Behaviour of electrostatic forces and Deposition Area in Electrospinning

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Extensive works in recent times on electrospinning and electrospun nanofibers have demonstrated the excellent flexibility of electrospinning for producing nanofibers ranging from 2nm to several micrometers with controlled fiber morphology, dimension and component from various polymeric material [1, 2]. Electrospun nanofibers have broad applications in diverse areas such as tissue engineering scaffolds, release control, filtrations, reinforcement, protective clothing, sensors, catalysis, defense and security[3] and environmental engineering. In this paper, we have demonstrated that PAN nanofibers can be electrospun from the tip of spinning nozzle by applying electrostatic force either by using positive or negative polarity voltage supply or by connecting grounded polarity electrode to spinning nozzle and high voltage polarity to collector. For the same polymer solution concentration (10-wt% PAN),the critical voltage for the generation of polymer jets from the ($PPNG_P$) electrospinning setup was 5KV, and the critical voltage for producing polymer jets from the ($PPNG_G$) electrospinning setup was 7KV.

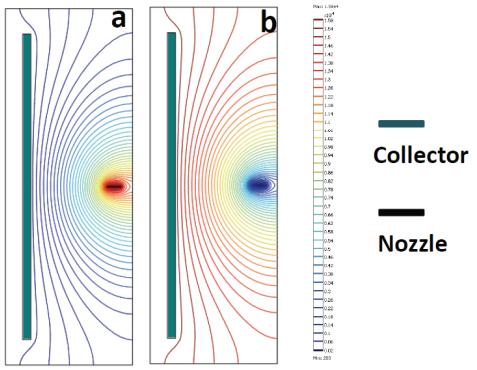

Figure 1. Shows the Electric field profile around needle and the collector **a)** in $PPNG_P$ electrospinning setup and **b)** in $PPNG_G$ electrospinning setup.

Under the same operating conditions, nanofibers generated from the conventional electrospinning setup were finner with a broader distribution than those produced by reverse polarity electrospinning setup. The fiber productivity increased linearly with increasing the applied voltage and solution concentration. However when the applied voltage is less than 16KV the productivity of reverse polarity electrospinning system is less than conventional electrospinning system.by analyzing the electric field around spinning nozzle , collector and in the electrospining zone, we observed that reverse polarity electrospinning system had a completley different electric field profile than the conventional electrospinning system. For the reverse polarity electrospinning system, the electric field lineswere mainly concentrated on the collector , whereas the conventional electrospinning system showed concentrated electric field lines at the spinning nozzle. The difference electric field concentration could be the main reason of producing thinner fibers, broader distbution with greator fiber deposition area from the conventional electrospinning setup, where as thicker fibers, narrow distribution with smaller fiber deposition area from reverse polarity electrospining system.

Refferences:

1 Ramakrishna, S., et al., *Electrospun nanofibers: Solving global issues.* Materials Today, 2006. **9**(3): p. 40-50.
2 Mit-Uppatham, C., M. Nithitanakul, and P. Supaphol. *Effects of solution concentration, emitting electrode polarity, solvent type, and salt addition on electrospun polyamide-6 fibers: A preliminary report.* in *Macromolecular Symposia.* 2004.

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