Effect of Target Shapes on Distribution of Polyacrylonitrile Nanofibers Prepared by Electrospinning Process

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ABSTRACT

The influence of target shapes on the distribution of as-spun polyacrylonitrile nanofibers prepared by electrospinning process was investigated. Electrospun polyacrylonitrile fibers were obtained with different shapes of target and various distances between needle and target using high voltage DC generator rated 20 kV. Additionally, the effect of magnetic field on the distribution of resulting nanofibers was also examined. The results showed that the maximum of fiber accumulation was obtained at the lowest distance between needle and target. Moreover, it was found that the target shape provided no significant effect on the distribution of resulting fibers. However, the distribution of fibers varied when the target was induced by magnetic field.

Key words: Electrospinning, Electrospun polyacrylonitrile, Polymeric nanofibers, Electric field, Magnetic field

INTRODUCTION

Electrospinning is a simple technique for producing nanofibers of inorganic oxide materials and organic polymers. The principle behind electrospinning is relatively simple: A polymer solution flows out of the tip of the capillary where a droplet is formed under the effect of the surface tension of the solution. A sufficiently-high electric charge is applied to the solution which leads to repulsive electrostatic forces between polymer and solvent molecules to overcome the surface tension, and a jet of polymer shoots away from the capillary towards a grounded collector (or target). Finally, nanofibers were collected on the grounded collector as a randomly-oriented web (Xianyan et al., 2002; Cory et al., 2004; Seong et al., 2005; Veli et al., 2005). Because of the small pore size and high surface area inherent in electrospun textiles, these fibers exhibit promise for exploitation in filtration, soldier's protective clothing applications (Deitzel et al., 2001; Gibson et al., 2001). Other applications that are being explored include scaffolding for tissue growth, optical and electronic applications (Christopher et al., 1999; Ian et al., 2000; Dhamaraj et al., 2004; Min et al., 2004).

Many process variables, including the electric field, the viscosity of solution, the nozzle-to-collector distance and the solution flow rate can affect the electrospinning process (David, 2000; Myung et al., 2004; Bumsu et al., 2005). However, the area deposited with electrospun fibers is still quite large. The control of deposition area is useful for nanofiber applications. In this contribution, we investigate the effect of target shapes and external magnetic fields on the distribution of as-spun polyacrylonitrile nanofibers.