

Phosphors for White Light-Emitting Diodes in the Applications on Illumination and Back Light with Energy Saving

Chun Che Lin (林群哲) and Ru-Shi Liu* (劉如熹)
Department of Chemistry, National Taiwan University

Abstract

We synthesize the UV-LEDs excitable phosphors and the Blue-LEDs excitable phosphors for white light-emitting diodes (WLEDs) in the applications on illumination and back light with energy saving. In the UV-LEDs excitable range, we emphasize the physical and chemical properties of the orthophosphate host family, $ABPO_4$, RE (A = Li, K, B = Sr, Ba; RE = Eu^{2+} , Tb^{3+} and Sm^{3+}). The desired single-mass yellow phosphor is successfully screened out from the $YVO_4:Bi^{3+}, Eu^{2+}$ system by using a combinatorial chemistry approach. $BaMgAl_{10}O_{17}$ (BAM) co-doped with Eu^{2+} and Mn^{2+} was synthesized in a solid-state reaction and their luminescence properties were investigated as functions of the concentrations of the sensitizer and activator. On the other hand, additional Ce^{3+} doping improved the luminescence of $Li_2SrSiO_4:Eu^{2+}$, which was a yellow phosphor for ultraviolet or blue light emitting diodes. The proposed argument was validated with the first principle calculation about the defects formation energies. Furthermore, a mixture of $Y_2Al_2O_7:Ce^{3+}$ (YAG:Ce) and $CaSiAl_2N_6:Eu^{2+}$ was coated on a blue LED, the resultant WLED had a high luminous efficiency of $\eta_e = 68$ lm/W, a high color rendering index of $R_a = 93$, and a color temperature of $T_c = 3,007$ K (at 50 mA).

UV-LEDs Excitable

Blue-LEDs Excitable

