

THE EFFECTS OF FLOW RATE AND THE DISTANCE BETWEEN THE NOZZLE AND THE TARGET ON THE OPERATING CONDITIONS OF ELECTROSPINNING

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ABSTRACT:

The behavior of the charged jet during electrospinning is affected by the interaction between electrostatic force, surface tension and viscoelastic force. This paper investigates the effects of flow rate (Q) and the distance (Z) between the nozzle and the target on the behavior of a polyethylene oxide (PEO) solution jet. It was found that the priority of Z and Q is higher than the voltage. Based on the high-speed photographs of the jet and the numerical simulation of the electric field distribution, the minimum required electric field strength (E) at the nozzle for continuous electrospinning is affected not only by the surface tension and viscoelastic force, but also by Q while other parameters including solution properties, processing conditions and ambient conditions are fixed. The minimum required E was little affected by Z in a large range from 20 cm to 35 cm. The required electric field to maintain steady spinning at short distance Z is greatly affected by evaporation and the required electric field is influenced by Q at a large distance Z . The electric field nonuniformity coefficient and the mean electric field strength (E_{av}) are found to be used to characterize the bending frequency. Our results indicate that the high bending frequency favors the formation of small fibers, whereas the jet path length has relative smaller effect on the fiber diameter. The results also demonstrate that the limited fiber diameter does not necessary occur at the lowest flow rate but is also affected by the electrical force per unit mass and evaporation.

Key words: electrospinning; PEO; electric field distribution; electric field nonuniformity coefficient