X-ray Powder Diffraction Analysis of the Novel Phosphors

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White light-emitting diodes (LEDs), which are performing with the combination of blue emitting LEDs and yellow phosphors, are considered as the next-generation light source. In addition, it has been announced by the government that incandescent lamps are banned to use after 2012 in Taiwan. The selection of applied phosphors is an important issue. Garnet $Y_3Al_5O_{12}$: Ce^{3+} (YAG: Ce^{3+}) phosphors are commercially available yellow phosphors in white LEDs [1]. However, several shortcomings such as low color stability, low color rendering index (CRI), and low color reproducibility, limit the scope for sustained applications [2]. To overcome these drawbacks, researchers work on looking for alternative luminescent materials. Recently, nitride-based phosphors attract researcher's attentions due to their high structural strength and excellent thermal stability. In this study, we developed a novel nitride phosphor, YSNC, which is considered a potential phosphor for LED-based application under UV excitation. The phase and purity of the products were identified by using high energy (λ = 0.774906 Å) X-ray diffraction (XRD) at beam line 01C2 of National Synchrotron Radiation Research Center (NSRRC) in Taiwan. The lattice constants were examined by fitting the full profile XRD patterns using the Rietveld method within the program GSAS.

Figure 1 illustrates the experimental XRD pattern of the solid-state derived YSNC phosphor heated at 1500°C for 20 h in the reducing atmosphere. The obtained diffraction pattern was refined using the program GSAS based on the Rietveld refinement method. The reliability factors, wR_p and R_p, were converged to 0.0604 and 0.0464, respectively. Based on the refined results, YSNC phosphors crystallized in monoclinic with a space group $P2_1/c$ (no. 14). The lattice parameters were obtained as a = 5.9659 Å, b = 9.9551 Å and c = 11.9501 Å. This structural analysis is helpful for us to make better understand of this novel material. The photoluminescence properties also can be explained through the structural information.

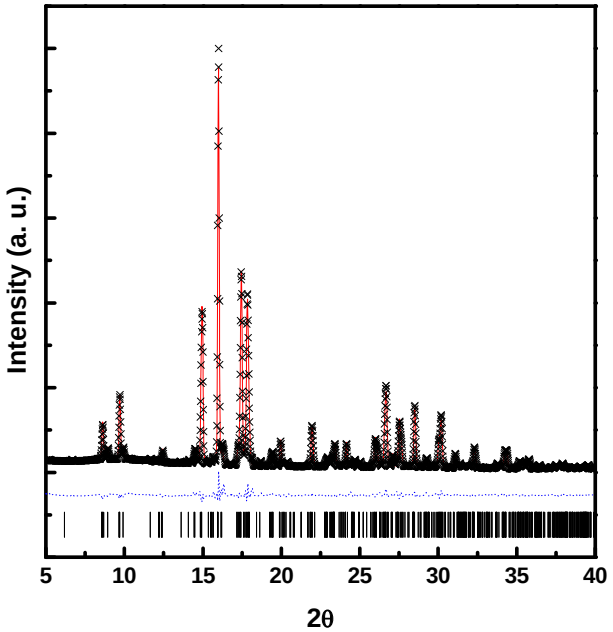

Fig. 1: Measured (×) and calculated (solid line) X-ray diffraction pattern of YSNC phosphor with difference profile (dot line) and positions of all the reflections (vertical bars).

References

[1] M. Yamada, Y. Narukawa, and T. Mukai, Jpn. J. Appl. Phys. **41**, L246 (2002).

[2] J. S. Kim, P. E. Jeon, J. C. Choi, H. L. Park, S. I. Mho, and G. C. Kim, Appl. Phys. Lett. **84**, 2931 (2004).