Electrophysical and electromagnetic properties of pure MWNTs and MWNT/PMMA composite materials depending on their structure

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In this work we have investigated electrophysical properties of pure multiwall carbon nanotubes (MWNTs) with different diameter and MWNT/polymethylmethacrylate (MWNT/PMMA) composites. Multiwalled carbon nanotubes were produced via CVD method. Variation of catalysts composition and reaction conditions allows to produce MWNTs with controllable and relatively narrow diameter distribution.

Electrophysical properties (dependences of conductivity from temperature and magnetic field) of pure MWNTs and MWNT/PMMA composites were investigated by four-point-probe technique in the temperature range 4.2 K-300K and in the magnetic field up to 6 T. Only quantum corrections for interaction electrons (QCIE) in quantum corrections to magnetoconductivity take place. This phenomenon was attributed to the absence of the bulk formations of amorphous carbon in MWNTs produced. From the data on QCIE we have estimated the constant of electron-electron interaction which is negative and monotonically falling with decrease of the mean diameter of MWNTs. The influence of MWNT defectiveness and structure on MWNT electrophysical properties is discussed.

MWNT/PMMA composites were prepared via coagulation technique via ultrasonic dispersion of MWNT in PMMA/NMP-DMF solution. MWNT content was varied in range 0.25-10 wt.%. MWNT distribution in polymer matrix was controlled using optical, scanning and transmission electron microscopy.

MWNT/PMMA composites, starting from small MWNT content, display high shielding efficiency (SE). Strong increase in SE occurs for MWNT content higher than 0.5 wt.%, correlating well with the percolation threshold of electrical conductivity. This phenomenon may be related with formation of long-range connectivity of MWNT network in PMMA matrix. Thus produced materials show high SE in millimeter wavelengths and may have high potential for use as components of various electronic devices due to their light weight, scalable technology and tailored properties.