

INFLUENCE OF HEAT TREATMENT ON OPTICAL CHARACTERISTICS OF GADOLINIUM SILICATE MONOCRYSTAL (GSO)

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Lately, the rare earth element silicates are widely used as high energy physics detectors. Cerium doped gadolinium silicate monocrystal Gd_2SiO_5 or GSO is one of such materials. In this work, the influence of high-temperature treatment of the cerium doped GSO monocrystals (Ce concentration is 0.5%) was studied by thermoluminescence (TL) methods and absorption spectra (AS) analysis. After irradiation in the TL curves one can observe peaks at 353, 383, 448, and 553 K. The studied dose dependence for these peaks showed that the saturation took place at the doses of 10^7 R. In the AS after irradiation one can observe peaks at 205, 220, 245, 270-300 and 350 nm in the UV region, whereas there is no absorption peaks in the visual part of spectrum apart from some insignificant spikes. In order to identify the nature of traps in TL curves the samples were undergone the oxidation-reduction annealing. After the oxidation annealing followed by gamma-irradiation positions and intensities of the TL peaks did not change. However, these peaks' intensities grow after the reduction annealing and the consequent gamma-irradiation (10^6 R). The consequent thermal treatment of the samples in oxidation environment after preliminary reduction in graphite decreases the intensities of the TL peaks. Thus, the heat treatment in various media demonstrated that the capture centres (CC) can be referred to the electron trap type. The energy depth E_3 calculated by the Urbach equation $E_3 = T, K/500$ gave the following values: 0.71, 0.77, 0.896, and 1.12 eV for the peaks at 353, 383, 448, and 553 K, respectively. In AS after reduction annealing one can observe the absorption bands at 350 nm conditioned by Ce^{3+} ions, decrease of the 240-260 nm absorption bands related to Ce^{4+} ions, and insignificant decrease of the 270-300 nm absorption bands related to Gd ions. After the oxidative annealing, the intensities of the Ce^{3+} related absorption bands decrease. After the gamma-irradiation the intensities of all mentioned above absorption bands increase. A relatively small saturation dose in CC and increase in absorption band intensities after the gamma-irradiation points on existence of pre-radiation defects, which cause the colour and capture centres under gamma-irradiation. These centres are formed at localisation of charge carriers at the mentioned defects. Such defects can be both impurity and structure pre-radiation defects. Possible mechanisms of the colour and capture centres formation together with the role played by cerium activator and the improvement of the basic characteristics of scintillators are discussed.