative Research Initiative Center for Block Copolymer Self-Assembly
and Department of Chemical Engineering, Pohang University of Science and Technology,
Pohang, Kyungbuk 790–784, P.O. Box 125 Republic of Korea
email: jkkim@postech.ac.kr

C.D. Han (✉)

Department of Polymer Engineering, The University of Akron, Akron, OH 44325, USA
email: cdhan@uakron.edu

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