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Investigations on photoelectrical properties of GaS Single Crystals Exposed to Irradiation by Hydrogen with 70 keV energy

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By the methods of Raman Light Scattering and Rutherford backscattering (RBS) it has been studied the rate of structural disorder of layered GaS crystals before and after hydrogen implantation (H2+) with energy 70 keV. The investigated p-GaS single crystals were grown by the Bridgman method in the Institute of Radiation Problems of the Azerbaijan National Academy of Sciences. When grown GaS were used excess sulfur (1.5%) in order to determine the possibility of filling vacancies with sulfur atoms. Electrical resistivity of the samples obtained along and perpendicular to C-axis at room temperature were 3x10E10 and 1x10E10 Ohm·cm, respectively. GaS samples of size 10x10x0.5 mm were used. It is shown that distribution of crystal components on depth uniformly and observed stoichiometric composition of the components of the compound up to dose 5x10E15 cm-2.

Summary

RBS studies have shown that the distribution of components in depth is uniform and stoichiometric composition of the compound components is fulfilled. The observed oxygen in RBS spectrum characteristic for the surface region may be associated with a degree of purity of the compound components. Implantation of hydrogen ions H2+ with 70 keV energy and a dose 5x10E15cm-2 shows that a critical dose of beginning of the amorphization is grater than 1x10E15 cm-2 and is in satisfactory agreement with the calculated value for such structurally complex crystal. From Raman spectra of the layered GaS crystals it is established that at Hydrogen implantation with doses below 5x10E15cm-2 position of the bands is preserved and intensity of the bands is increased, that is connected with the improvement of the stability of crystal lattice, and at a dose 5x10E15cm-2 is observed decrease in the intensity of bands. It is obtained that photoresponse of sample increased (from 0.66 to 5.3 times) with dose up to 1x10E15 p/cm2 in the wide wavelength range (490nm-900nm). New peaks with maximum at λ=668 nm and λ= 739nm and appeared on the spectrum of irradiated sample. The energy of new levels is 0.58 eV and 0.77 eV. The photorespose started to decrease dramatically with dose (up to 5x10E15 p/cm2) due to the increase in the degree of structural disorder (amorphization). Determination of the critical dose of amorphization beginning allows the use of ion implantation for the creation of quantum dots in layered GaS crystals when at a sub-threshold dose is formed material containing nano-sized crystalline and amorphous regions.

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