

Structural and Oxidation Resistance Enhancement of Carbon Nano-Fibers by Silicon Nano-Particles Incorporation

Silicon nanoparticles role in improving of oxidation and structural properties of carbon nano-fibers was examined. The carbon to silicon ratios were controlled by managing the initial Si to Polyacrylonitrile (PAN) percentages. The structural, morphological, and thermal properties were characterized using X-Ray diffraction and Raman spectroscopy, Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), and thermogravimetric analysis (TGA). After sufficient heat treatment, the silicon nanoparticles combine with carbon to form carbon-silicon carbide nanofiber which showed around twice oxidation resistance over the carbon nanofibers alone. Furthermore, TEM proved that SiC has a major contribution in ordering of carbon structure. The determination of SiC crystal size was carried out using X-ray results obtained at different temperatures and holding times. The SiC grain growth was predicted using kinetic models and its exponent was found to be around $n = 4$ with an activation energy around 35 KJ/mol.K. For such growth, the dominant grain growth mechanism was grain boundary diffusion.