

## Characterization of narrow-band emitting phosphor $\text{Na}_5\text{Al}_3\text{F}_{14}:\text{Eu}^{2+}$ discovered by local structure similarity

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Phosphor-converted light-emitting diodes (pc-LEDs) have applications in various fields, taking advantages of their high energy efficiency and long lifetime. The emission color of the phosphor is derived from the luminescence spectrum, especially the excitation, emission wavelength, and the full width at half maximum (FWHM). Narrow-band emitting phosphors are utilized for the backlight of liquid crystal displays (LCDs) to improve the color purity of red-green-blue light and expand the color gamut of display. The nitride phosphor  $\text{SrLiAl}_3\text{N}_4:\text{Eu}^{2+}$  with the  $\text{UCr}_4\text{C}_4$ -type structure has attracted much attention because it has the narrow-band red emission [1]. However, the discovery of the narrow-band emitting phosphors is a challenging program because the relationship between the full width at half maximum (FWHM) and the local structure around  $\text{Eu}^{2+}$  is still unknown.

Data-driven approach is an effective technique to search the host material of the narrow-band emitting phosphors. Herein, we discovered a new narrow-band emitting phosphor  $\text{Na}_5\text{Al}_3\text{F}_{14}:\text{Eu}^{2+}$  by a local structure similarity (LSS) [2]. 2D t-distributed stochastic neighbor embedding (t-SNE) plot for the 8-coordinated local structures are shown in Fig. 1. This plot revealed that the local structure of Na1-site of the  $\text{Na}_5\text{Al}_3\text{F}_{14}$  located to near the Sr-sites of the narrow-band emitting phosphor  $\text{SrLiAl}_3\text{N}_4:\text{Eu}^{2+}$ , indicating that the  $\text{Na}_5\text{Al}_3\text{F}_{14}$  is a suitable host material for the  $\text{Eu}^{2+}$ -activated narrow-band emitting phosphor. We successfully synthesized a powder of the narrow-band emitting phosphor  $\text{Na}_5\text{Al}_3\text{F}_{14}:\text{Eu}^{2+}$  by a solid-state reaction method.  $\text{Na}_5\text{Al}_3\text{F}_{14}:\text{Eu}^{2+}$  exhibited a narrow-band emission at 396 nm with a full width at half-maximum of 30 nm.

References: [1] P. Pust et al., *Nature Mater.* **13** (2014) 891-896, [2] S. Takemura et al., *Sci. Technol. Adv. Mater.* **22** (2021) 185-193.

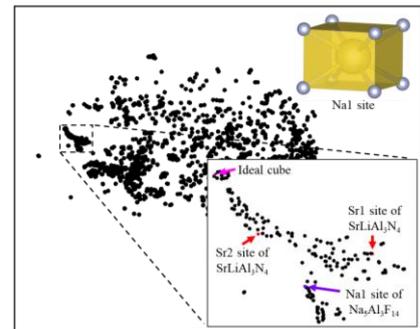


Fig. 1. 2D t-SNE plot for 8-coordinated alkali-centered local structure.