ELECTROSPINNING OF CELLULOSE USING NON-VOLATILE AND NON-FLAMMABLE SOLVENTS: IONIC LIQUIDS

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Abstract: Electrospinning is an expedite method used to prepare nanosized fibers driven by an external electric force applied on the surface of polymer solutions (or melts). Cellulose electrospun fibers have great potential in distinct applications, such as membranes, biosensors, electronic and optical devices, as well as enzymatic and catalytic supports. Nevertheless, the intrinsic lack of solubility of native cellulose in water and most organic solvents, constitutes a major obstacle for its proficient utilization and electrospinning. Among new potential solvents for cellulosic biomaterials, ionic liquids (ILs) have been attracting considerable attention. The aim of this work is the production of nanosized cellulose fibers from electrospinning using non-volatile solvents, namely ionic liquids. From the large array of possible ILs, 1-ethyl-3-methylimidazolium acetate was selected as the main solvent. Electrospun cellulose fibers with an average diameter within (470 ± 110) nm were obtained. To further enhance the solvent thermophysical properties, aiming at reducing the surface tension, a second and surface active ionic liquid (1-decyl-3-methylimidazolium chloride) was used as an additive. From the binary mixture of ILs, improved electrospun cellulose fibers with an average diameter of (120 ± 55) nm were attained. Electrospun cellulose fibers were analyzed by SEM (scan electron microscopy), X-ray Diffraction Spectroscopy, FTIR (Fourier Transform Infra-Red Spectroscopy) and TGA (Thermogravimetric analysis) to evaluate their structural integrity, morphology and crystallinity. Raw cellulose used for electrospinning was found to be of Type-I polymorph. After the cellulose dissolution in the ILs, and subsequent regeneration, cellulose fibers are highly amorphous with the remaining crystalline parts being polymorphs of Type-II. The thermal stabilities of electrospun fibers are only slightly lower than that of raw cellulose. Finally, the photoluminescence spectra of both raw and electrospun cellulose fibers were acquired and compared indicating that the cellulose emitting centers are not affected by the dissolution of the polymer in ionic liquids [1].

References:

1. M. G. Freire, A. R. R. Teles, R. A. S. Ferreira, L. D. Carlos, J. A. Lopes-da-Silva, J. A. P. Coutinho, Electrospun nanosized cellulose fibers using ionic liquids at room temperature, *Green Chem.* 13 (2011) 3173-3180.