PHOTOLUMINESCENCE AND PHOTOSTIMULATED LUMINESCENCE IN THE X-RAY STORAGE PHOSPHOR $BaBr_2$ DOPED WITH CERIUM

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Information in X-ray storage phosphor screens is stored in the form of electron and hole trap centres stable at room temperature. Upon photostimulation of the electron trap centres, the electron recombines with the hole trap centre resulting in luminescence (PSL) at a nearby activator which is usually a rare-earth dopant ion. Promising candidates for this kind of application are rare earth activated fluorobromozirconate (ZBLAN) glass ceramics containing PSL-active $BaBr_2$ nano-particles [1, 2]. Due to reduced light scattering these glass ceramics may have better spatial resolution than the presently used powdered crystal phosphors. For a detailed understanding of these glass ceramics it is essential to investigate the X-ray storage and read-out processes of bulk $BaBr_2$ phosphors since the glass-base of the glass-ceramic itself shows no PSL. Results on Eu-activated $BaBr_2$ have been published earlier [3, 4, 5].

After X-irradiation at room temperature 1000 ppm Ce-doped $BaBr_2$ shows a PSL effect which is comparable to that of commercially used Eu-doped (1000 ppm) BaFBr. At room temperature the PSL spectra show a resolved doublet at 347 and 375 nm, and an unresolved one at about 420 nm. Stimulation spectra of PSL show broad bands peaking at 480 and 550 nm, respectively. At low temperatures near 20 K the PSL spectrum shows only the second doublet at 382 and 410 nm, now better resolved. The doublet separations agree very well with the expected energy splitting of the cerium ground state due to spin-orbit coupling, thus the doublets are attributed to the $5d \rightarrow 4f$ emission of the Ce^{3+} activator. The low temperature PSL stimulation spectrum of the second doublet agrees with the F centre absorption spectrum in undoped $BaBr_2$ [6], i.e. the F centres are PSL-active electron trap centres. The photoluminescence spectra at room temperature are similar to those of the PSL, but in contrast to PSL they show at low temperatures an additional doublet at 330 and 353 nm. Thus, we are dealing with at least three different Ce sites in $BaBr_2$, out of which two participate in PSL at room temperature and only one at low temperatures. The presence of multiple Ce^{3+} sites is confirmed by EPR investigations.

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