FABRICATION, MORPHOLOGY, AND STRUCTURE OF ELECTROSPUN PAN-BASED CARBON NANOFIBERS

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ABSTRACT

This study reports the fabrication, morphology and structure of carbon nanofibers prepared by electrospinning a precursor of polyacrylonitrile (PAN)/dimethyl formamide (DMF), followed by carbonization of the electrospun nanofibers. Effects of PAN concentration (4-12 wt.%) and applied voltage (5-15 kV) on the morphology and distribution of the as-spun nanofibers diameter were investigated. Fibers with diameter ranging from 100 nm to 1600 nm were obtained depending on the electrospinning condition. The diameters of the as-spun nanofibers increased with increasing the solution concentration. On the other hand, the diameters of the fibers decreased with increasing applied voltage. The optimal parameters for obtaining the PAN-nanofibers with narrow size distribution of 481 ± 101 nm and without beads formation along the fibers were revealed. These good nanofibers were subjected to carbonization in either argon or nitrogen atmosphere at 1000 °C for 2 h. Carbonization in nitrogen and argon resulted in the nanofibers of 249 ± 37 nm and 225 ± 31 nm in diameter with 97.2 % and 95.9 % in purity, respectively, but the thermal-resistant ability was not much different. The D and G peaks from Raman scattering were analyzed using Gaussian-Lorentzian curve-fitting, and the graphitic crytallite domain

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size (L_a) was estimated from the ratio of the integrated intensity of D and G peaks. The domain size of the graphite layers was 2.87 ± 0.31 nm and 3.02 ± 0.79 nm for the nanofibers carbonized under nitrogen and argon atmosphere, respectively.

Keywords: Electrospinning, Polyacrylonitrile (PAN), Carbon nanofibers; Scanning electron microscopy; Thermogravimetric-differential thermal analysis; Raman spectroscopy