Nanophase-separated structures of AB block copolymer / C homopolymer blends with hydrogen bonding interaction

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Introduction
The block copolymers consisting of incompatible polymers form self-assembled structures in bulk[1], such as spherical-, cylindrical-, bicontinuous- and lamellar ones depending on their compositions. Polymer blends of AB/B type also show the same morphological change with composition, however amounts of the homopolymer solubilized into corresponding domains of AB block polymer are limited. [2] In this study morphology of AB/C polymer blends with attractive interactions such as hydrogen bonding interaction was investigated by transmission electron microscopy (TEM) and small-angle X-ray scattering (SAXS).

Experimental
poly(styrene-b-2-vinylpyridine) diblock copolymer (SP, Mw=130K, weight fraction of polystyrene ws=0.67), poly(2-vinylpyridine) (P, Mw=3K), and poly(4-hydroxystyrene) (H, Mw=8k) were used as component polymers. Blend sample films of SP/P and SP/H were prepared by solvent casting from THF solutions and annealing at150°C for 5 days under vacuum.

Results & Discussion
The morphology of parent SP diblock copolymer shows hexagonally-packed cylindrical structure. As P was added to the SP the blend’s morphology transferred to lamellar ones. However addition of more P homopolymer causes macrophase separation, as shown in Figure 1. In contrast, in SP/H blends, macrophase separation of their components did not exist and various nanophase separated structures were observed in wide composition range as shown in Figure 1 and 2. It is due to miscibility of P and H via hydrogen bonding interactions, which are considered as the driving force producing uniform nanophase separated structures in wide composition range.

References