Enhancing Mechanical Strength of Nanofiber Mats by Coaxial Electrospinning and Thermal Treatment

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ABSTRACT
Electrospun nanofibers find many engineering applications because of their porous structure, high specific surface area, and relative ease of manufacture. However, the applications of nanofiber-based engineering products are limited by their low mechanical strength. Current technologies to improve the mechanical strength often result in structural deformations, e.g., shrinkage. This work aims to improve the mechanical strength of nanofiber mats aimed by coaxial electrospinning and thermal treatment. Homogenous PVDF-HFP nanofibers prepared by electrospinning were heated at 178 ºC for 5 to 30 minutes. The thermal treatment increased the tensile strength of the nanofiber mats by 50% or greater. In addition, the porosity and electrolyte uptake of the heat-treated samples remained stable, indicating a minimal impact on the structure of the nanofiber mats prior to the onset of sudden severe shrinkage at 180 ºC. Nonetheless, the thicknesses of the mats varied with treatment time. The mechanical strength will be further improved by coaxial electrospinning, with PAN core and PVDF-HFP sheath, followed by thermal treatment. The corresponding effectiveness will be reported in terms of mechanical strength, physical deformation, and scalability of the heat treatment process.