Color-tunable garnet solid-solution phosphor for cost reduction

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Most of lamps based upon phosphor downconversion of blue light-emitting dioes (LEDs) use $Y_3Al_5O_{12}:Ce^{3+}$ garnet (YAG:Ce^{3+}) phosphors mixed in a silicone resin and then coated on top of a blue LED. Garnet structure (cubic, space group *Ia*-3*d*) is recognized as highly stable and efficient host for white LED applications. However, yellow YAG:Ce^{3+} phosphor are associated with patent infrigement while a replacement of lutetium with ytrrium in the smilar structure $Lu_3Al_5O_{12}:Ce^{3+}$ (LuAG:Ce^{3+}) phosphor would raise the cost of the LED device.

In this study, we prepared solid solutions between the garnet structure LuAG:Ce^{3+} and $Lu_2CaMg_2Si_3O_{12}:Ce^{3+}$ (LCMSO:Ce^{3+}), which yields the phosphor $Lu_{2.95-x}Ce_{0.05}Al_{2-2x}Mg_{2x}Al_{3-3x}Si_{3x}O_{12}$. The LCMSO:$Ce^{3+}$ end-member has been reported to have longer emission wavelength compared to LuAG:Ce^{3+} phosphor. Solid solutions between LuAG:Ce^{3+} and LCMSO:Ce^{3+} give highly efficient (QE > 90 %), highly color-tunable (λ_{em} = 521 to 578 nm) phosphors with reduced amount of lutetium that have great potentials for use in white LED lighting.

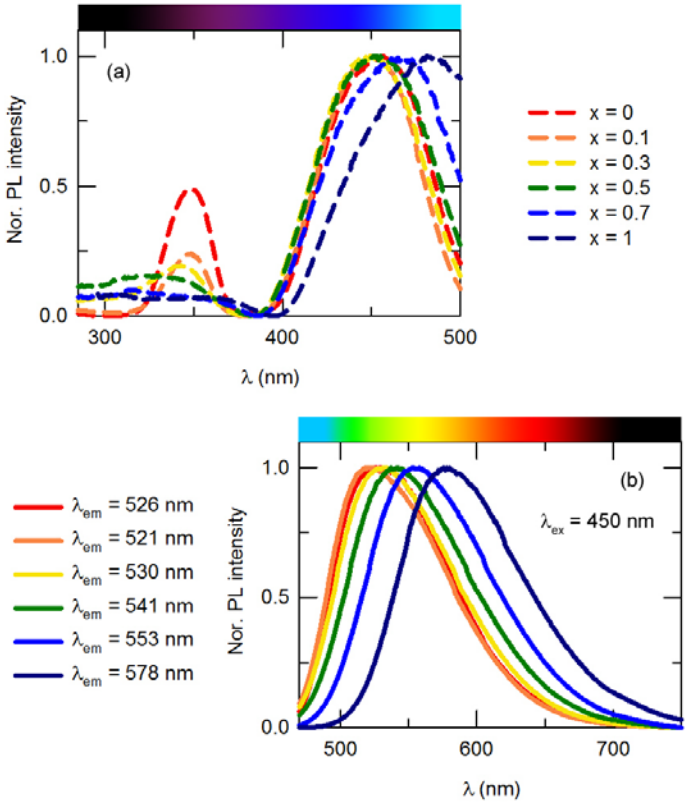

Fig. 1. Photoluminescence (a) excitation spectra and (b) emission spectra of (1-*x*)$Lu_3Al_5O_{12}:Ce^{3+}$-*x*$Lu_2CaMg_2Si_3O_{12}:Ce^{3+}$ at room temperature.

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