Temporal Changes in Optical Characteristics of White Light Emitting Diodes under UV Irradiation

Bong-Jin Cho, Ji-Sun Kim, Jae-Hyeon Ko*
Department of Physics, Hallym University, ChunCheon city, Gangwondo 200-702, Korea

Tel.:82-33-248-2056, E-mail: hwangko@hallym.ac.kr

White light emitting diodes (LEDs) consist of blue LED chips and wavelength-converting materials such as phosphors or quantum dots.[1] Recently, ultra-violet (UV) LED chips have attracted attention because tri-color phosphors may be combined with UV-LED to realize white light sources of high color rendering index. In this case, all the materials comprising the white LED should not degrade under UV irradiation. The purpose of this study is to investigate the effect of UV irradiation on the optical characteristics of white LEDs.

In this study, we used near-UV lamp (λ=365nm) as a UV source. A conventional white LED was used, which was constructed by using a blue chip(λ=450 nm, IWS-L5056-UB-K3) and phosphor materials(YAG($Y_3Al_5O_{12}$:Ce), RG(Red+Green), LuAg($A_{l5}Lu_3O_{12}$)). Phosphor particles were mixed in an epoxy (NOA 65), and this mixture was coated on the blue chip and cured under UV source. After completion of white LED, it was put under UV lamp at the irradiation of 0.405 cm^2/W, and its optical characteristics were measured every 100 hours. Fig. 1 shows the change in the emitting spectrum as a function of the UV irradiation time for the YAG-included white LED. Fig. 2 shows the change in the color coordinates for the total irradiation time of 800 hours. The total changes in the color coordinates are Δx=0.013 and Δy=0.014. Fig. 3 shows the change in the luminance as a function of the irradiation time. Fig. 1 and Fig.3 show that the overall spectral characteristics and the luminance do not change over the irradiation time of 800 hours. Therefore, it is concluded that the UV irradiation affects only the color coordinates of the YAG-included white LED. This may be attributed to the chemical change in the epoxy resin caused by the UV irradiation. Some chemical bonds in the resin may be broken by the UV photons, and so-called yellowing phenomenon may occur. Detailed comparision of three kinds of white LEDs will be presented.

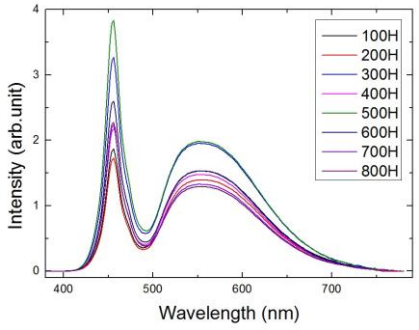

Fig. 1

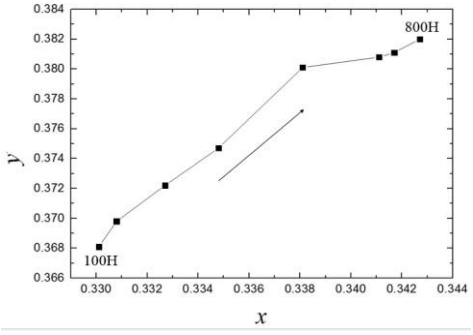

Fig. 2

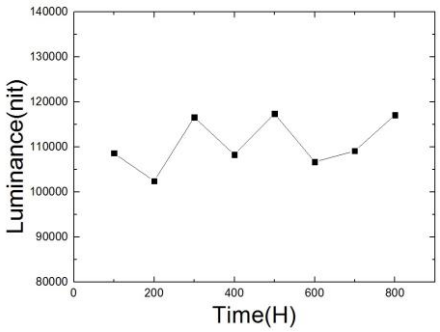

Fig. 3

Fig. 1. Change in the emitting spectrum of a YAG-included white LED as a function of the irradiation time.
Fig. 2. Change in color coordinates of a AG-included white LED as a function of the irradiation time.
Fig. 3. Change in the luminance of a YAG-included white LED as a function of the irradiation time.

References

1. E. F. Schubert, *Light-emitting Diodes* (Cambridge University Press, Cambridge, New York, 2006)