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Structural and electrical studies on carbon-silica nanocomposites elaborated by sol-gel method

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Abstract:

The general class of organic/inorganic nanocomposites materials is a fast growing area of research. Their electrical properties can be engineered by tuning the fabrication method, processing conditions and filler's geometric and physical properties. In this work, carbon-silica nanocomposites were elaborated by sol-gel technique. Silica aerogel nanoparticles are first prepared in supercritical conditions of the solvent after dissolving tetraethoxysilane (TEOS) as a precursor of silica in ethanol. SiO_2 nanoparticles were then mixed with resorcinol-formaldehyde (RF) carbon precursor solution with several concentrations ranging between 0.20 and 0.99. The samples were dried by increasing temperature from ambient to 150 °C by step of 10 °C/day and then pyrolysed under controlled argon atmosphere at different temperatures between 600 and 1500 °C. The TEM image of nanocomposite with 50% of RF concentration and pyrolized at 675 °C (RF-SiO_2-0.5-675) shows that the sample was mainly composed of homogenous spherical nanoparticles with 14 to 20 nm in diameter while for RF-SiO_2-0.5-1300 the nanoparticles were found to have various shapes and were more agglomerated. The XRD investigations carried out on samples pyrolyzed at 675 °C outline that the materials have an amorphous structure for all RF concentrations. The V-I characteristics for RF-SiO_2-0.5-675 sample exhibit a non linear behavior for all measurement temperatures ranging between 80 and 300 K. Furthermore, the ac-conductivity measurements show that samples have a semiconductor behavior.