Nanocomposites and nanomaterials

Synergistic enhancement of the electrical and thermal conductivity in the ternary composites

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Different types of the carbon nanoparticles are well known and promising candidates as filler in polymer composites. Extraordinarily, electrical properties and specific shape with high aspect ratio (AR), relatively small volume concentrations of carbon nanotubes (CNT) or graphite nanoplatelets (GNP) required for percolation threshold achievement, allow us to produce composites with excellent percolation threshold, responsible for mechanical, thermal, and electrical properties of a composite [1,2].

A three-dimensional (3-D) Monte Carlo model is developed for predicting electrical conductivity of polymer matrix composites filled with conductive graphite nanoplatelets (disks) and/or carbon nanotubes. The conductive fillers are modeled as a 3-D network of finite sites that are randomly positioned. The percolation behavior of the network is studied using the Monte Carlo method, which leads to the determination of the critical filler volume fraction (or the percolation threshold). There are several controlling parameters for different types of filler, namely the nanotubes or nanodisks diameter and their aspect ratio.

The dependence of the electrical and thermal conductivities on the morphology of the filler components, as well as the effect of the simultaneous presence of the nanoparticles with a different aspect ratio, were investigated as well as conditions of realizations of the synergistic effect in ternary composites.

1. *Sagalianov I., Vovchenko L., Matzui L., Lazarenko O.* Synergistic Enhancement of the Percolation Threshold in Hybrid Polymeric Nanocomposites Based on Carbon Nanotubes and Graphite Nanoplatelets // Nanoscale Research Letters.-2017.**-12.-**P. 140.
2. *Sagalianov I., Vovchenko L., Matzui L., Lazarenko O., Oliynyk V., Lozitsky O., Ritter U.* Optimization of multilayer electromagnetic shields: a genetic algorithm approach // Materialwissenschaft und Werkstoftechnik.-2016.**-47(2-3).-**P. 263–271.