Approach for AlN White-light luminescence by adjusting the bivalence and trivalence of Eu doped ratio

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Light-emitting diodes (LEDs), made from YAG phosphor and GaN films, are highly efficient lighting sources that save a great deal of energy and money[1]. In order to reduce the Stokes energy conversion losses between the film and phosphor and simplify the manufacturing process, we use AlN as a host material and doped with Eu to produce white luminescence by tuning the trivalence and bivalence of Eu ratios[2]. The luminescence of AlN:Eu excited by a 260 laser integrated in the visible light wavelength shifted from blue to the red light zone in the CIE 1931 chromaticity coordinates as the Eu^{3+} increased, which was validated by X-ray absorption near edge structure (XANES) method.

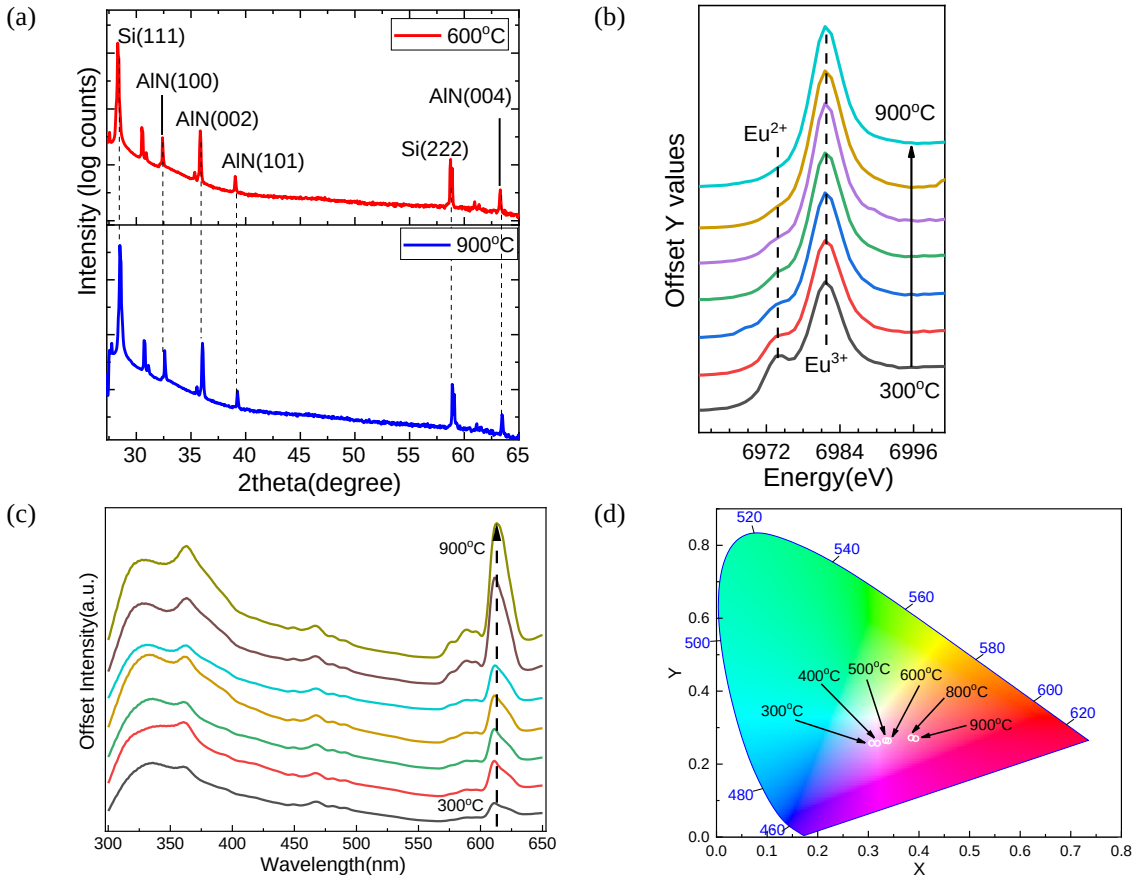

Fig. (a) XRD spectrum of AlN thin film grown on Si(111) substrate annealing at 600°C and 900°C after growth. (b) In the XANES, the Eu^{2+} ions transferred to trivalent states when the annealing temperature increased was found by observing the peak intensity changes. (c) The intensity of peak at 612nm due to $^5D_0$-$^7F_2$ of Eu^{3+} becoming higher with the annealing temperature rising. (d) The light color varied shown by CIE 1931 color space.

References

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[2] Yin LJ, Zhang SH, Wang H, et al. Direct observation of Eu atoms in AlN lattice and the first-principles simulations. J. Am. Ceram. Soc. 2019; 102:310-319.