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CREATION PROCESSES OF FRENKEL DEFECTS IN $Lu_3Al_5O_{12}$ AND Al_2O_3 SINGLE CRYSTALS .

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The formation energy of a pair of Frenkel defects exceeds the energy gap ($E_{FD} > E_g$) in pure and doped Al_2O_3, MgO and $Y_3Al_5O_{12}$ single crystals, which are highly resistant against irradiation by X- or γ-rays. However, the creation of Frenkel defects in these crystals takes place under a swift-ion-irradiation that provides extremely high excitation density inside the tracks of heavy ions. Both the universal impact mechanism and novel nonimpact ones [1] are responsible for the radiation damage under such irradiation conditions. For instance, the energy released at the recombination of a hot (nonrelaxed) electron-hole (*e-h*) pair can exceed the value of E_{FD}. The latter radiation processes were revealed in Al_2O_3 crystals, pure or doped with Cr^{3+}, Gd^{3+}, Sc^{3+} ions [2]. The present study continues such investigations in $Lu_3Al_5O_{12}$ (LuAG) crystals irradiated for the first time by 2.14-GeV U^{238} ions (GSI, Darmstadt) at 300 K. LuAG crystals doped with different concentrations of luminescent rare-earth Ce^{3+} ions have been investigated as well.

The methods of VUV spectroscopy (exciting photons of 6-30 eV) at 6, 80 and 300 K as well as the methods of thermoactivation spectroscopy (temperature region of 6-720 K, preliminary irradiation of the samples by VUV photons or an electron beam at 6 or 300 K) allowed to detect a small amount of pre-irradiation (as-grown) F^+ centers, the number of which was significantly increased in the samples irradiated with swift heavy ions. The cerium-concentration dependence on the competition between energy transfer to Ce^{3+} impurity ions or other nano-size structural defects has been analyzed in LuAG:Ce^{3+} crystals at the selective photocreation of cold *e-h*, hot *e-h* pairs, cation excitations or the groups of some spatially correlated electronic excitations. The function mechanisms of LuAG:Ce^{3+} fast scintillators are discussed. Particular attention has been placed on the formation of several spatially correlated electronic excitations by one exciting photon (i.e. multiplication process).

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[3] A. Lushchik, Ch. Lushchik, T. Kärner, P. Liblik, V. Nagirnyi, E. Shablonin, A. Shugai, E. Vasil'chenko, *Radiat. Meas.*, submitted.