広色域ディスプレイ用バックライトLED ～ Eu^{2+}賦活β-sialon蛍光体、Mn^{4+}賦活K_2SiF_6蛍光体

Wider Color Gamut LED Backlight using β-sialon:Eu^{2+} and K_2SiF_6:Mn^{4+} Phosphors

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The ever-changing technologies make it come true or get better in the image quality and color saturation of liquid crystal displays used in televisions, mobile phones, computer, tablet PCs and car navigators, of which the backlight technology contributes greatly to these improvements. Recently, phosphor-converted white light-emitting diodes (wLEDs) are considered as emerging backlight units for replacing conventional CCFL (cold cathode-fluorescence lamps) ones because they promise a thinner, lighter, brighter, and more vivid display.

To date, both the narrow-band β-sialon:Eu^{2+} and the deep-red $CaAlSiN_3$:Eu^{2+} are accepted as the most suitable phosphors for wLED backlights due to their high efficiency, high stability and reliability. On the other hand, $CaAlSiN_3$:Eu^{2+} has some drawbacks that prevent it from achieving much larger color gamut and higher brightness of the backlight: (i) a broader emission spectrum covering a considerable amount of the spectral energy that is lost after filtering, and (ii) a large spectral overlap between the excitation spectrum of $CaAlSiN_3$:Eu^{2+} and the emission spectrum of β-sialon:Eu^{2+} that increases the usage amount of the green phosphor. Therefore, it is essential to find an alternative narrow-band red phosphor to further enhance the color reproducibility and brightness of the wLED backlight. K_2SiF_6:Mn^{4+} is such a red phosphor that has very sharp line spectra. In this work, we attempted to combine both of the narrow-band KSF:Mn^{4+} and β-sialon:Eu^{2+} phosphors with an InGaN blue LED to fabricate wLED backlight. The prepared three-band wLEDs have color temperatures of 7828, 8114 and 8611 K for LCD displays and a luminous efficacy of 91–95 lm/W. The calculated color gamut is 94–96% relative to the NTSC standard in the CIE 1976 color space, respectively (Fig.1). It indicates that both of the narrow-band K_2SiF_6:Mn^{4+} and β-sialon:Eu^{2+} phosphors can be considered as the most suitable luminescent materials for use in large color gamut and high efficiency wLED backlights.

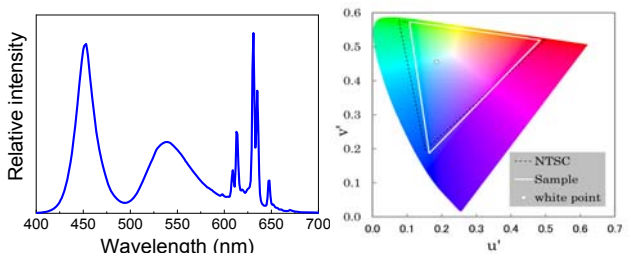

Figure 1 EL spectrum (left) and the CIE 1976 color coordinates (right) of the wLED (8611 K).

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Reference

1. L. Wang, X.J. Wang, K. Takahashi, K.-i. Yoshimura, M. Izumi, N. Hirosaki, and R.-J. Xie, *Opt. Express*, **2015**, 23, 28707-28717.

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