

# Fluorescence properties with redshift of $\text{Eu}^{2+}$ emission in novel phosphor-silicate apatite $\text{Sr}_3\text{LaNa}(\text{PO}_4)_2\text{SiO}_4$ phosphors

Jung Hyun Jeong<sup>1,\*</sup>, Yue Guo<sup>1</sup>, Kiwan Jang<sup>2</sup>, Ho Sueb Lee<sup>2</sup>, Dong Soo Shin<sup>3</sup>

<sup>1</sup>Department of Physics, Pukyong National University, Busan 608-737, South Korea

<sup>2</sup>Department of Physics, Changwon National University, Changwon 641-773, South Korea

<sup>3</sup>Department of Chemistry, Changwon National University, Changwon 641-773, South Korea

\*jhjeong@pknu.ac.kr

## Abstract

The apatite like-compounds  $\text{Sr}_{10}(\text{PO}_4)_6\text{F}_2$  can easily modified by various anionic and cationic substitutions with different ion sizes due to the flexibility of the apatite structure. One category is a silicate-substituted apatite following the pattern:  $(\text{PO}_4)^{3-} + \text{F}^- = (\text{SiO}_4)^{4-}$ . Huang et al.[1] have reported that the emission spectra of  $\text{Eu}^{2+}$  ions shows red shift after the replacement of  $(\text{PO}_4)^{3-}$  by the more covalent  $(\text{SiO}_4)^{4-}$  group in apatite. Another separate category is two divalent alkaline earth cations replaced by one trivalent rare earth ion and one monovalent alkaline earth cations, following the pattern as:  $2\text{Sr}^{2+} = \text{La}^{3+} + \text{Na}^+$ . The La-Na combination reduces the symmetry of the atomic arrangement from  $P6_3/m$  to  $P3$  [2]. Follow these ideas, we generate the new phosphor-silicate apatite  $\text{Sr}_3\text{LaNa}(\text{PO}_4)_2\text{SiO}_4$ .

In this study, a series of  $\text{Eu}^{2+}$ -activated novel phosphor-silicate apatite  $\text{Sr}_3\text{LaNa}(\text{PO}_4)_2\text{SiO}_4$  phosphors were synthesized via a conventional high temperature solid-state reaction. The XRD results revealed that the phosphors possessed single-phase and the incorporation of small amount  $\text{Eu}^{2+}$  ions did not induce any significant changes in the crystal structure. The reflectance spectra showed an overall red shift of the wavelength to 700 nm. The two different crystallographic sites of  $\text{Eu}^{2+}$  ions had been confirmed by their lifetimes. Energy transfer of two kinds  $\text{Eu}^{2+}$  centers were demonstrated both from dipole-dipole interaction. All of the phosphors exhibited strong broad absorption bands in the near ultraviolet (near-UV) range, revealing the phosphor-silicate phosphor interesting for application in the output wavelength of the near-UV used phosphor-converted LED chips.

## References

- [1] X. Wang, J. Gan, Y. Huang, H.J. Seo, The doping concentration dependent tunable yellow luminescence of  $\text{Sr}_5(\text{PO}_4)_2(\text{SiO}_4):\text{Eu}^{2+}$ , *Ceramics International*, 38 (2012) 701-706.
- [2] J.F. Rakovan, J.M. Hughes, Strontium in the apatite structure: strontian fluorapatite and belovite-(Ce), *The Canadian Mineralogist*, 38 (2000) 839-845.

## Figures

