Photoluminescence of $LiLa_2BO_5:Eu^{3+}$ as a New Red Phosphor for LEDs

Ryo Yoshimatsu, Hisashi Yoshida

NEC Lighting, Ltd. R&D Division
3-1,Nichiden Minakuchi-cho Koka-gun Shiga
528-8501, Japan
E-mail : hisashi_yoshida@nelt.nec.co.jp

The white LEDs have been of interest as new light sources. It is well known that mainly the white LEDs are two types by the difference of the excitation light. In the case of using blue LEDs, a part of blue light is transmitted by the yellow-whitish emitted phosphors, such as YAG:Ce, and it takes out as white light. On the other hand, in near-ultraviolet (near-UV) LEDs the mixing phosphors of three colors (red, green and blue) are used. This concept is similar with 3-band fluorescent lamps. However, the phosphors with highly efficient excitation by the Blue and/or near-UV light emitted from LEDs are still under development. Especially, the luminescence intensity of red phosphors is not sufficient for use in the general lamps.

We are studying and developing the new phosphors for the white LEDs. As a new red phosphor, we developed the luminescence material of Eu^{3+} ions doped in lithium borate [1]. Figure 1 shows the luminescence spectra of $LiLa_2BO_5:Eu^{3+}$ and $Y_2O_2S:Eu^{3+}$ (commercial red phosphor) at room temperature. The $LiLa_2BO_5:Eu^{3+}$ phosphor has a layered crystal structure. In addition, we are investigating about the structural parameters in detail. The luminescence spectra under the excitation at 394-nm light consist of strong emission lines in the red regions. It is considered that the red emissions of each phosphor are originated from Eu^{3+} ions. As results of excitation spectra in Fig. 2, it is found that the red emissions of $LiLa_2BO_5:Eu^{3+}$ are effectively stimulated under the excitation at 394-, 466- and 535-nm light. The structures of excitation spectra are composed of some narrow-line shapes because of the 4f-4f forbidden transitions in Eu^{3+} ions. However, the width of these photo-absorption lines of $LiLa_2BO_5:Eu^{3+}$ is wider than that of $Y_2O_2S:Eu^{3+}$. Therefore, it is considered that the $LiLa_2BO_5:Eu^{3+}$ phosphor is possible as a new red phosphor with highly luminous efficiency for the white LEDs if the photoemission wavelength of the LEDs chip is in agreement with the peak wavelength of the excitation spectrum.

Reference

[1] R. Yoshimatsu, H. Yoshida, M. Minamoto and Y. Nishikage : INTERNATIONAL DISPLAY WORKSHOP 2003 (IDW'03), (2003) Php-13.

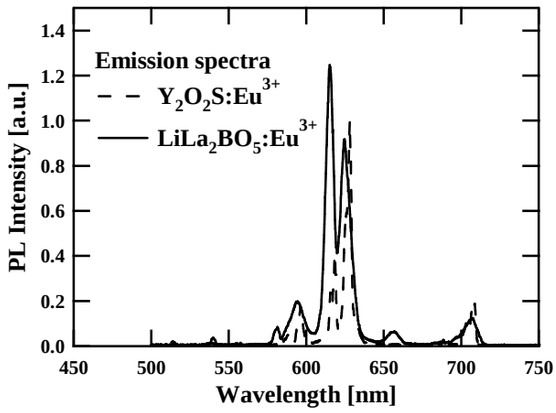

Fig. 1 The luminescence spectra of $LiLa_2BO_5:Eu^{3+}$ (solid line) and $Y_2O_2S:Eu^{3+}$ (dash line) under the excitation at 394-nm light.

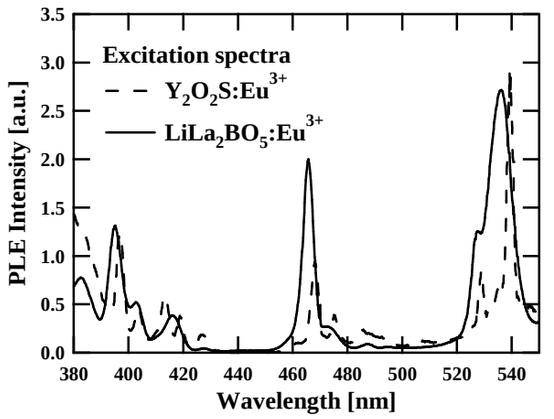

Fig. 2 The excitation spectra of $LiLa_2BO_5:Eu^{3+}$ (solid line) and $Y_2O_2S:Eu^{3+}$ (dash line) for the 615- and 627-nm emission line, respectively.