Supporting Information for

Design of phosphor white light systems for high power applications

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Experiment method for preparation of $K_2TiF_6:Mn^{4+}$

The K_2MnF_6 powders:

A mixture of 9.0 g KHF_2 and 0.45 g $KMnO_4$ were dissolved in 30 mL 48% HF to form a purple solution. Then 0.1 mL 30% H2O2 solution was added to the solution drop by drop. The deep solution gradually turned yellow precipitation. The obtained yellow powder was washed with acetone several times and finally dried at room temperature.

$K_2TiF_6:Mn^{4+}$ phosphors:

36 mg of K_2MnF_6 was dissolved in 2 mL 48% HF solution, and then a different amount of commercial K_2TiF_6 powder (0.5 g, 0.75g, 0.9 g, 1g, 2.5g, 5g) was added to the HF solution separately. The liquid-solid mixtures were stirred at room temperature for about 20 minutes. The white powder turned to light yellow after the liquid-solid exchange reaction, indicating the Mn^{4+} doping successfully into the K_2TiF_6 matrix. The obtained light yellow powder was washed with 5% HF twice, then several times with acetone, and finally dried at room temperature.

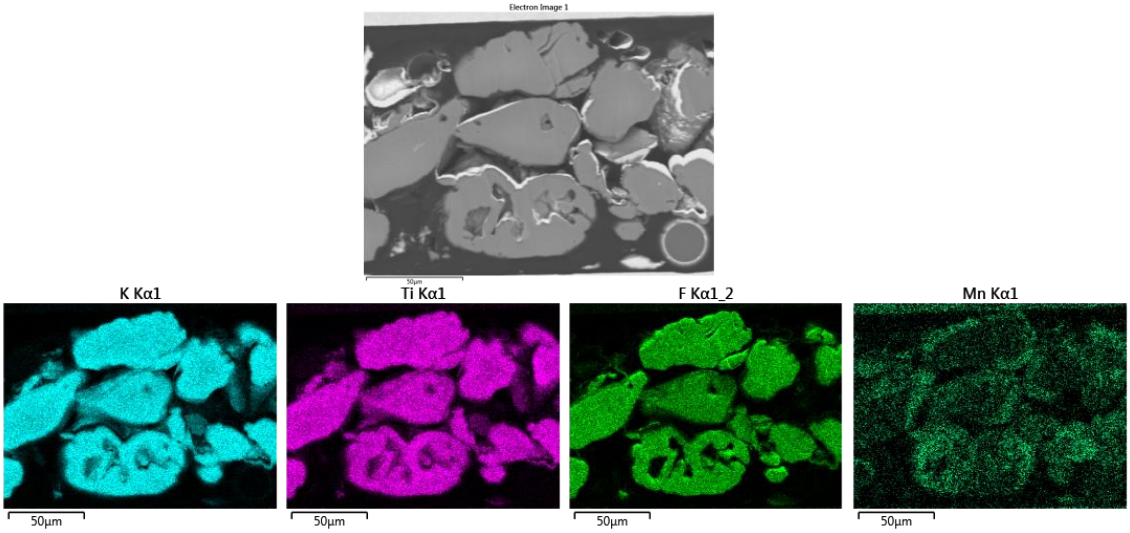

Figure S1 SEM images of a cross-section of K_2TiF_6:Mn^{4+} microparticles for K, Ti, F, and Mn elemental mappings in the same selected areas.

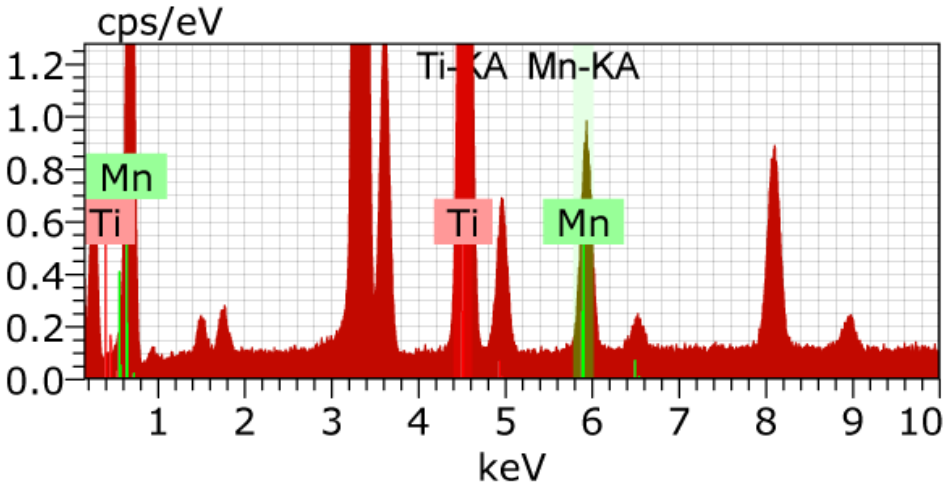

Figure S2. EDS spectrum of the microparticle shows the presence of K, Ti, F and Mn elements.

Photophysical experimental methods

Power Conversion Efficiency

The power conversion efficiency was measured under a high power 442nm laser diode system. The pump was pulsed with a repetition rate of 60 Hz for pulse durations of 300 μs. This laser diode system was set up with 16 laser diodes that provide in excess of 5 kW/cm^2 peak power density. Using a lens system, the emission from the sample was collected and focused onto a UP55N thermal power meter with an aperture of 55 mm. To simulate the thermal effect, the sample was mounted onto an aluminum back with a resistive heater and was controlled with thermal couples and a temperature controller for active feedback.

Photoluminescence Lifetime

The photoluminescence lifetime measurements were obtained using the same laser diode system as the power conversion efficiency setup. The resistive heater sample holder was also utilized in obtaining high-temperature measurements. The collected output was illuminated onto a DET10A biased high-speed silicon photodetector, with an aperture of 0.8 mm^2 and a rise time of 1 ns. The decay curve was then fit to an exponential, and the time constant was extracted.