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Electrospun Silk-Cellulose Composite Nanomaterials using Ionic Liquid Regenerated Films

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Abstract: Electrospinning is a widely used technique to draw recalcitrant biopolymer solutions into micro to nanoscale materials in a simple and economical way. The first focus of this research involved using ionic liquids as a non-volatile solvent for natural insoluble biopolymers such as silk and cellulose (or cellulose derivatives). Compared to traditional organic solvents, ionic liquids can dissolve the biopolymers without altering the molecular weight of the biopolymer. The second focus of this research explored the dissolution of IL-regenerated composites into organic solvents and directly electrospun to produce composite nanomaterials. Various ratios of silk-cellulose bio-composite films regenerated from ionic liquids were used as the raw materials and sequentially dissolved/dispersed into Formic Acid-$CaCl_2$ solution in order to initiate electrospinning of silk-cellulose nanomaterials. In this study, 1-ethyl-3-methylimidizolium acetate (EMIMAc) ionic liquid was used and the regenerated films were coagulated in baths of EtOH or water. Because of the variability of ionic liquids, the nanomaterials produced using this technique have unique and tunable properties such as large surface area to volume ratios and low structural defects. FTIR and SEM results suggest that the structure and morphology of the final nanosized samples becomes more globular when the biopolymer composition ratio has increased cellulose content. TGA results demonstrated that the electrospun materials have better thermal stability than the original films. This two-step electrospinning method, using ionic liquid as a non-volatile solvent to first dissolve and mix raw natural materials, may lead to extensive research into its biomedical and pharmaceutical applications in the future.

Keywords: Ionic Liquids; Electrospinning; Silk; Cellulose; Biomaterials

3.2. Figures, Tables and Schemes

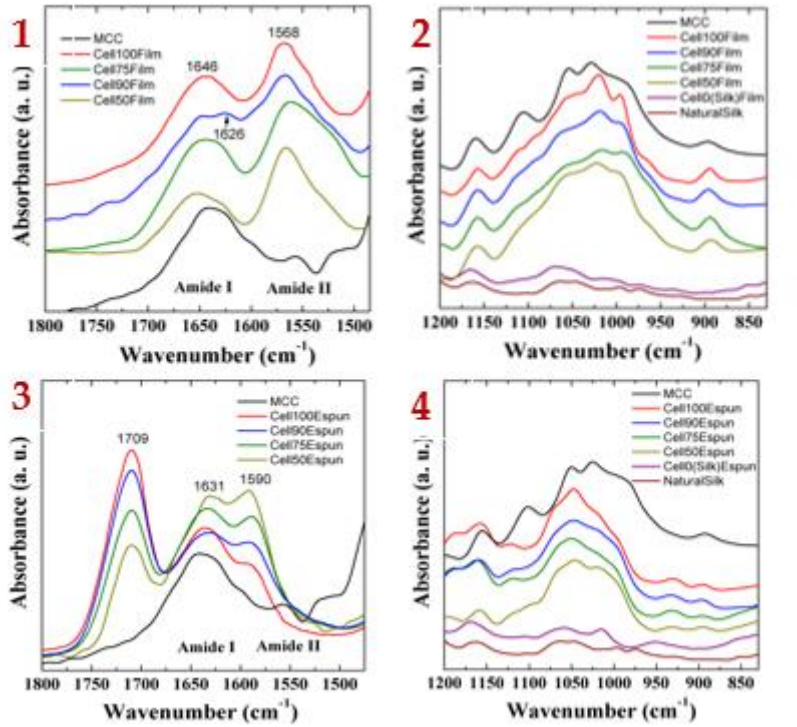

Figure 1. FTIR spectra comparing EMIMAc generated films and their electrospun nanomaterials in the regions of 1500-1800 cm^{-1} and 800-1200 cm^{-1}.

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