Charge transport in arrays of carbon nanotubes

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Verification of charge transport mechanisms in carbon nanotubes (CNT) arrays is a crucial task for utilizing of their electrical transport properties in devices and sensors. In this report electron transport processes in CNT arrays of different geometry will be discussed. Charge transport mechanisms in single-wall carbon nanotubes and multi-wall carbon nanotubes (MWCNT) arrays were investigated and determined [1]. Terahertz radiation induced hopping conductivity was found in the SWCNT fibers and SWCNT coatings of silica fibers for the first time [2, 3].

Impedance measurements of SWCNT fibers were investigated. It was found that in the low frequency range ($f < 1$ kHz) at low temperatures and at bias voltage $U > 2$ V sign of the imaginary part of impedance was changed from negative to positive, indicating the existence of the crossover from capacitive reactance to inductive one. This crossover was induced by the decrease of height of the energy barriers between nanotubes at the increase of bias voltage. As a result decrease of the impedance of the fibers is accompanied by the rising of the role of kinetic inductance of separate nanotubes [4].

A crossover between metallic (dR/dT>0) and non-metallic (dR/dT<0) temperature dependence of the resistance as well as low-temperature saturation of resistance in high bias regime was found in CNT based composites [5] and SWCNT films [6, 7].

Quantum corrections to conductivity of SWCNT films were investigated. The magnetoresistance (MR) data demonstrated influence of weak localization (WL) and electron-electron interactions on charge transport properties. The low-field negative MR with positive upturn was observed at low temperatures. At $T > 10$ K only negative MR was observed in the whole range of available magnetic fields. The negative MR can be approximated using 1D WL model. The low temperature positive MR is induced by contribution from electron-electron interactions [7].

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