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Self Assembled Structures in Electrospun PS-b-PI Nanofibers

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The formation of submicron scale fibers with various domain shapes via electrospinning poly (styrene-block-isoprene) (PS-b-PI) has been investigated. Monodisperse PS-b-PI block copolymers with 20 and 30 vol% of PI were synthesized using anionic polymerization and were dissolved in THF. Solutions of 10 to 40 wt% of block copolymer in THF were electrospun, and fibers with average diameters from 200 nm to 5 micron meter were obtained. Small Angle X-Ray Scattering (SAXS) and Transmission Electron Microscope (TEM) studies revealed that spheres and cylinders of PI domains can be formed in electrospun fibers. Hexagonal PI cylinder domains are formed during electrospinning of with 30% PI copolymer, while both TEM and SAXS data of as-spun fibers with 20% PI copolymer show a mixture of spheres and cylinders. We note that these domain structures in fibers are not as well developed as those in films. This is possibly due to the short residence time involved in the electrospinning process. The TEM and SAXS studies show more uniform domain structures in the fibers after the annealing process.

Finally, the effect of the elongational deformation on physically confined assembly of PS-b-PI copolymers during electrospinning has been investigated. A coaxial electrospinning scheme which consists of a PS-b-PI copolymer and silica precursor as core and skin layer, respectively offers a unique opportunity to study the effect of elongational deformation on the formation of domain structures under in situ confinement of a submicron level by the silica skin layer. The TEM and SAXS studies of confined assembly of PS-b-PI copolymer nanofibers in silica reveal the development of unique domain structures. The effect of annealing on these confined assembly is also presented.