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TSL OF ZIRCONIUM DIOXIDE CERAMICS IRRADIATED WITH FAST IONS *

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ZrO_2 (band gap 5.0-5.5 eV) is considered today one of the most important materials used in modern measuring technology, nanoelectronics and photonics. It has a significant luminescence yield, high reflectance, low phonon energy, and high thermal and chemical stability. Phosphors based on ZrO_2 are used for the manufacture of oxygen sensors, biological sensors, laser technology devices, optoelectronic devices, UV and ionizing radiation dosimeters, scintillators, high-energy radiation visualization devices, etc. For these applications, an important task is to ensure the stability of the luminescent properties of the material when exposed to various types of radiation. This problem is especially relevant when using ZrO_2-based devices in military and space technology, as well as in the nuclear industry.

In present work ZrO_2 compacts were studied. Compacts were formed by cold uniaxial pressing in the range of (900-1500) kgf/cm of nanostructured zirconium dioxide powder produced by the plasma chemical method (sample type 1 and 2), ultra-dispersed ZrO_2 powder (sample type 3). The samples were irradiated with 200 MeV Xe and 4.8 MeV N ions in fluence range (10^{10}- 10^{14}) cm^{-2} at cyclotron DC-60 (Nur-Sultan, Kazakhstan). Thermoluminescence (TL) properties of ZrO_2 compacts were investigated to determine the possibility of their use for dosimetry of pulsed electron beams (130 keV, 2 ns). The virgin and ion-beam-irradiated (Xe and N) compacts were irradiated with a test dose of 5 kGy pulsed electron beam. TL was measured in the linear heating mode at a rate of 2 K/s in the spectral range of 200-600 nm. TL curves of the virgin and irradiated compacts showed two TL peaks at 330-430 K and 430-550 K. The peak at 430-550 K is most intense in the nonirradiated sample. The greatest change in the TL intensity of this peak occurs in the sample irradiated with N ions: 2 to 3 times reduction. The kinetic parameters of the TL peak at 430-550 K (kinetic order b, activation energy E, and frequency factor S) were determined from the analysis of the TL curves.

The greatest changes in the kinetic parameters compared to the unirradiated compacts are observed in the samples irradiated with N ions. This samples are characterized by an order of kinetics close to 1 (b = 1.1), indicating that the probability of trap recapture of charge carriers is low.

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