

## Evolution of Eu and Mn oxidation state in doped BaMgAl<sub>10</sub>O<sub>17</sub> during x-ray irradiation

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BaMgAl<sub>10</sub>O<sub>17</sub> (BAM) is a technologically very important host for luminescent impurities: when doped with Eu it is one of the best blue phosphors on the market, when doped with Mn it is a green emitting phosphor, albeit with poor efficiency. Doping with both Mn and Eu greatly improves the green emission from Mn and opens the way to the use of BAM:Eu,Mn as an alternative to more expensive rare-earth based green phosphors.

Optimization of BAM based phosphors is of great importance for modern lighting applications. The interplay of structural and electronic properties at the atomic level on the luminescent efficiency is still not well understood.

High resolution x-ray absorption spectroscopy (XAS) is a chemically selective technique probing the local coordination and electronic structure of a selected atomic species and can be used to investigate both Eu and Mn in singly doped and co-doped BAM phosphors. When applied to inorganic phosphors, x-rays do not only act as a probe but also as a source of excitation and potential irreversible damage. By collecting the radioluminescence from the sample in parallel to x-ray spectra a complete view on sample efficiency and evolution of impurities local structure is obtained.

We systematically investigated Eu and Mn singly and co-doped BAM phosphors with high resolution XAS at Eu L<sub>III</sub>- and Mn K- edges in two sets of BAM samples. Mn is always found in 2+ oxidation state and preferentially in tetrahedral sites. Eu impurities on the contrary are found in both 2+ and 3+ oxidation states, with Eu<sup>2+</sup>/Eu<sup>3+</sup> ratio varying from sample to sample. X-ray irradiation at high flux induces relevant variations to this scenario: Eu undergoes fast oxidation to Eu<sup>3+</sup> while the local structure of Mn is unaffected. In parallel, the luminescence of both Mn and Eu degrades at a rate following Eu oxidation.

Our investigation confirms that the stability of the conduction layer, where Eu is incorporated, plays a central role in determining luminescence properties of BAM [1,2]. The rate of Eu oxidation was found sample dependent, indicating that growing conditions and/or co-doping may affect the stability of the conduction layer.

[1] P. Boolchand, K. C. Mishra, M. Raukas, A. Ellens, P. C. Schmidt, Phys. Rev. B 66 (2002) 134429.

[2] G. Bizarri, B. Moine, J. of Luminesc. 113 (2005) 199-213.