Some Aspects of Electrospinning Fundamentals & Nanofiber Applications

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ABSTRACT

Electrospinning is a promising technique to produce polymeric fibers with submicron diameters. Different fiber morphologies can be obtained by manipulating the solution properties and processing variables; the former include solution viscosity, conductivity, and surface tension, whereas the latter comprise applied voltage, solution flow rate and tip-to-collector distance.[1] Bead-free fibers are generally produced provided that a semi-dilute solution with entangled chain conformation is used. Solutions with a lower concentration yield fibers with a lower diameter. This phenomenon is associated with the different entanglement density developed in the electrospinning solution. To date, the quantitative relation between the fiber diameter (d_f) and chain entanglement density is not clear yet. In this work, several polymer solutions are investigated to reveal the impact of chain entanglement. A simple relation[2] is derived; $d_f = d_{f,e}(\phi/\phi_e)^{2.49}$, where ϕ and ϕ_e are the solution concentration and entanglement concentration, respectively, and $d_{f,e}$ is the diameter of fibers electrospun from the solution with a concentration of ϕ_e. In this presentation, some possible applications of nanofibers are also addressed, including (1) polymer nanocomposites, (2) solvent adsorption/desorption, and (3) drug release.

[1]. C. Wang, C. H. Hsu, J. H. Lin, Scaling laws in electrospinning of polystyrene solutions, *Macromolecules* **2006**, 39,7662-7672.
[2]. C. Wang, Y. Wang, T. Hashimoto, Impact of entanglement density on solution electrospinning: a phenomenological model for fiber diameter. *Macromolecules* **2016**, 49, 7985-7996.