Supporting Information

for

Unleashing the Glow: Upconverting Nanoparticles Recharge Persistent Luminescent Materials – applications in 3D-printing and optical coding

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1. Ln oleate precursors preparation

In a standard synthesis of rare earth (RE) oleate, 60 mmol of RE oxide (RE_2O_3) was dissolved in a water solution of hydrochloric acid (in 10 mL water to 17 mL acid ratio). The obtained mixture was heated twice to near evaporation of all water, and then the remaining solution was diluted in 80 mL of water. The solution was mixed with 120 mL of ethanol and 210 mL of n-hexane in a three-neck round bottom flask, adding 180 mmol of sodium oleate. After that, the mixture was heated for 18 h at 60 °C under reflux. Next, the hexane phase was collected, and the solvent evaporated, resulting in solid RE oleate.

2. UCNPs purification

Nanoparticles were isolated in the following procedure: 1 – centrifugation of after-synthesis mixture at 8,000 g for 5 min; 2 – dispersing the precipitate in 5 mL of n-hexane and then adding ethanol to the 40 mL total; 3 – dispersing the obtained precipitate in 15 mL of n-hexane and centrifugation at 2,000 g for 5 min; 4 – in the end, the supernatant was agitated with 25 mL of ethanol and centrifuged for 7 min at 10,000 g.

3. Spectroscopic characterization

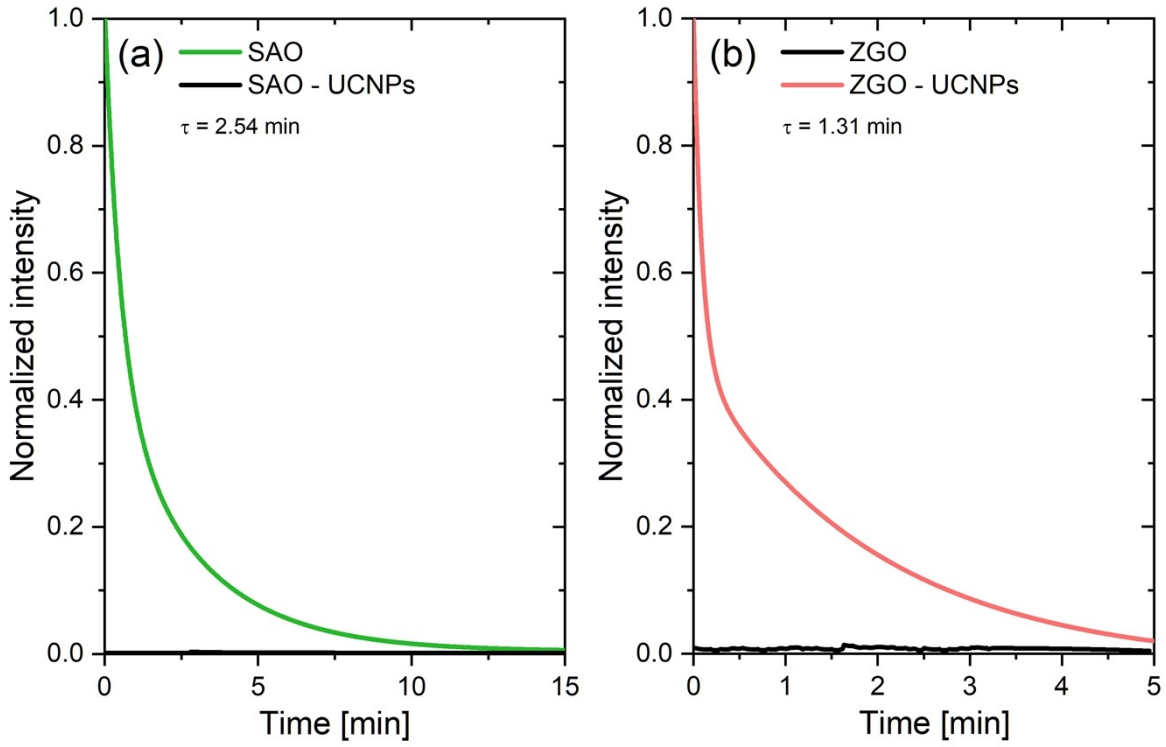

Fig. S1. Normalized decay curves of (a) $SrAl_2O_4:Eu^{2+},Dy^{3+}$ (SAO), $SrAl_2O_4:1\%Eu^{2+},0.5\%Dy^{3+}$-UCNPs (SAO-UCNPs) and (b) $ZnGa_2O_4:0.5\%Cr^{3+}$ (ZGO) and the composite $ZnGa_2O_4:0.5\%Cr^{3+}$-UCNPs (ZGO-UCNPs) materials after 5 min irradiation with a 975 nm laser with a power density of 6 $W \cdot cm^{-2}$. The curves for ZGO and SAO were normalized by dividing them by the maximum emission initensity of the corresponding sample containing UCNPs.

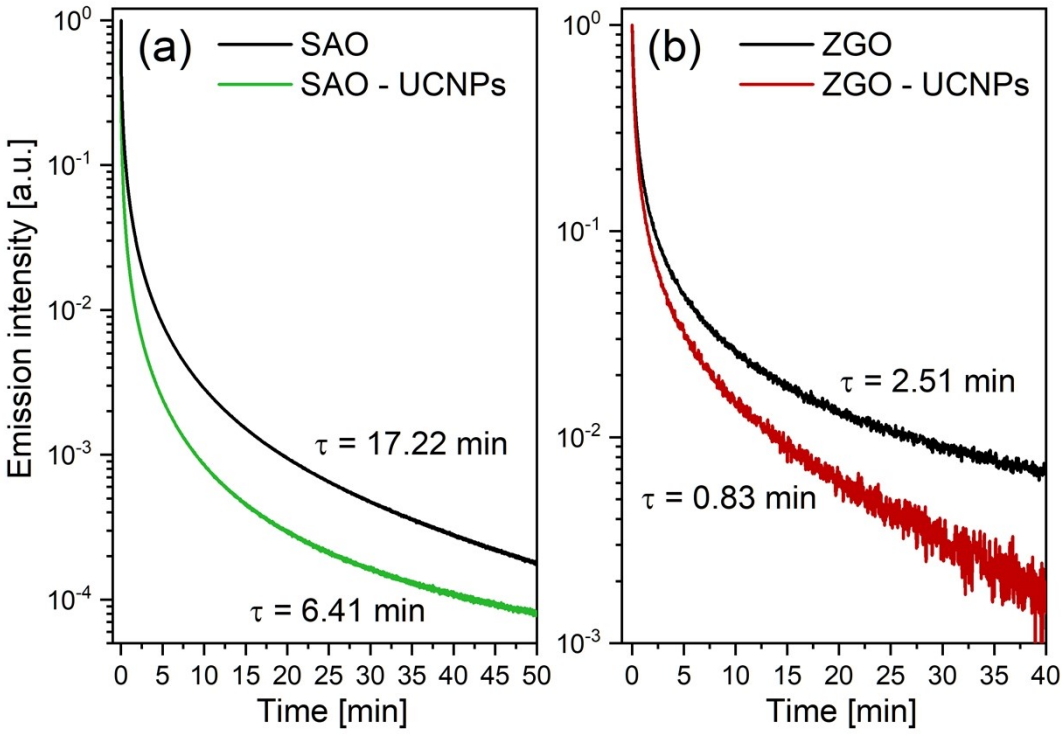

Fig. S2. Normalized decay curves of (a) $SrAl_2O_4:Eu^{2+},Dy^{3+}$ (SAO) and $SrAl_2O_4:1\%Eu^{2+},0.5\%Dy^{3+}$-UCNPs (SAO-UCNPs) and (b) $ZnGa_2O_4:0.5\%Cr^{3+}$ (ZGO) and the composite $ZnGa_2O_4:0.5\%Cr^{3+}$-UCNPs (ZGO-UCNPs) measured under pulsed (5 s pulse) irradiation with a 375 nm 50 mW laser and PMT as a detector.