Yellow YAG:Ce Single Crystal Phosphor with High Thermal Stability for High-Power White Light Source

Taewook Kang[3], Heelack Choi[3], Youngsic Kim[2], Sunghoon Lee[2], Jeonggon Ryu[2], Jaehyoung Park[1], Seokkyu Lim[1] and Jongsu Kim[1]*

[1]Dept. of Display science and Engineering, Pukyong Nat'l University, Busan 608-737, Korea

**Tel.:82-51-629-6416, E-mail: jsukim@pknu.ac.kr*

[2] R&D Business Lab , Hyosung Corporation, Anyang 431-080, Korea

[3]Dept. of Materials Science and Engineering, Pukyong Nat'l University, Busan 608-739, Korea

For high-power light-emitting diode(LEDs) or laser diodes (LD) (> 1 watt per a single package), the conventional structure with yellow phosphor powders dispersed in the organic epoxy resin exhibit a significant drop in efficiency at high blue irradiations and high temperatures (100 ℃ ~ 150 ℃). It is due to burning of organic epoxy resin as well as blackening of phosphor surface. The yttrium aluminum garnet ($Y_{3-x}Al_5O_{12}:Xce^{3+}$, YAG:Ce) has the excellent thermal conductivity (~ 10 W/m·K) compared with other silicate phosphors (~ 1.5 W/m·K). The high thermal conductivity prevents local heating from a concentrated high-power blue irradiation and provide a good lumen maintenance at a high temperature, and thus a long lifetime is expected. Thus a single crystal YAG phosphor is suggested as an alternative to phosphor for high-power lighting source. Consequently we have studied YAG:Ce single crystal phosphor. Yellow-emission YAG single crystal phosphor was grown through a floating zone method. It showed a broader blue excitation and yellow emission spectra with much higher thermal quenching ratio at 200 ℃ of about 92 % due to the f-d transition of Ce^{3+} ion than the conventional powder as seen in Fig. 1. The single crystal as a color conversion material was pumped by a blue laser diode with optical power of 5 watt, and thus high-power white light with color temperature of 5000 K was generated.

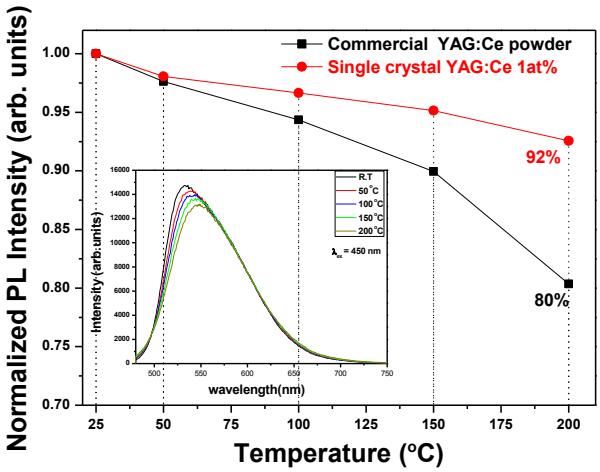

Fig.1. Thermal quenching spectra of YAG Single crystal and commercial powder phosphors

Acknowledgment

This work was financially supported by Hyosung company.