ELECTROSPUN METAL-BASED NANOFIBERS AND PARAMETER STUDY OF THE ELECTROSPINNING PROCESS

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Ceramic nanofibers find great interest in filtration technology. Especially the potential use in aggressive atmospheres or for catalytic purposes is ideal for ceramic nanofibers. In order to be able to produce ceramic nanofibers reliably, it is necessary to understand the electrospinning parameters and whether they are comparable to known findings with pure polymer fibers. Reported in this study is the he impact of electric field strength, needle diameter, feed rate, and solid concentration on the mean nanofiber size of the polymer pre-stage and calcined metal oxide fibers. Metal nanofibrous filter samples made of ceria and alumina oxides were produced in the laboratory. The produced metal oxide samples were prepared by diluting a 2:1 (w:w) of polyvinylpyrrolidon and a nitrate salt of the desired metal oxide in a solution of ethanol and water (concentration 10 wt.% to 16 wt.%). The electrospinning voltage ranged from 15-20 kV. The feeding rate was from 0.3 to 0.5 mL/hr and the used needle diameters ranged from gauge 20 (0.603 mm ID) to 18 (0.838) with a constant needle-to-collector distance of 15 cm. After 10 minutes of electrospinning, the samples were calcined for 10 hours at 100-550 °C. The samples were characterized using FE-SEM imaging. Results were analyzed following a 2k factorial design plan. The produced mean nanofiber diameters ranged from 227 nm for calcined alumina to 2197 nm for polymer containing ceria. It could be concluded that the concentration of solids had the greatest effect on the fiber size, while the needle diameter and its interactions with other parameters could be neglected.