Defects Related Scintillation Properties of Yttrium-Aluminum Garnet Crystals

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Crystals of yttrium aluminum garnet (YAG) emit a broad luminescence band peaking at 300 nm under x-irradiation associated with the presence of anionic and cationic vacancies, their complexes and antisites. The summary of the supposed origin of defects is presented in [1-3]. Radio-luminescence of pure crystals most probably related to excitons localized around defects, due to violation of the stoichiometric composition. This is supported by the absence of emission and absorption bands in UV range in the nanocrystalline films and optical ceramics produced at lower temperatures.

The investigation is devoted to reveal the defects related effect on scintillator performance of pure yttrium aluminum garnet crystals.

Absorption in UV-VIS-IR, emission and thermostimulated luminescence as well as scintillation properties were determined for different kind of nominally pure crystals. The variable concentration of defects, which correspond to the absorption band in the range of 200 - 400 nm, was estimated. The undoped crystals excited with X-ray demonstrate the complicated emission band in UV wavelength region with peak at around ~290-310 nm. The experimental results point out that the concentration of native structure defects plays an important role in emission efficiency. The intensification of luminescence is only due to suppressing trapping defects. The results obtained shows that the emission' intensity is enhanced in samples which have the highest transparency in UV region.

According to the pulse height spectra recorded under γ ^{137}Cs, the light outputs of pure YAG crystal is nearly twice higher than BGO, and closed to Ce-doped crystal. Decay times constants were estimated to be approximately 7 ns and 460 ns, which agrees the data resulted in [4]. Factors affecting the scintillation efficiency in YAG have been discussed. Scintillation properties show the promising of YAG crystal application as a scintillator.

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