Electrospinning of Biopolymers: Applications

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Looking genuinely at nature, nanofibers often serve as a basic platform where either organic or inorganic components are built upon. For instance, cellulose nanofibers would represent the building block in plants while collagen nanofibers in the animal body. The fiber structure exhibits, from a structural point of view, the certain ability to transmit forces along its length and, thus, reducing the amount of materials required. While strong enough for their designed purpose, nanofibers have the added advantage of giving high porosity to the natural supports which allows faster diffusion of chemicals to the inner structure. To follow this extraordinary nature's design, a process that is able to fabricate fiber nanostructures from a variety of materials and mixtures is an indispensable pre-requisite. Control of the nanofibers arrangement is also necessary to optimize such structural requirements.

Electrospinning is a physical process used for the formation of ultrathin fibers by subjecting a polymer solution to high electric fields. At a critical high voltage (5-25 kV), the polymer solution droplet at the tip of the needle distorts and forms a Taylor cone to be ejected as a charged polymer jet. This stretches and is accelerated by the electrical field towards a grounded and oppositely-charged collector. As the electrospun jet travels through the electrical field, the solvent completely evaporates while the entanglements of the polymer chains prevent it from breaking up. This results in the ultrathin polymer fibers deposition on a metallic collector to habitually assemble the fibers as non-woven mats.

Since the electrospinning is a continuous process, fibers when winded can be as long as several metres or even kilometres. The formed fibers are not only ultrathin and relatively large in length but also fully inter-connected to form a three-dimensional network.

The current paper will highlight some recent advances carried out within our research group in which various applications of the high voltage spinning processing technique making use of biopolymers and biopolymeric blends will be reviewed (1-10).

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