Factors that Influence Electrical Conductivity of Carbon Nanotube (CNT) Composites at Extremely Low Loading Values

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Abstract

The addition of conductive fillers to highly insulating polymeric matrices is known to significantly increase the electrical conductivity of their composites. It is also widely accepted that the loading required to produce conductive composites when using high aspect ratio fillers, such as carbon nanotubes, is well below 1%. However, many of the variables that contribute to the electrical performance of the composites at low loadings are still unexplored. The aim of this study was to identify what process parameters have the largest influence on the electrical conductivity of CNT-epoxy composites at low and extremely low loadings, close and below the percolation limit. Elements of various percolation models effectively explain the impact that these parameters have on the electrical conductivity trends observed in CNT-epoxy composites at low loadings. In contrast, the known models cannot fully explain the electrical conductivity values, or their variability, at extremely low loadings. For the later, where the electrical conductivity presents a dependency with the applied input current/voltage, a separate mechanism is proposed.