ELECTRODYNAMIC PROPERTIES OF NANOCARBON MATERIALS FOR EMI SHIELDING IN THE S-BAND OF MICROWAVES

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This work presents materials based on SWCNT and graphene with outstanding EM-shielding characteristics in the S-band of microwave frequencies (2-4 GHz). The work proposes a method for creating materials based on SWCNT - buckypaper, which consists of aerographic spraying of a suspension with nanotubes on a substrate followed by evaporation of the liquid component. The work uses two types of SWCNT - with inclusion of metallic particles (synthesis catalyst) and without. Measurements of reflection and transmission coefficients of thin plates made of such materials in the S-band of microwave wavelengths were carried out. Plates made of such materials have a high reflection coefficient (at the level of copper) and a low transmission coefficient (from -20 dB to -60 dB). It is shown that for achieving the highest total shielding effectiveness (TSE) it is necessary to use SWCNT purified from the catalyst, as well as a liquid component with the lowest surface tension coefficient without the presence of surfactants in its composition. A unique characteristic is possessed by a plate made of graphene, synthesized by the CVD method and transferred to a PET substrate. The reflection coefficient of such a plate is close to -15 dB, and the transmission coefficient is about -3 dB, i.e. such thin plates weakly reflect and significantly absorb the incident microwave power.

The work also presents the measurement of conductivity of materials based on SWCNT in this frequency range. The conductivity measurement was carried out by two methods. The first one is the standard TRL method, based on calculating the conductivity from S11 and S21 characteristics of a waveguide, in the cross section of which a plate made of the studied material is installed. The second method is the authors' proposal. This method is based on measuring the quality factor of a resonator, part of the surface of which is made of the studied plates. A comparison of the conductivities measured by two methods was carried out. The conductivity of the obtained composite samples ranges from 0.015 to 0.200 MS/m.

The results of this work can be used for developing materials with high absorption for EMI-shielding applications, as well as materials with high conductivity for using such materials as a substitution for metal parts in microwave devices.