CONNECTING CRYSTAL STRUCTURE AND LUMINESCENCE, THE CASE OF $SrAl_2O_4:Eu^{2+}$

J. J. Joos, J. Botterman, P. F. Smet

LumiLab, Department of Solid State Sciences, Ghent University, Krijgslaan 281-S1, 9000 Gent

Center for Nano- and Biophotonics (NB Photonics), Ghent University, St-Pietersnieuwstraat 41, 9000 Gent

Keywords: Europium, Luminescence, Empirical modeling

Photoluminescent materials or phosphors are ubiquitous in today's technology driven society, for example in LEDs, scintillators or safety signalling. These inorganic materials are composed of a host crystal doped with one or multiple metal ions, activating the luminescence [1]. The luminescence of the metal ion is often strongly dependent on the crystal structure of the host compound. Ultimately the goal of scientific research is not only to explain luminescent properties from the structure of the compound, but also designing new materials through tuning of the crystal structure and chemical composition of the host compound.

Upon codoping with Dy^{3+}, $SrAl_2O_4:Eu^{2+}$ is well-known because of its persistent luminescence, i.e. it shows an extremely long lasting green afterglow. Although frequently used in safety signalling and all kinds of gadgets, the origin of the persistent luminescence is not yet fully explained [2]. More specifically, a second, blue emission band occurs at low temperature. Recently, it has been shown that this emission band is of importance in explaining the trapping and detrapping mechanism behind the persistent luminescence in this material. Different conflicting explanations for the occurrence of the blue emission are available in literature [3].

In this work, empirical models relating the luminescence of lanthanide ions with structural parameters of the host are applied to explain the peculiar luminescence in Eu^{2+} doped $SrAl_2O_4$. It is shown that the blue and green emission bands originate from europium ions substituting two non-equivalent Sr sites inside the host crystal, even if both sites are rather similar.

References

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