TERAHERTZ DIELECTRIC PROPERTIES OF MWCNT/PE COMPOSITES

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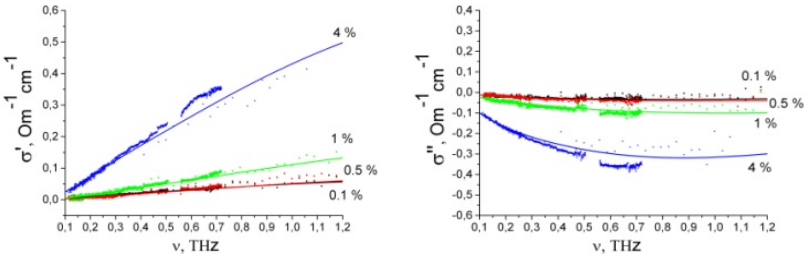
One of nanocomposite potential applications is connected with designing of materials with selected dielectric response in different frequency ranges. In the present work, the composites formed by multiwall carbon nanotubes (MWCNT) embedded using different processes into polyethylene (PE) matrix were obtained. Their dielectric susceptibility spectra at cw and pulsed THz radiation at different peak power levels were studied.

The dielectric properties of MWCNT/PE composites were tested using THz-TDS and BWO spectrometer as well as high peak power THz gas laser. The “low” peak power pulses were produced by eee-type optical rectification of femtosecond pulses from MaiTai SP (Spectra-Physics, USA) laser in a GaSe crystal. In cw mode, the dielectric susceptibility spectra were measured at BWO spectrometer (KDP, Russia) at average THz powers of 5-25 mW. To model the MWCNT/PE dielectric permittivity, Maxwell-Garnett effective medium approximation (EMA) was used.



Real and imaginary conductivities of MWCNT/PE composites, as obtained at “low” THz peak power at THz-TDS and BWO-spectrometers. MWCNTs contents are given in the legends.

The possibility to tune the dielectric properties of the MWCNT/PE composites by changing MWCNT content was verified. Generally, dielectric response of the composites remains invariable up to hundred kilowatts of THz peak powers and can be modeled within effective medium approximation.

PHOTOELECTRICAL CHARACTERISTICS OF Ga_2O_3-GaAs STRUCTURES

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Thin Ga_2O_3 films possess a wide variety of applications including the fabrication of gas sensors, solar-blind photodetectors, phosphors and other devices. It is known that film properties are strongly dependent on the synthesis conditions. The present study is aimed at the investigation of high-temperature annealing and oxygen plasma treatment effects on the photoelectrical characteristics of Ga_2O_3/GaAs layered systems. The GaAs epitaxial layers (N_d = 8.9·1015 cm^{-3}) grown on n-type GaAs plates ($n_0 \approx 10^{18}$ cm^{-3}) were used as substrates. Ga_2O_3 films were grown by photoelectrochemical oxidation or anodic oxidation methods. The reaction produces oxides of gallium and arsenic at the surface. In order to remove the volatile arsenic oxide, the annealing in H_2 atmosphere is conducted at300 °C for 10 min. In order to obtain phase β-Ga_2O_3, the annealing at 900 °C (30 min) in Ar is carried out. After that the samples were exposed to the oxygen plasma (20, 30, 50 min, 90 °C). The phase composition of the films was determined by X-ray diffraction (XRD) analysis. The surface morphology was investigated by atomic force microscope (AFM).

As-grown oxide films were amorphous. According to the XRD results it can be assumed that introduction of oxide atoms in Ga_2O_3 lattice leads to the formation of β-phase crystallites with different crystallographic orientation. From the AFM analysis it is evident that annealing induces amorphous to a polycrystalline phase transformation. The reduction of charge carriers concentration takes place in GaAs after the growth of Ga_2O_3 film. The effect depends on the duration of O_2 exposure. The photoresponse is observed for samples only after the high-temperature annealing. After the O_2 exposure for 20 min, the most transparent films were obtained. Maximum sensitivity is