RECOMBINATION PROCESSES IN $PbWO_4$ AND $PbWO_4$:Tb CRYSTALS

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Before [1, 2] the spectral-luminescent and kinetic properties of $PbWO_4$ and $PbWO_4$:Tb crystals have been investigated. It was determined that the doping with Tb^{3+} impurity of $PbWO_4$ crystals leads to improvement of X-ray luminescence (XL) kinetic parameters and decreasing of the intensity of thermostimulated luminescence (TSL) peaks in the temperature range 150–250 K. It was established that IR-irradiation of $PbWO_4$:Tb^{3+} crystals preliminary X-ray excited at 90 K leads to appearance of photostimulated luminescence (PSL) flash. This report is focused on the joint analysis of spectroscopic characteristics of the luminescence in $PbWO_4$ and $PbWO_4$:Tb^{3+} crystals at X-ray and nitrogen laser excitations.

The steady-state XL spectra of nominally pure $PbWO_4$ crystals at 90 K are characterized with non-elementary wide asymmetric band peaked at 460 nm. Doping with terbium impurity of $PbWO_4$ crystals leads to appearance of Tb^{3+} ions luminescence. The activator emission is observed only on the luminescence spectra at laser excitation of $PbWO_4$:Tb^{3+}. The luminescence in the lead tungstate crystals is due to self-trapped excitons and excitons, localized near Pb^{3+}, Tb^{3+} impurity ions, WO_3, WO_2 or WO vacancies. The TSL curves of pure $PbWO_4$ crystals is considerably depended from the conditions of their preparation and type of excitation. The non-elementary peak at 115 K is observed on TSL curves in the pure and activated crystals. Stored lightsum is released during thermal and optical bleaching. The lightsum curve released by IR-illumination from 850–3500 nm region is characterized by peak at 108 K. The analysis of TSL peak shows that the process of photostimulated release of stored lightsum is occurred with monomolecular kinetics. The nature of TSL peak at 108 K is due to [$WO_3(F^-)$-Pb^{3+}] centers. Formation of the F^--centers in the pure crystals mainly occurs near Pb^{3+} ions at filling oxygen vacancy with three electrons. The thermal decay of [$WO_3(F^-)$-Pb^{3+}] centers leads to creation of (WO_4^{2-})* excitons, localized near [WO_3(F)-Pb^{2+}] complex centers. The PSL arises in electronic stage of recombination process as result of photostimulated electrons delocalization mainly from F^--centers on the initial stage and chiefly from F-centers on the second one.

References

[1] L.V.Kostyk, A.E.Nosenko, S.S.Novosad, I.V.Kayun, Functional Materials (2003), v. **10**(1) p. 125–129

[2] L.Kostyk, S.Novosad, Radiation Measurements (2004), v. **38** p. 711–714