Role of oxygen and the fluorine-bromine ratio in the storage mechanism of $BaFBr:Eu^{2+}$

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The role of oxygen in the storage mechanism of the storage phosphor $BaFBr:Eu^{2+}$ is investigated. It is known for $BaFBr:Eu^{2+}$ that a divalent oxide is located on an anion site keeping an anion vacancy in its vicinity for charge compensation. Electrons generated upon x-ray absorption are trapped in these vacancies forming F-centers whereas simultaneously generated V_k centers are trapped at Eu^{2+} [1]. Upon photostimulation, electrons are liberated from their traps and subsequently recombine with trapped holes resulting in the characteristic Eu^{2+} luminescence at 390nm. This read out process is called photostimulated luminescence (PSL).

In the present investigation it is shown that even though oxygen seems to be essential to provide sufficient vacancies and thus F-centers, a maximum of the PSL efficiency occurs at a comparatively low content of oxygen. It is assumed that a surplus of oxygen leads to the increased trapping of hole centers at oxygen competing with the hole trapping at Eu^{2+}. It is shown that the oxygen fraction is theoretically controllable together with the F-center lattice site (bromine F_{Br} or fluorine F_F) by a tiny unbalance of the employed halides and the ratio of cation and anion precursors in which the cation precursor is the oxygen source additionally. For the controlled introduction of bromine, fluorine and oxide a one-step synthesis with the precursors $BaCO_3$, NH_4Br, and NH_4F [2] was utilized. Thus micron sized powders of $BaFBr:Eu^{2+}$ powders were obtained and analyzed by photoluminescence, PSL, and remission measurements.

References

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