ELECTRO-STRUCTURAL PHENOMENA IN IMMERSED CARBON NANOTUBE FIBRES

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Abstract

Carbon nanotube (CNT) fibres spun directly from a floating-catalyst CVD reactor consist of porous networks of nanotube bundles with specific surface areas around 100 m2/g. When compared with conventional carbon fibres, the considerably high accessible surfaces result in an increased level of interaction with the surrounding medium. A better understanding of these interactions could lead to the successful application of these fibres in high-performance composites, smart textiles, sensors and actuators, and/or energy storage and transmission. The poster summarizes our most recent findings regarding the interactions of CNT fibres with organic liquids. We rely on small-angle x-ray scattering, DC resistivity, impedance spectroscopy, rheology, and contact angle measurements to describe reversible changes in the connectivity of the network of nanotube bundles and how these structural changes affect the electrical properties of the fibres. When the fibres are immersed in organic liquids, for which the energetic cost of making more surface is lower than in air, stressed interbundle junctions spring open to release elastic energy causing an increase in resistance. The fibres recover their original resistances when dried. In polar liquids, the field resulting from the accumulation of electric charge in open interbundle junctions causes them to close as the probe current in a four-point electric circuit is increased; this causes a non-ohmic behaviour in which the resistivity of the fibres is modulated by the applied field. These phenomena are independent from any property exclusive to CNTs and we suspect they may also occur in other hierarchically-structured materials.

Keywords: Carbon nanotubes, fibres, electro-structural phenomena, smart textiles

Author did not supply full text of the paper/poster.