

Photoluminescence transparent ceramic with adjustable spectrum for laser lighting

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Laser diodes (LDs) packaged with transparent ceramics show the low thermal expansion coefficient and high thermal conductivity, but there is a problem of the low CRI owing to the lack of red component in current transparent ceramics. Mn^{2+} doped garnet transparent ceramics with adjustable color from yellow to red have been prepared via a solid state reaction-vacuum sintering process, which have a high transmittance of 78.6% at 800 nm. Two main emission peaks of this ceramic is monitored at 590 and 749 nm, the gratifying luminous performance improvement is obtained due to the charge compensation effect, electron cloud expansion effect and efficient energy transfer. LD system fabricated with the obtained ceramics and blue LD shows a high color render index (CRI) of 80, low color temperature (CCT) of 4098 K, and good luminous efficiency of 96.91 m/W.

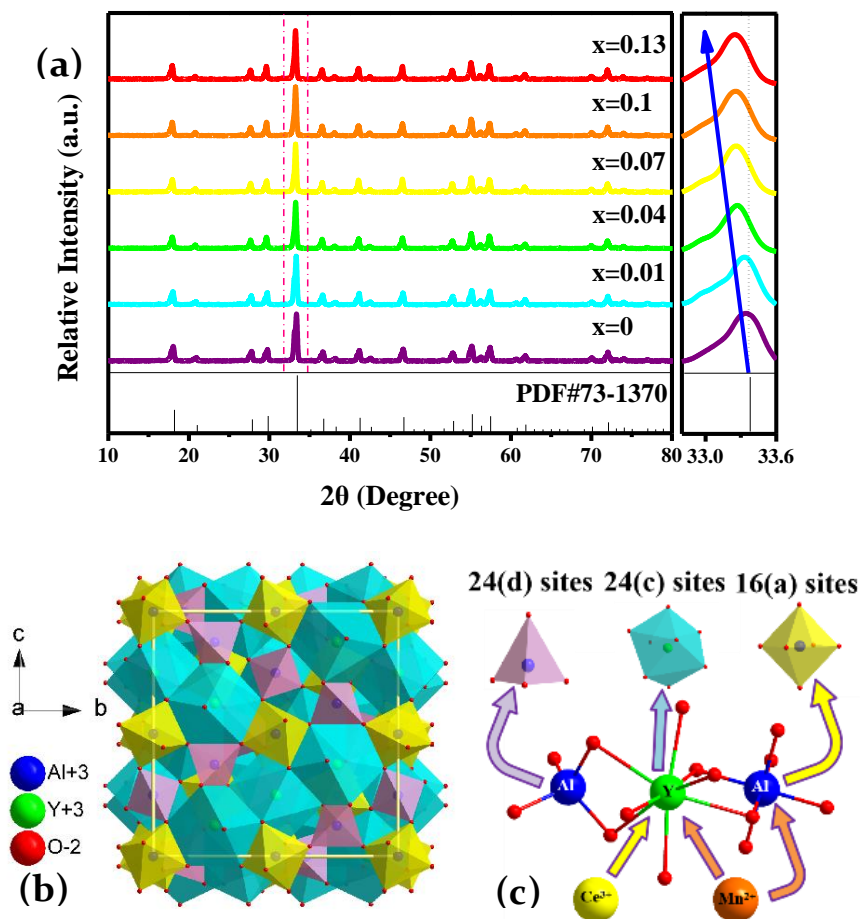


Figure 1. (a) XRD patterns of $YAG:0.06Ce^{3+}, xMn^{2+}$ ($x = 0-0.13$) luminescent transparent ceramic. (b) Schematic crystal structure sketch. (c) Crystal structure atom substitution diagram.

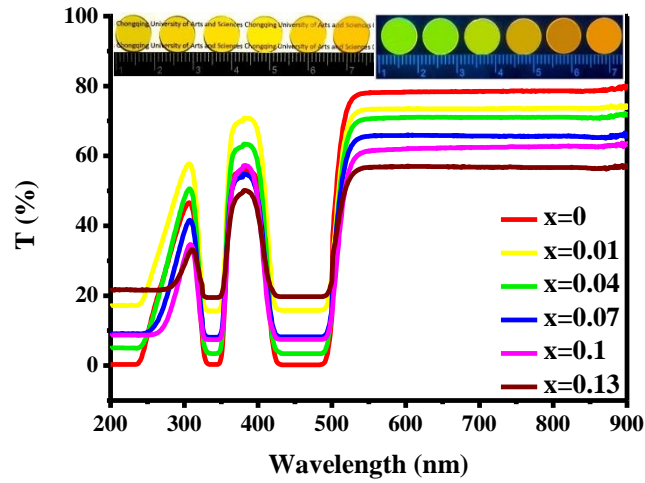


Figure 3. In-line transmission spectrum of fluorescent transparent ceramics YAG:0.06Ce³⁺, xMn²⁺ (x = 0-0.13). The insets are images taken under visible light and 365 nm ultraviolet light.

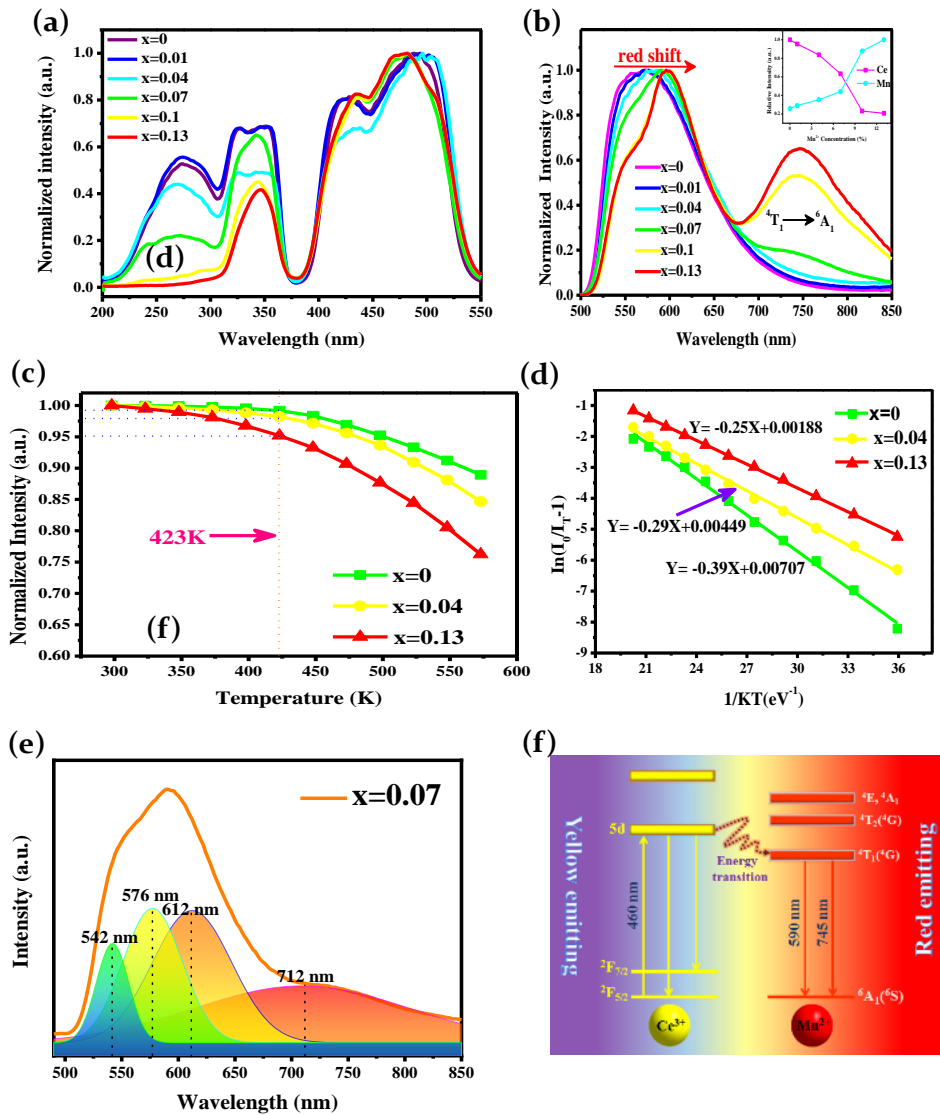


Figure 4. (a) PLE spectra and (b) PL spectra of YAG:0.06Ce³⁺, xMn²⁺ (x = 0-0.13). (c) PL temperature-dependent curve and (d) Plot of $\ln(I_0/I_t - 1)$ against $1/kT$ of YAG:0.06Ce³⁺, xMn²⁺ (x = 0, 0.04, 0.13). (e) PL spectrum fitting of YAG:0.06Ce³⁺, 07Mn²⁺. (f) Schematic illustration of energy transfer process.