Phase Transition from Hexagonally Packed Cylinders to Squarely Packed Cylinders in Block Copolymer/Homopolymer/Nanoparticle Nanocomposites induced under Magnetic Fields

Bo-Siang Jhang (張博翔)[1] and Che-Yi Chu (朱哲毅)[1*]

[1]Department of Chemical Engineering, National Chung Hsing University, Taichung, Taiwan
cychu0123@dragon.nchu.edu.tw

Abstract

It has been reported that the cylindrical domains formed by block copolymers almost tend to organize in a hexagonal lattice rather than a square lattice due to the better efficiency for space filling in the former case. While in the present study, we investigate the effect of magnetic field strength on the formation of squarely packed cylinder (SQ) structure in the nanocomposites formed by polybutadiene-*block*-poly(ethylene oxide) (PB-*b*-PEO) diblock copolymer, PB homopolymer, and Fe_3O_4 nanoparticles. The as-cast PB/PB-*b*-PEO/Fe_3O_4 nanocomposite film initially formed the stable hexagonally packed cylinder (HEX) structure. When the HEX-forming nanocomposite film was annealed under an applied magnetic field, the HEX phase was found to transform into the SQ structure. Interestingly, HEX was recovered after moving the sample away from the applied magnetic field, indicating that SQ observed here was a kinetically trapped structure. In other words, the use of magnetic Fe_3O_4 nanoparticles in this nanocomposite system could efficiently serve as a structure-directing agent to control the packing of block copolymer microdomains by the magnetic field.

Keywords – block copolymer、magnetic nanoparticle、squarely packed cylinder