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Abstract

Abstract: The electric field and temperature are the two important factors that influence the fiber diameters and properties in the melt electrospinning process. It is commonly known that the polymer jet behavior is governed by the electric field within spinning area. In the present work, the 3D electric fields were simulated by COMSOL Multiphysics，a comprehensively designed and properly-conducted analysis was carried out to investigate the effects of the electric field on the jet behavior, the diameter, the crystal structures, and mechanical properties of the resultant fibers. An auxiliary electrode was invited to enhance the electric field strength. The high-speed photography was adopted to capture the jet motion, and also, the numerical simulation was used to understand the electric field distribution. By making use of the whipping amplitude and whipping frequency, the characteristics of jet behavior were described. It was found that by applying an auxiliary electrode, the average fiber diameter reduced from 61.01 μm to 9.06 μm, and the crystallinity and strength of the fiber was improved with the help of the higher electric filed intensity. In addition, the more uniform electric field would produce finer and more uniform fiber because of the more stable jet motion.

Figures used in the abstract

Figure 3: Comparison between electric field distributions of melt electrospinning setups with and without an auxiliary electrode: (a) (c) center plane along z-axis and xy-plane at z = 50 mm of melt electrospinning setup without an auxiliary electrode, (b)(d) center plane along z-axis and xy-plane at z = 50 mm of melt electrospinning setup with an auxiliary electrode, and (e) comparation of the electric field intensity from the spinneret to the collector along z-axis in the melt electrospinning system with and without an auxiliary electrode.