Surface Morphologies of Electrospun Fibers Induced by Electric Field

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Introduction

The electric field plays a key role in the formation of fibers during electrospinning process. The electric field strength and shape caused by the applied voltage between the spinneret and collector governs the electrospinning process.

In this study, a comprehensively-designed and correctly-implemented analysis was carried out to investigate the effects of electric field on jet behavior and fiber morphology. Both working distance and applied voltage, respectively, were adjusted to manipulate the electric field shape and strength. The three-dimensional electric fields were simulated to understand the electric field distribution.

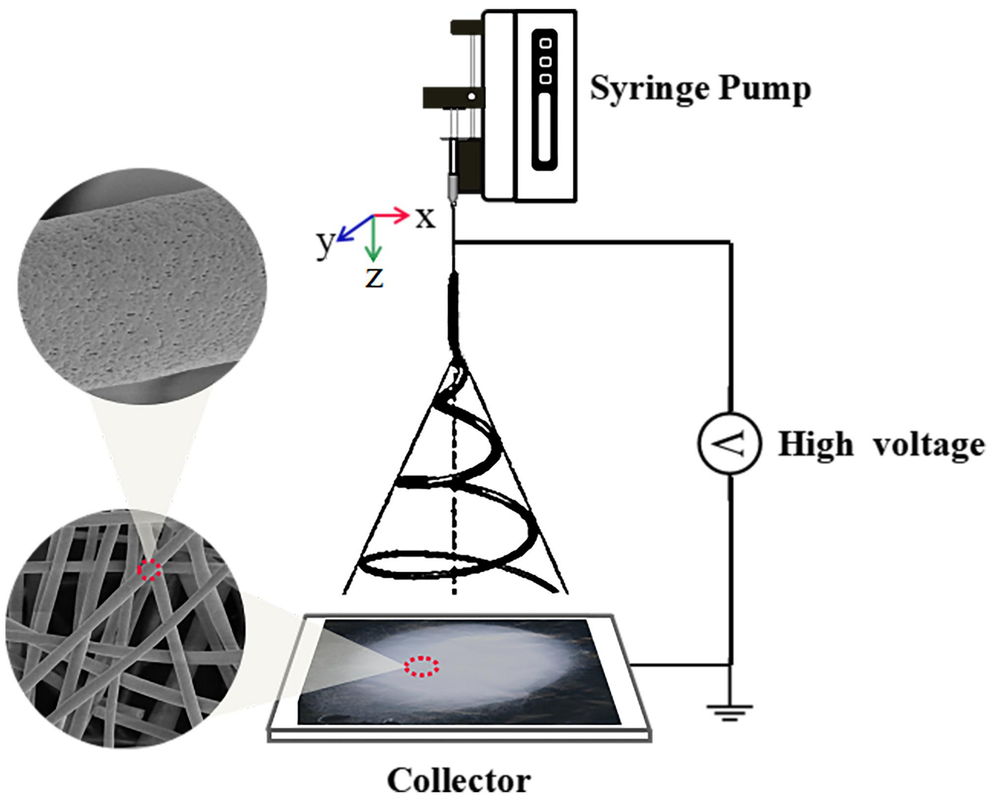

Figure 1. Schematics of experimental setups

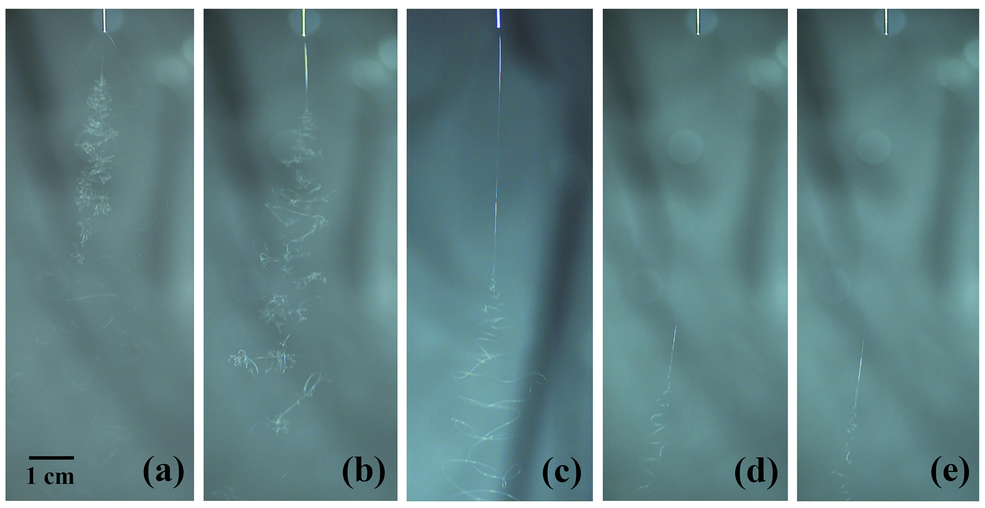

Figure 2. Jet trajectories captured by high-speed photography

Results

The directions of the electric fields with different working distances were different, a shorter working distance creates a more deflected electric field near the spinneret. With the increasing of working distance, the electric field distribution in the central area of the spinneret becomes more uniform, and the electric field intensity decreases with working distance increasing.

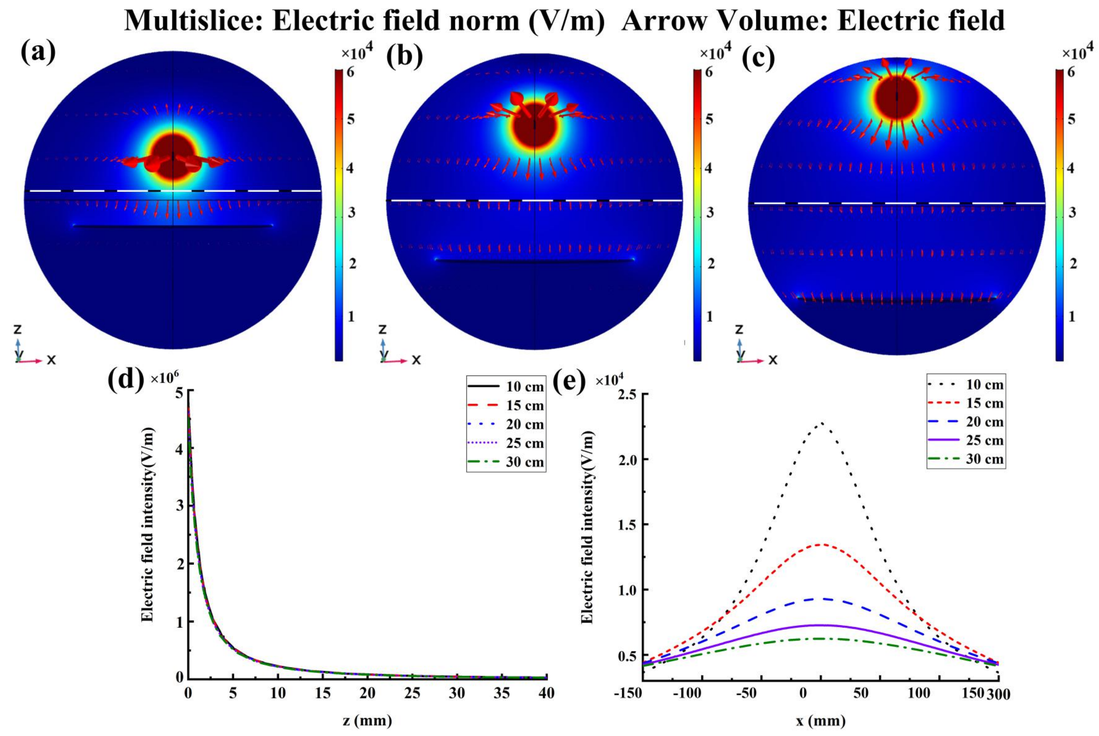

Figure 3. (a-b) Calculated electric field distribution in x-z plane at different working distances: (a) 100 mm, (b) 200 mm, (c) 300 mm; (d-e) Electric field intensities with different working distances: (d) electric field intensity along z-axis, (e) electric field intensity at the centerline along x-axis

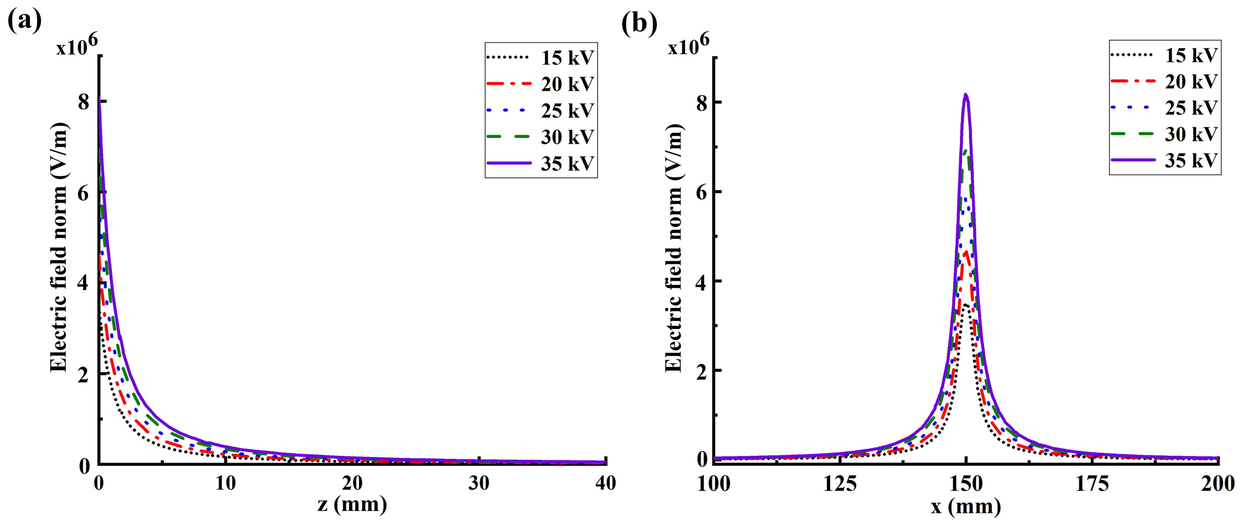

Figure 4. Electric field intensities with different applied voltages: (a) electric field intensity along z-axis and (b) electric field intensity at z = 0 along x-axis.

Conclusions: This work describes investigations on the effects of electric field on jet behavior and resultant fiber morphology during the electrospinning process, using both experimental and simulation methods. The simulation results show that varying the working distance and applied voltage will change the electric field shape and strength, respectively.

References: Maghsoodlou S, Noroozi B, and Haghi AK. A Simple Model for Solvent Evaporation in Electrospinning Process. **Nano** 2016; 12: 1-12.