Dispersion-State and Particle-Aspect-Ratio Effects on the Thermal Conductivity of Multi-Wall Carbon Nanotube Suspensions

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The thermal conductivity of aqueous suspensions of multi-wall carbon nanotubes is experimentally studied for varying particle loadings, surfactant concentrations, and particle dispersion states, and compared with the predictions of an effective-medium theory. To carry out a detailed comparison with theoretical predictions, particle-aspect-ratio distributions are measured. It is shown that the measured conductivities are largely consistent with effective-medium theory with a reasonable choice of Kapitza resistance and particle aspect ratio. The nanotube dispersion state was altered by introducing ethanol to the suspension, which promotes rapid bundling by causing the surfactant to desorb from the nanotubes. Measurements of the thermal conductivity are coupled to optical absorption measurements to show the strong effect of the nanotube dispersion state on the suspension's conductivity.