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Enhancing mechanical properties of polyelectrolyte complex nanofibers with graphene oxide nanofillers pretreated by polycation

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Abstract

The wide application of polyelectrolyte complex (PEC) nanofibers has been restrained by their unsatisfactory mechanical properties due to high porosity. In this study, we proposed a strategy for improving the mechanical properties of PEC nanofibers using graphene oxide (GO) fillers pretreated by polycation. Chitosan/gelatin (CS/GE) was adopted as the PEC model system. Through the proposed preparation procedure, GO/CS/GE nanofibers can be obtained successfully by electrospinning. Fourier transform infrared spectroscopy (FITR) and differential scanning calorimetry (DSC) results revealed the strong interactions between GO and PEC matrix, which resulted from the synergistic effect of electrostatic attraction and hydrogen bonding. The effective dispersion of GO in CS/GE matrix was verified through TEM and XRD analysis. As demonstrated by the results of tensile testing, mechanical properties of CS/GE can be effectively enhanced with the addition of GO fillers. At 1.5 wt% filler content, GO/CS/GE nanofiber membranes achieved 358% augment of tensile strength, 175% improvement of Young's modulus and 460% boost of toughness compared with neat CS/GE, which were attributed to effective filler-matrix interactions and good dispersion of fillers. Therefore, the inclusion of GO fillers into PEC through the procedure proposed in this study is a promising strategy for mechanical enhancement of PEC nanofibers.

Keywords:

A. Fibres; A. Nano composites; B. Mechanical properties; C. Stress transfer; E. Electro-spinning

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