Luminescence properties of $YAl_3(BO_3)_4$:Gd phosphor under vacuum ultraviolet excitation

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Recently, new phosphors with highly efficient excitation are required for mercury-free fluorescent lamps and plasma display panels. It was reported that the fluoride phosphors doped with Gd^{3+} and Pr^{3+} ions have the strong ultraviolet (UV) emission under the excitation by vacuum-ultraviolet (VUV) light [1]. In the YF_3:Gd,Pr phosphor, the photoemission line is observed at 311 nm and originated from $^6P_{7/2}$ to $^8S_{7/2}$ transition of the Gd^{3+} ions. The high intensity of 311-nm emission is due to the $4f^2$-4f5d allowed transitions of Pr^{3+} ions and a highly efficient transfer of energy from Pr^{3+} to Gd^{3+} ions. Since this result, it seems that the Pr^{3+} sensitizer is needed for fluoride host crystal in order to make the strong emission of Gd^{3+} ions. On the other hand, in much oxide host crystal it is considered that the photoemission intensity does not increase even if it adds the sensitizer because 4f5d excited state of Pr^{3+} ions exist below 50,000 cm^{-1} [2]. Therefore, we are investigating the new oxide host crystal for emitting the UV luminescence of Gd^{3+} ions strongly under VUV excitation. In this work, we report on a Gd^{3+} ions doped in $YAl_3(BO_3)_4$.

Figure 1 shows the emission and excitation spectrum of $YAl_3(BO_3)_4$:Gd at room temperature. The emission spectrum under the excitation at 160-nm light consists of only a strong emission line at 313 nm. At present, it is about 15 times the peak intensity of 313-nm emission as compared with that of 351-nm emission in $BaSi_2O_5$:Pb (conventional UV phosphor). It is found that the 313-nm emission is effectively stimulated under the excitation in the range below 180 nm.

The flat-type fluorescent lamp was developed using the $YAl_3(BO_3)_4$:Gd phosphor. Figure 2 shows the time dependence of the UV light output for fluorescent lamps. As a result, it has checked that the light output intensity of the new UV-B flat-type fluorescent lamp was maintained for much longer time than that of the UV-A flat-type fluorescent lamp with the conventional phosphor.

Reference

[1] H.Yoshida, M.Minamoto, Y.Nishikage, T.Hirai and S.Sakuragi : The 200th Meeting of the Electrochemical Society, Abstract No.1291 (2001).
[2] P.Dorenbos : J. Lumin. **91,** 91 (2000).
[3] N.Yokosawa, K,Suzuki, E.Nakazawa : Proc. the 9th International Display Workshops, in press, (2002).

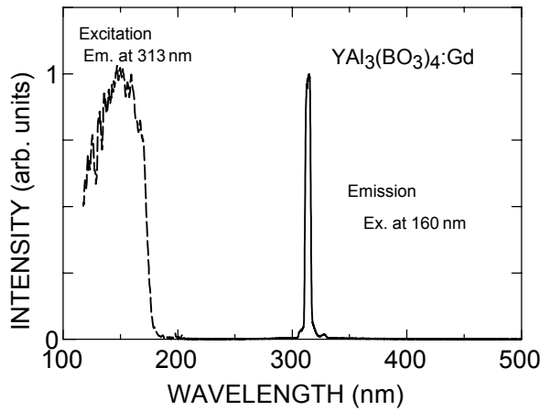

Figure 1 The emission spectrum of $YAl_3(BO_3)_4$:Gd under the excitation at 160-nm light (right side) and the excitation spectrum for the 313-nm emission line (left side).

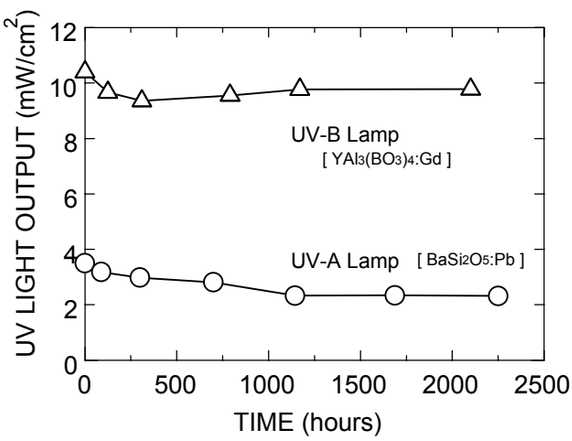

Figure 2 Time dependence of the UV light output for fluorescent lamps with $YAl_3(BO_3)_4$:Gd phosphor (UV-B) and $BaSi_2O_5$:Pb phosphor (UV-A).