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Finite size effects in nanocomposite thin films, fibers, and mats
L.I. CLARKE, D.R. STEVENS, E.W. SKAU, L.N. DOWNEN, T.J. HOFFMAN, Dept. of Physics, NC State University, Raleigh, NC — Composites consist of particles embedded within a supporting matrix. The matrix properties are enhanced by formation of a network of particles which spans the material and imparts some quality of the particle to the composite, even at relatively low doping levels. Such percolation processes have been extensively studied, with a particular focus on the role of particle size and shape on network formation. However, with modern fabrication techniques, composites can now be formed where the sample size is similar to that of the particle. In this case, finite size effects may become experimentally important. We present experimental and 3-D continuum Monte Carlo simulation studies of finite size effects in nanofibers (individually or in random mats) and thin films. We find that when any dimension of the sample is less than 10-20 times the largest dimension of the particle, finite-size effects may occur. This result is particularly important when the particle has a large aspect ratio (e.g., carbon nanotubes) and thus a long length, comparable with sample size.

Laura Clarke
Dept. of Physics, NC State University, Raleigh, NC

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