Nanocomposites and nanomaterials

Electrical properties of composite materials with electric field assisted alignment of the filler

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The aim of this work was to establish correlation between the electrical properties of nanocarbon/polymer composite materials (CMs) with different content of carbon filler and the peculiarities of the filler distribution which are formed under the influence of an electric field during polymerization of the CMs.

Fig 1. Concentration dependence of GNPs/epoxy CMs conductivity with aligned by electric field and uniformly distributed filler.

Low-viscosity epoxy resin was used as the polymer matrix in the CMs. Two different types of carbon nanoparticles were used as the filler: disk-shaped graphite nanoplatelets (GNPs) and multiwall carbon nanotubes (MWCNTs) which are in the form of strongly elongated cylinders. To obtain CMs with modified by the electric field assisted redistribution of the filler physical properties one part of the prepared composite mixture was subjected to the AC electric field to the completion of polymerization process. Another part of the composite mixture was left without any additional influence. As it was evidenced by optical microscopy of CMs containing low filler quantity, under AC electric field carbon nanoparticles align along the lines of the electric field.

The analysis of the percolation curves for the prepared CMs have shown that there is the shift of percolation threshold towards lower filler content for the CMs with aligned filler distribution (fig. 1).

But the effectiveness of the electric field assisted alignment of GNPs and MWCNTs is different. In the model of carbon nanoparticles alignment under the influence of electric field it can be explained by differences in the electric field induced rotation torque due to the shape of GNPs and MWCNTs. The other parameters of the model are the viscosity of the polymer matrix, the filler content in CMs, electric field configuration, electrical properties of the matrix and the filler separately.