Design of High-χ Block Copolymers for Sub-10 nm Patterning

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Directed self-assembly (DSA) of block copolymers (BCPs) on chemical patterns takes the advantages of block copolymer self-assembly and conventional lithography and attracts more and more attention in the past decade. DSA of BCP materials can form periodic, perfectly registered and ordered nanostructures over large areas. Poly(styrene-*b*-methyl methacrylate) (PS-*b*-PMMA) is perhaps the most thoroughly studied BCP material because PS and PMMA blocks have almost same surface energies (γ) and show non-preferential wetting at the free surface under the thermal annealing condition. This particular property allows the formation of perpendicularly oriented domains on substrates under thermal treatment, which is essential for BCP lithography. However, the intrinsic relatively small Flory–Huggins interaction parameter (χ) of PS-*b*-PMMA limits the smallest accessible domain period (L_0) to ~22 nm, while sub-10 nm feature, i.e. L_0 < 20 nm, is generally demanded for next generation lithography. In this talk, I will present our recent work on the design, synthesis and DSA of three high-χ BCPs: PS-*b*-PLA and PS-*b*-PLGA. These BCPs have much higher χ than PS-*b*-PMMA and the smallest achievable L_0 is <15 nm. They also have nearly equal γs, which allows the formation of perpendicular domains under thermal treatment. DSA of these high-χ BCPs has been demonstrated on chemical patterns to fabricate sub-10 nm features.

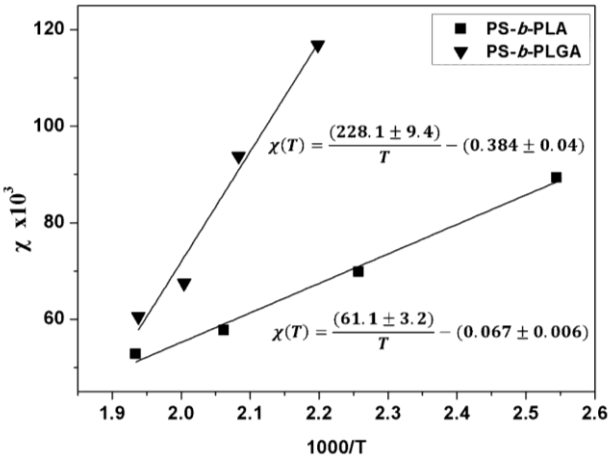

Figure 1. The temperature dependence of χ for PS-*b*-PLA and PS-*b*-PLGA.