EFFECT OF ELONGATION AND SHEAR ON THE STRUCTURE OF BLOCK COPOLYMER NANOCOMPOSITES EXHIBITING VARIOUS MORPHOLOGIES IN THE ORDERED STATE

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Block copolymers nanocomposites are materials which may exhibit a rich variety of microstructures, depending on the molecular structure of the copolymer and on the nature and shape of the nanoparticles. When in the ordered state, the blocks are usually arranged in lamellar, cylindrical or spherical nanometer-sized domains. The addition of nanoparticles, such as organoclays, may stabilize or alter the copolymer morphology. The rheological properties of such materials are very sensitive to the morphology and to the shape and degree of dispersion of the nanoparticles. When subjected to shear, and especially extension, some domains and particles usually align with the flow, producing highly anisotropic samples. The rheological properties of such aligned materials will also be anisotropic. The interactions between the nanoparticles and the copolymers either may help or inhibit the alignment of block domains, and they may also affect the kinetics of order-order transformations.

In this work, nanocomposites of styrene-ethylene/butylene-styrene (SEBS) triblock copolymers were prepared using different techniques. The copolymers studied primarily have cylindrical morphology, but exhibit order-order transition (OOT) above certain temperatures, forming spherical domains. And when prepared via solution, they may form a lamellar structure. The influence of clay nanoparticles on the rheological properties of each of these morphologies, on the kinetics of transformation and on the microstructural alignment of the samples was evaluated. Shear and elongational tests were carried out in the linear and non linear viscoelastic regimes. Some samples were tested in two perpendicular directions in order to evaluate their anisotropy. The structures were then studied by small angle x-ray scattering and transmission electron microscopy. It was possible to observe that it is easier to align the lamellar structure than the cylindrical, for most systems studied. The structural alignment in extension is very sensitive to the extension rate, and the degree of nanoparticles dispersion also plays an important role in most phenomena studied.