Electrical and thermoelectric properties of the composite polytetrafluoroethylene-multi-walled carbon nanotubes

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The inclusion of metallic nanotubes in a multilayer polymer structure opens up the possibility for new materials that may differ in electric and thermoelectric properties like the individual nanotubes and polymers in pure form, as it shown by measuring the electrical conductivity and Seebeck coefficient.

Interaction of molecules with the surface of the nanotube polymer has a Van der Waals nature, and application of a mechanical load to the composite lead to hydrostatic compression of nanotubes and they can move almost freely in the volume of the polymer, it allows to considerably increase their conductivity.

Due to the significant length of the nanotube and its small diameter the addition of even 4-5 wt. % CNTs into the matrix of PTFE forms a single conductive network of CNTs that changes the insulating state of the composite to a conducting (percolation). The change of nanotube concentration from 2 to 25 wt. % lead to increasing of the electrical conductivity of the composite to 10 orders.

It was also shown that at low concentrations of CNT the Seebeck coefficient is strongly depend on the degree of compression of the nanocomposite under piston. It ranges from 37 to 47 mV / K. The value of the Seebeck coefficient for PTFE + 25% CNT in the range from 37.5 to 45.3 mV / K, for 5% of PTFE + CNT - from 42.3 to 43.5 mV / K, and for PTFE + 3% CNTs - from 43.8 to 46.8 mV / K.

For samples of PTFE-CNT nanocomposite with a lower concentration of carbon nanotubes Seebeck coefficient is higher in accordance with their higher Q factor (Fig. 1).

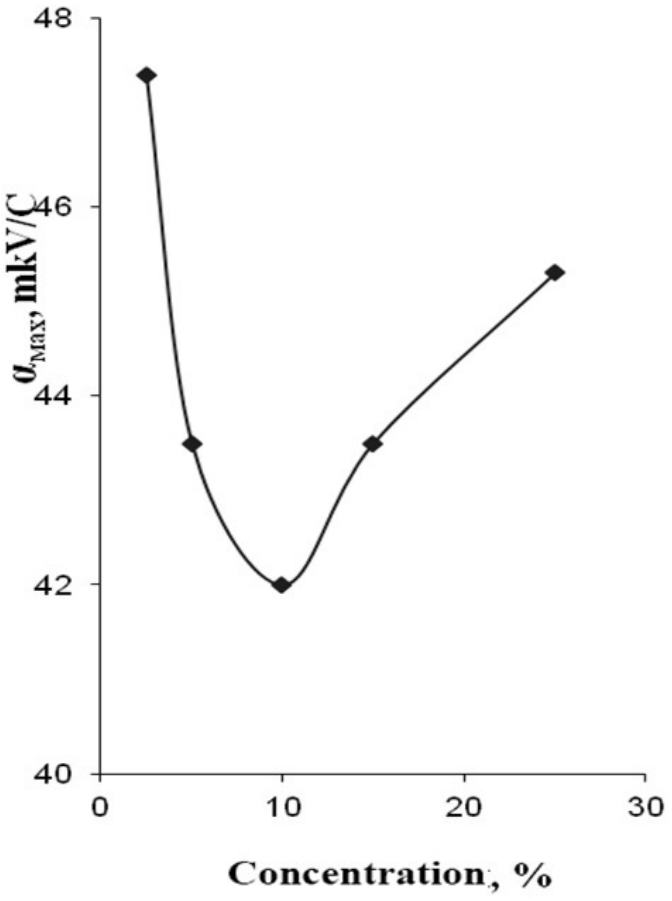

Fig. 1. The dependence of the Seebeck coefficient peaks on the CNT concentration in PTFE.