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A Novel Air-Flow Electrospinning Setup for Controlling Fiber Distribution and Morphology

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Abstract. Electrospinning (ES) is a vital technique for producing ultrafine polymer fibers, and it is widely used in various applications. However, conventional electrospinning setups with some polymer solutions face challenges like bead formation and inconsistent fiber diameters. Integrating airflow into the system helps stretch the fiber and speed up the evaporation of polymer jets, thereby improving fiber morphology. Despite these benefits, incorporating airflow complicates the setup and makes it less user-friendly, as achieving precise laminar airflow toward the jets is difficult. To address these problems, we developed a novel electrospinning attachment featuring easily adjustable slits incorporating controlled airflow with a pressure regulation system as shown in **Fig. 1**. The design allows for convenient adjustment of airflow direction through replaceable slits and blades. Its simplicity allows for easy blade replacement at different angles to control airflow toward the polymer jet. In our experiments, we tested two different slits angles of 30° and 60° (3D printed using FDM technology) to the setup. The results showed that controlled airflow significantly reduced bead formation and produced more uniform fiber diameters. With a 60° slit angle at 0.1 bar, the average fiber diameter was 647.6 nm, decreasing to 526.4 nm at 0.2 bar. Conversely, fibers spun with a 30° slit angle had an average diameter of 712.55 nm at 0.1 bar, with minimal change at 0.2 bar. These findings indicate that controlled laminar airflow with adjustable slit angles substantially improves the properties of electrospun fiber mats.

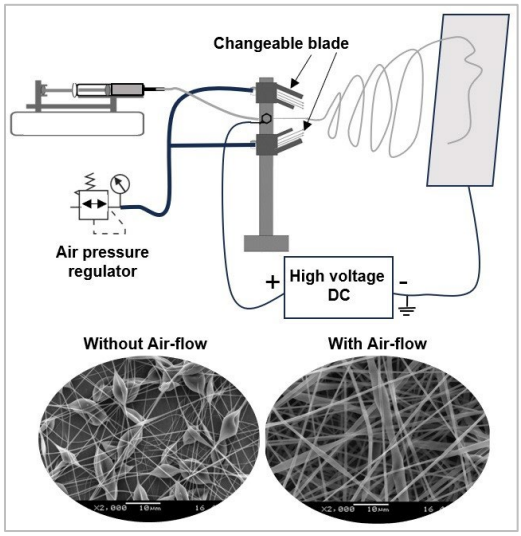

Fig. 1. Schematic drawing of air-flow electrospinning setup and the fibers obtained.

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