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Monte Carlo simulations of the effect of nanotube length distribution on the percolation resistivity in single-walled carbon nanotube films JEREMY HICKS, ASHKAN BEHNAM, ANT URAL, University of Florida

— Employing Monte Carlo simulations, we generate and calculate the resistivity of multilayer films made up of single-walled carbon nanotubes with various nanotube length distributions. Each layer in the film acts as a charge-percolating 2D mesh with contacts to adjacent layers. First, we study the case when the tube-tube contact resistance dominates the resistivity. For randomly oriented nanotubes, we find that, the resistivity of the film, as well as its overall percolation probability correlate strongly with the root mean square (RMS) length of the nanotubes near the percolation threshold regardless of distribution. As the nanotubes in the film become increasingly aligned, the resistivity correlation shifts to higher order in length. On the other hand, if the nanotube resistance dominates the resistivity, the resistivity of the film correlates strongly with the average nanotube length. These results, which can be explained by physical and geometrical arguments, show how individual nanotube parameters contribute to the macroscopic characteristics of the film. They also show that computational studies are an essential tool for providing insight into the percolation transport in single-walled carbon nanotube films.

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