Universality of microphase separation induced by strongly selective solvents in semi-dilute solutions of block copolymers

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1. INTRODUCTION

Block copolymers (BCPs) form various kinds of microdomain structures, the sizes of which are contingent on the molecular sizes. Ultra-high-molecular-weight BCPs enables us to fabricate photonic crystals. However, they contain a lot of defects or distortion and are far from equilibrated state because of the high viscosity. We found that highly ordered microdomains are formed in semi-dilute solutions of strongly selective solvents. We have succeeded in the fabrication of non-linear optical materials [1]. In this study, we investigated whether this technique could be applicable to various kinds of BCPs with proper solvents.

2. Results and Discussions

BCPs utilized in this study were polystyrene-*b*-polymethylmethacrylate, polystyrene-*b*-polybutadiene and polystyrene-*b*-poisprene of high molecular weight. Solvent mixtures of toluene and alcohols or alkanes, or tetrahydrofurane with water were used. Toluene and tetrahydrofuran are good solvents for all of the BCPs used. The systems were in the disordered state with the weak segregation power, i.e., at the low polymer concentration or with the low selectivity of the solvent mixtures. For any type of BCP system, the microphase separation was induced when the selectivity was increased by the addition of proper amount of alcohols, alkanes or water as strongly selective solvents. The increase in selectivity of the mixtures and the consequent phase behaviors were well controlled by the selectivity of the alcohols, alkanes and water.

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