NON-EQUILIBRIUM MORPHOLOGIES OF ELECTROSPUN AMPHIPHILIC COPOLYMERS

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ABSTRACT

The synthesis of poly(ethylene oxide)-*block*-polyacrylonitrile diblock copolymers was conducted by single-electron transfer living radical polymerization. PEO-Br macroinitiators with different chain lengths (1000, 2000, 5000 g/mol) were obtained by the esterification of poly(ethylene glycol) methyl ether with 2-bromoisobutyryl bromide. Fourier transform infrared spectroscopy and nuclear magnetic resonance studies confirmed the composition of PEO-Br macroinitiator and related diblock copolymers. Results obtained by size exclusion chromatography showed that diblock copolymers with high molar mass and relative good control were achieved. Electrospinning is a technique that allows the production of nanofibers through an electrically charged polymer solution or melt. Although the setup for electrospinning is simple, the process itself is a complex interplay between factors such as the electrical charges, surface tension, solvent evaporation, solidification, stretching and rheology. The structure of polymer fibers is controlled simultaneously by the combined effects of solvent evaporation and stretching of the jet and polymer molecules. The process is very rapid, with fibers reaching the collector in about 0.1s. Such fast fiber formation leads to non-equilibrium morphologies and in the case of crystallisable polymers, the crystal structures are imperfect and small. By manipulating the factors that influence the process, it is possible to control the morphology of the fibers. In this study solution electrospinning was performed to produce nanofibers from the synthesized diblock copolymers.

By means of thermal analysis we will study the following phenomena:

1) the confinement effect induced by the nanometric size of the nanofibers;
2) the presence of stresses and chain alignment due to the electrospinning procedure;
3) the crystallization kinetics on nanofibers, which will be compared to the wide angle x-ray diffraction and calorimetric measurements;
4) the influence of the crystalline phase on the amorphous phase dynamics by comparing amorphous and semi-crystalline complex systems.