Electronic Supplementary Material (ESI) for Journal of Materials Chemistry C.

Electronic Supplementary Information

Formation mechanism, improved photoluminescence and LED applications of red phosphor $K_2SiF_6:Mn^{4+}$

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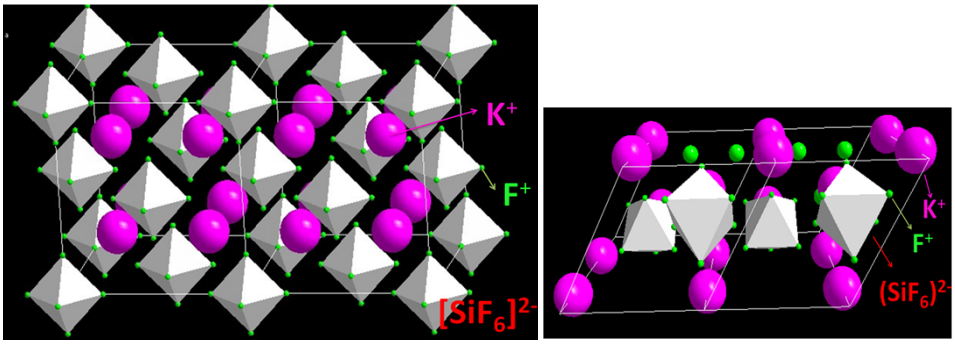
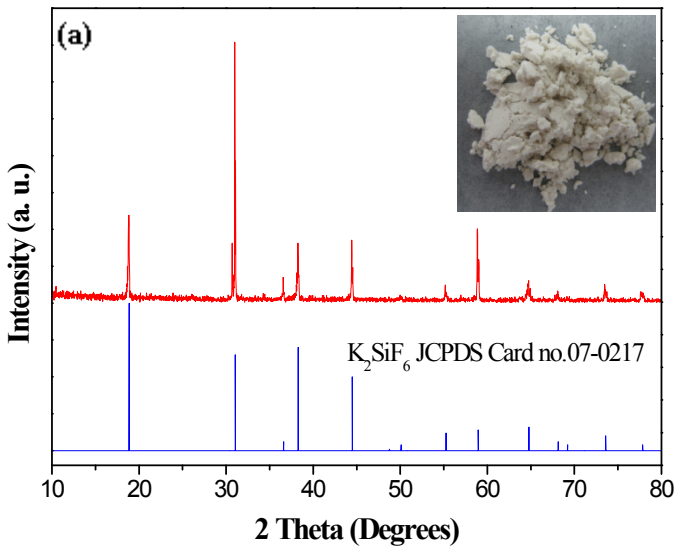


(a) Cubic (b) Hexagonal

Figure S1. The structure projection of K_2SiF_6 with (a) cubic and (b) hexagonal structures plotted by software Diomand 3.0.



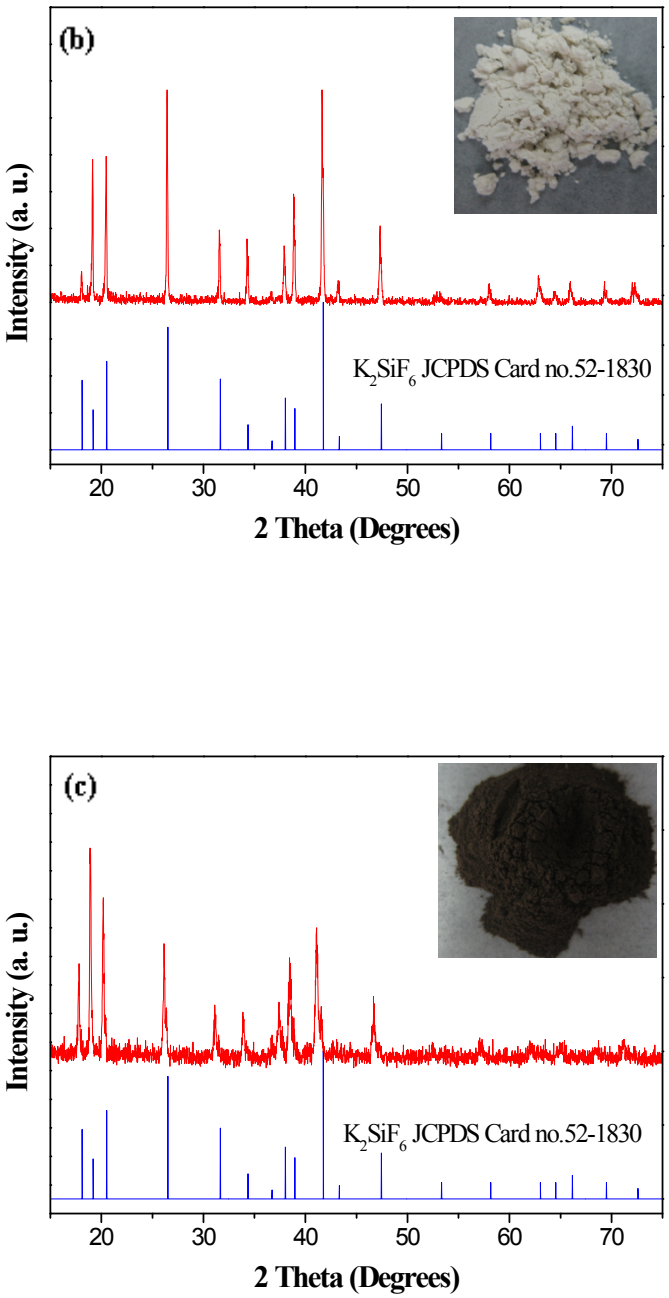


Figure S2. XRD and images of samples (a-c) prepared from (a) 0.505 g KNO_3, 4.45 g $(NH_4)_2SiF_6$, 0.1975 g $KMnO_4$, 20 mLHF and 20mL H_2O, (b) 0.29 g KF, 4.45 g $(NH_4)_2SiF_6$, 0.1975 g $KMnO_4$ and 40 mL 20% HF, (c) 0.29 g KF, 4.45 g $(NH_4)_2SiF_6$, 0.1975 g $KMnO_4$, 0.6 mL H_2O_2 and 40 mLH_2O at room temperature. The three samples show no luminescence under UV lamp.

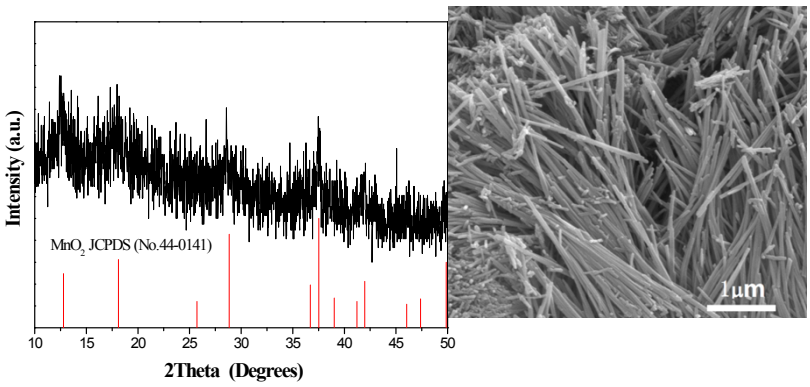


Figure S3. (a) XRD pattern and (b) SEM image of the brown solid sample synthesized from $KMnO_4$ (10.1 mol/L) and HF (wt.10%) in hydrothermal reaction at 120 ^oC for 12 h.

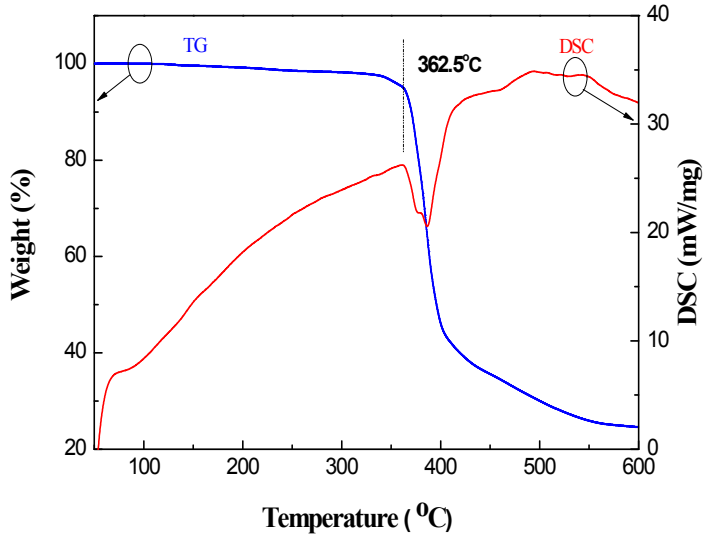


Figure S4 Thermogravimetrics (TG) and different scanning calorimeter(DSC) graphs of as synthesized $K_2SiF_6:Mn^{4+}$ under N_2 atmosphere. The thermal stability of the red phosphor $K_2SiF_6:Mn^{4+}$ is investigated by thermogravimetrics analysis and different scanning calorimeter (DSC; Netzsch STA 449 C, at a heating rate of 10K/min).

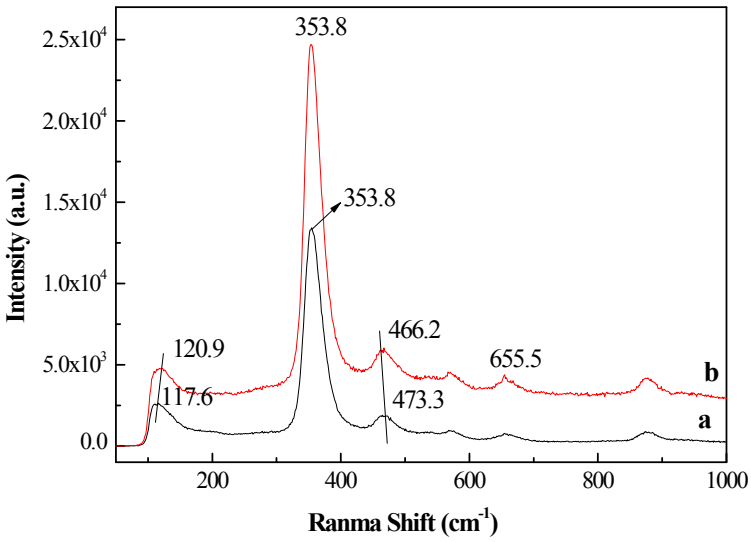


Figure S5. Raman spectra of phosphor (a) undoped K_2SiF_6 and (b) $K_2SiF_6:Mn^{4+}$.

Raman spectra were performed on a JY-T64000 Raman spectroscopy at room temperature with a laser excitation at 632.8 nm (1.96 eV, 3 mW).

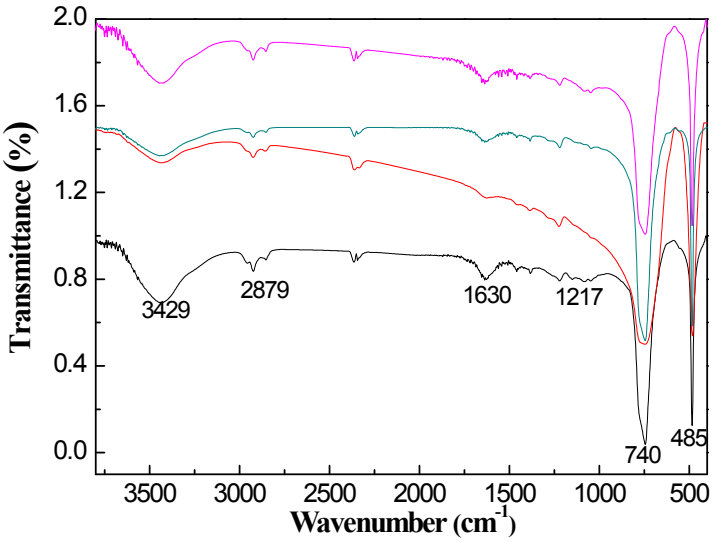


Figure S6. Infrared spectra of phosphors $K_2SiF_6:Mn^{4+}$ named (a) KSFM-1, (b) KSFM-2, (c) KSFM-3, and (d) KSFM-4.

The infrared spectra were performed on Perkin-Elmer 580 B infrared

spectrophotometer using the KBr pellet technique.

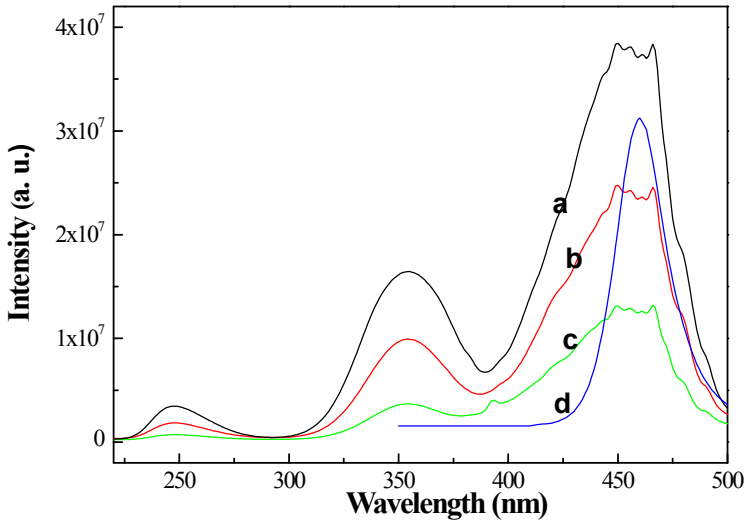


Figure S7. Excitation spectra of red phosphor $K_2SiF_6:Mn^{4+}$ monitored at (a) 628 nm, (b) 612 nm, and (c) 646 nm; (d) curve is normalized electro-luminescence spectrum of InGaN LED chip.

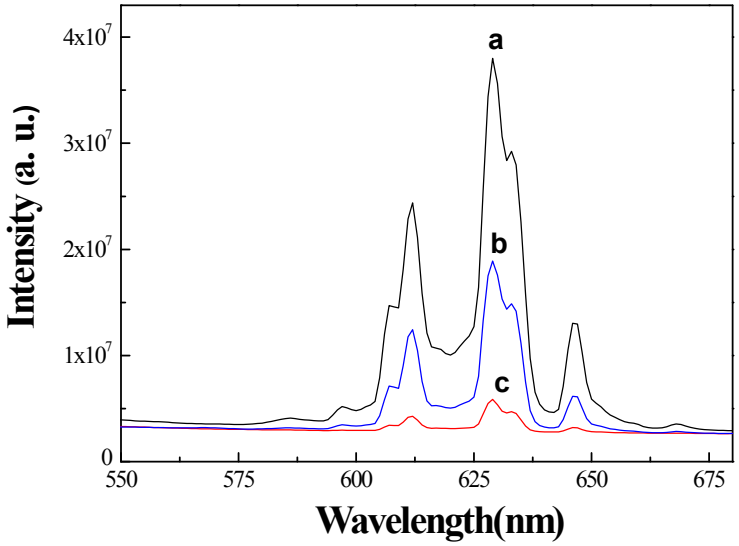


Figure S8. Emission spectra of red phosphor $K_2SiF_6:Mn^{4+}$ excited at (a) 450 nm, (b)

355 nm, and (c) 250 nm.

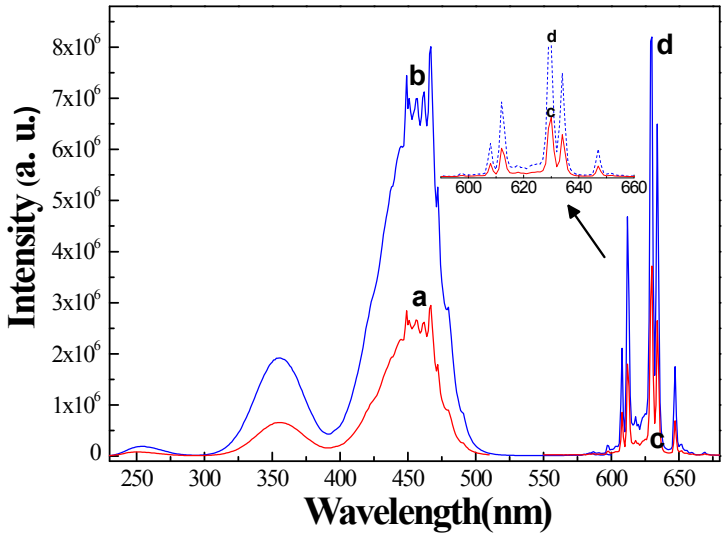


Figure S9. Excitation (a, b: monitored at 629 nm) and emission (c, d: excited at 467 nm) spectra of as-prepared red phosphor $K_2SiF_6:Mn^{4+}$ named KSFM-2 and KSFM-4.

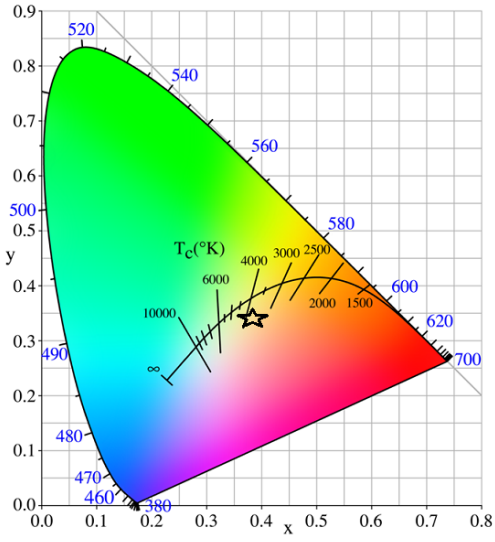


Figure S10. CIE (*X, Y*) coordinate diagram showing chromaticity point (marked by symbol of star) of WLED fabricated with yellow phosphor YAG:Ce and our as-prepared red phosphor $K_2SiF_6:Mn^{4+}$ on GaN chip.