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MAR03 -7.9.6. Carbon Nanotubes and Related Nanomaterials

Imaging and Electrical Characterization of Nanotube Networks in SWNT/Polymer Composites

S. Jesse, M. A. Guillorn, D. W. Austin, I. N. Ivanov, A. A. Puretzky, S. Viswanathan, P. F. Britt, and D. B. Geohegan

In addition to enhanced mechanical properties, interconnected networks of carbon nanotubes are envisioned to provide directional thermal and electrical conductivity paths within multifunctional polymer composites. Their sensitivity to the surrounding polymer matrix and environment are envisioned as the basis for novel electronic devices as well as chemical, biological and photonic sensor arrays. Advancement in these areas requires fundamental understanding of the conduction within nanotube bundles and their junctions which form the composite network. To this end, we have investigated the current-voltage response of 100 nm - 800 nm thick SWNT/PMMA composite films using arrays of lithographically patterned electrodes of various geometries. SEM and AFM images of the composite/electrode configuration revealed the structure of the conductive network within the polymer matrix. Voltage contrast and EBIC (electron beam induced current) scanning electron microscopy are used to map paths of current flow through the composite. In addition, potential maps of charged composites are generated using atomic force microscopy. Image analysis of microscopy data was used to determine the number of connections, the distances between connections, and the connectivity of the network. Correlation of network geometry, current-voltage response, and node-voltage analysis was used to estimate the average resistivity of nanotube bundles and their interconnections. The nature and cause of non-ohmic responses measured in the composites of various nanotube weight loadings will be discussed.

Presenting (and contact) author:
Stephen Jesse
MS-6056, Bldg. 3150, ORNL
P.O. Box 2008
Oak Ridge, TN 37831-6056
Phone: 865-576-5097
FAX: 865-576-3676
Email: sjesse@utk.edu