Determination of $F_{ddd}$ phase boundary in polystyrene-block-polyisoprene diblock copolymer

MYUNG IM KIM, SATOSHI AKASAKA, TSUTOMU WAKADA, MIKIHITO TAKENAKA, HIROKAZU HASEGAWA, Department of Polymer Chemistry, Graduate School of Engineering, Kyoto University

We previously reported the discovery of a novel bicontinuous microdomain structure with $F_{ddd}$ symmetry in polystyrene-block-polyisoprene (SI) diblock copolymer. In this study, we investigated the phase behavior of eight SI diblock copolymer samples having slightly different compositions ($0.627 \leq f_{PI} \leq 0.653$) by SAXS and TEM to determine the phase boundary of the $F_{ddd}$ structure in the phase diagram of SI. The SI having the lowest $f_{PI}$ ($= 0.627$) showed only disorder-lamella (L) transition but no order-order transition. The SI having the largest $f_{PI}$ ($= 0.653$) showed disorder-gyroid (G)-L transition with decreasing temperature, but did not show $F_{ddd}$ phase. The other six SI samples having $f_{PI}$ values between these two exhibited disorder-G-$F_{ddd}$-L transition with decreasing temperature. Consequently, we could determine the compositional region where $F_{ddd}$ phase is thermally stable, which is in good agreement with that predicted by SCFT.

Myung Im Kim
Dept of Polymer Chemistry,
Graduate School of Engineering, Kyoto University

Date submitted: 02 Dec 2008