Fabrication of PLA-ZnO Nano filters: The Role of the Electrospinning Method in Defining Material Properties

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Abstract:

The selection of a fabrication strategy is critical in engineering the properties of advanced composite materials. This study investigates the development of antimicrobial air filters from polylactic acid (PLA) and zinc oxide (ZnO) nanoparticles, comparing the influence of two distinct electrospinning methods: single-needle and coaxial.

The resulting nanofibers were characterized using scanning electron microscopy (SEM), micro-RAMAN and Fourier transform infrared spectroscopy (FTIR) to investigate their morphologies and chemical compositions. This characterization confirmed that each technique resulted in a distinct material architecture, with differences observed in the final spatial arrangement of the polymer and nanoparticle components.

The resulting materials demonstrated high-performance functionality, including particulate filtration efficiencies exceeding 90% for aerosols (0.3 to 10 µm) and significant antimicrobial activity against both *E. coli and S. aureus*. This work establishes that the electrospinning method directly influences the final material architecture, which in turn dictates its functional performance, highlighting the importance of process selection in material design.