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Investigation of damages in Y3Fe5O12 single crystals irradiated with swift heavy ions using Raman spectroscopy

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The Raman spectroscopy method was used to study the radiation damage formed along the path of swift heavy ions in a yttrium iron garnet (Y3Fe5O12, YIG). YIG single crystals have been irradiated with swift Xe and Bi ions with energies of 167 and 715 MeV, respectively. Irradiation was carried out at room temperature in the range of fluences from 1011 to 1013 ions /cm2. Analysis of the Raman spectra showed that for fluence values greater than 1012 ion/cm2 for Xe and Bi ions, the irradiated near-surface layer is completely amorphous, which made it possible to indirectly estimate the effective damage radius from one ion (latent track radius). Measuring the thickness of the amorphous layer in YIG after irradiation with high-energy Xe and Bi ions made it possible to estimate the threshold for the formation of latent tracks. In addition, shifts in the position of peaks in the Raman spectra were recorded depending on the penetration depth of the ions, which indicates the appearance of internal mechanical stresses in the crystals after irradiation. The results obtained in this work is compared with previously obtained direct data (transmission electron microscopy) and indirect methods (Rutherford backscattering spectroscopy, X-ray diffraction).

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