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

Vishnikina V.V.[1], Kalygina V.M.[1], Petrova Yu.S.[1], Prudaev I.A.[1], Tolbanov O.P.[1], Atuchin V.V.[1,2,3]

[1]*Functional Electronics Laboratory, Tomsk State University, Tomsk, Russia*
[2]*Laboratory of Optical Materials and Structures, Institute of Semiconductor Physics, SB RAS, Novosibirsk, Russia*
[3]*Laboratory of Semiconductor and Dielectric Materials, Novosibirsk State University, Novosibirsk, Russia, atuchin@isp.nsc.ru*

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 observed for the samples annealed at 900 °C which were exposed to the oxygen plasma during 20 min. The sensitivity increases from 240 nm to 200 nm; in this spectral region the β-Ga_2O_3films are not transparent and absorb the radiation. The relation is established between the oxygen plasma treatment duration and the of β-phase crystallite emergence with different crystallographic orientation. It is shown that after high-temperature annealing the films become transparent in visible range and photocurrent is explained by the generation of charge carriers in the space charge region of the semiconductor.

CONDUCTION MECHANISM OF METAL-TiO_2-Si STRUCTURES

Kalygina V.M.[1], Egorova I.S.[1], Prudaev I.A.[1],
Tolbanov O.P.[1], Atuchin V.V.[1,2,3]

[1]*Functional Electronics Laboratory, Tomsk State University, Tomsk, Russia*
[2]*Laboratory of Optical Materials and Structures, Institute of Semiconductor Physics, SB RAS, Novosibirsk, Russia*
[3]*Laboratory of Semiconductor and Dielectric Materials, Novosibirsk State University, Novosibirsk, Russia, atuchin@isp.nsc.ru*

The conduction mechanism in metal-TiO_2-Si structures was studied. Titanium oxide film with thickness of 70 nm was prepared by magnetron sputtering on silicon epitaxial layer with a donor concentration $N_d = 7 \cdot 10^{14}$ cm^{-3}. The Si-substrate with dielectric film was separated into several parts. One part was not subjected to annealing and two pieces of the plate were annealed in Ar for 30 min at temperatures T_a = 500°C or 750ºC.

Regardless of the annealing temperature, on the direct current-voltage characteristic (CVC) in double logarithmic scale there are three sections, each section can be fitted by function $I \sim U^m$. The first section of CVC is observed at bias voltages up to 0.1 V with $m \approx 1$. In the second section ($0.1 \leq U \leq 1.0$ V), the m value depends on the annealing temperature and is equal to 2.8 – 4.9. At the third section, m reduces to 2 at voltages >0.9 V. In the voltage range corresponding to the second section of the CVC direct current (I_{dir}) depends weakly on temperature. Similar results were obtained for the structures annealed at T_a = 500 and 750°C. At negative potentials on the gate, the dependence of current (I_{rev}) on voltage is represented by a straight line with a slope of m = 0.5 in over the voltage range of $1 \cdot 10^{-3}$ – 10 V in the double logarithmic scale. With increasing temperature the reverse current increases exponentially.