Abstract Submitted
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Modeling Optical Properties of Carbon Nanotube Forests by Waveguides B.D. WOOD, T.C. SHEN, Utah State University, J.S. DYER, V.A. THURGOOD, Space Dynamics Lab, N.A. TOMLIN, J.H. LEHMAN, National Institute of Standards and Technology — Carbon Nanotube (CNT) Forests are vertically grown carbon nanotubes. They have been reported to be the blackest man-made materials- desirable not only for optical calibration but also for energy conversion, antireflection, and radiometry. Effective medium theory (EMT) has been proposed to explain the behavior of optical transmission and reflection in the mid-IR region. However, by varying CNT density and forest height, we find EMT either cannot fit the transmittance spectra or can fit a single spectrum with a large fill factor and alignment uncertainty. Further, the near unity index of refraction generated by EMT cannot fit the observed interference pattern of reflectance. Here we demonstrate that the optical transmission and reflection of the CNT forests can be modeled by cylindrical waveguides. Using the dielectric functions and a reduced conductivity of graphite, we find that all transmittance curves fit this model. CNT density can be correlated to the effective radius of the waveguide which provides a length scale dictating the onset of reflection from CNT forests, an important factor for applications. Transmittance and reflectance data from CNT forests grown on Al and Nb coated Si substrates will be discussed.

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