Development of anisotropic composite materials for electromagnetic applications

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Composite materials, consisting of carbon nanotubes (CNTs) and polymer matrix, are promising materials for electromagnetic (EM) shielding. Anisotropic composite materials, which can selectively absorb EM radiation, attract especial interest. Such composite materials can be demanded in creation of strong and thin EM screens with the required values of the absorption coefficient. Here we discuss two methods for development of anisotropic composites. In the first method, multiwall CNTs synthesized by chemical vapor deposition (CVD) method were deposited on quartz, glass or Si substrate by solvent evaporation or by spin-coating method. CNTs orientation on the dielectric surfaces was achieved by applying the directional force. After that polymer solution was applied on the obtained CNTs layer and dried until complete solvent evaporation. Finally, polymer material with CNTs was carefully detached from the dielectric substrate. In the second method CNTs were mixed with polystyrene taken in the required proportion, dispersed in toluene and carefully stirred for complete dissolving of polystyrene. The obtained composite slush was applied over metallic plate and dried at ambient conditions. The forge-rolled method or stretching method was used for orientation of CNTs in polymer matrix. CNTs length was predominantly about 100 μm which is equal to the wavelength of terahertz radiation. Reorientation of CNTs in predominant direction on the dielectric surfaces and in the polymer matrix as a result of applied force was shown. Occurrence of anisotropic dielectric response in the obtained samples was demonstrated.

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Fabrication and characterization of Er- and Gd-implanted tin dioxide films

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Tin dioxide (SnO_2) is wide band gap semiconductor that is widely used in gas sensors and different optoelectronic applications [1]. Doping of semicondiuctors by rare-earth elements provides possibility of their use as active optical elements due to existence of radiative transitions in a wide wavelength range [2]. We report here fabrication procedure and optical properties of polycrystalline SnO_2 films implanted with Gd3+ and Er3+ions. DC reactive magnetron sputtering from tin sputtering target in the gas mixture of Ar and O_2 was used for tin dioxide films preparation. After sputtering process samples were subjected to heat treatment in air in the temperature range 200-600 ^{0}C. Optical absorption spectra of tin dioxide films were measured using UV-Vis spectroscopy within 220-900 nm range of wave length. Estimation of the band gap transition energy gives value of about 3.6 eV. Than samples were implanted by Gd3+ and Er3+ions with a dose in the range 1012-1014 cm-2 and rapid thermal annealing at 700 ^{0}C during 1 minute in nitrogen atmosphere. Photoluminescence spectra of Er- and Gd-doped tin dioxide films was measured with UV laser (325 nm) as excitation source. Emission at ~550 nm was observed SnO_2 films implanted both by Gd3+ and Er3+ions. The origin of visible emission might be related to 4f transition in rare-earth (RE3+) ions or to defect levels associated with oxygen vacancies. References

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[2] F. Gu, S. F. Wang, M. K. Lu, Y. X. Qi, G. J. Zhou, J. Crystal Growth 255, 357 (2003).

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