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ELECTROSPINNING OF NANOFIBERS FROM MULTI-PHASE AMPHIPHILIC COPOLYMERS CONTAINING HIGHLY EXFOLIATED GRAPHENE NANOPLATELETS

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ABSTRACT

Multi-phase amphiphilic copolymers of poly(dimethylsiloxane)-block-poly(methylmethacrylate) (PDMS-b-PMMA) were synthesized and the solution electrospinning of these materials containing graphene was investigated. Copolymers with well-defined structures and different PDMS content were obtained by atom transfer radical polymerization (ATRP) using bromine end-capped PDMS (PDMS-Br) as the macroinitiator. The synthesized block copolymers were successfully electrospun into nanofibers using dimethylformamide /chloroform mixture (60:40 vol%) as electrospinning solution medium. Graphene oxide (GO) of different loading was then added to the copolymer solution and the resultant nanocomposites were also electrospun into nanofibers. Transmission electron microscopy (TEM) and scanning electron microscopy (SEM) showed the successful formation of the electrospun fibers obtained from the PDMS-b-PMMA amphiphilic copolymers and their graphene-based nanocomposites with dimensions in the nanometer range. Excellent dispersion of the GO nanosheets within the obtained electrospun fibers was achieved. At relatively high GO content the fibers showed mainly intercalated morphologies. In contrast, when PDMS-b-PMMA containing longer PDMS blocks were used (5000 and 10000 g/mol), the PDMS-b-PMMA/GO nanocomposites resulted in fibers with fully exfoliated structures, irrespective of the GO filler loading. Examination of the nanocomposite fibers by TEM proved the formation of an exfoliated morphology.

Keywords: Electrospinning, polymer nanofibers, block copolymers, graphene.