

Supplementary Information for

## Up-conversion charging of Tb<sup>3+</sup>-activated garnet phosphor

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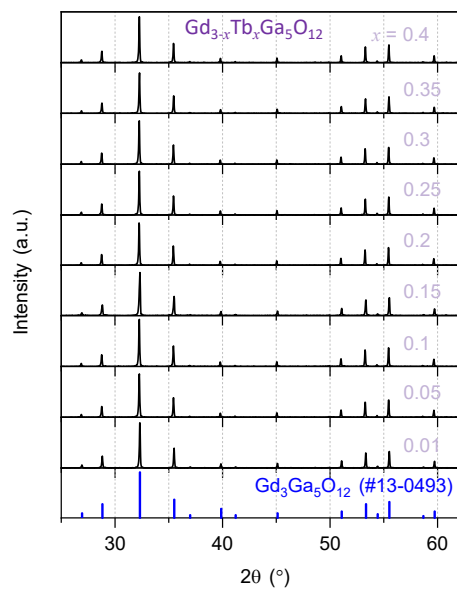
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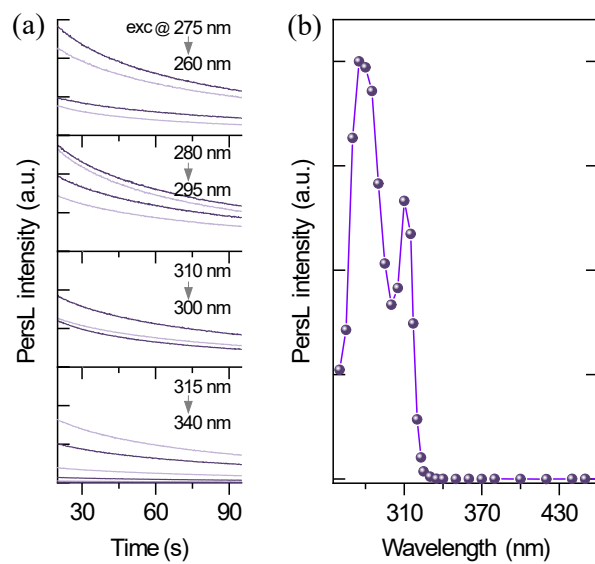
**Brief summary** – This file contains: (1) X-ray diffraction patterns; (2) persistent luminescence excitation spectrum; (3) fluorescence decay curve; (4) UCC persistent luminescence upon illumination with a 375 nm laser; (5) UCC upon illumination by a combined excitation with 488 and 532 nm lasers.

Supplementary material



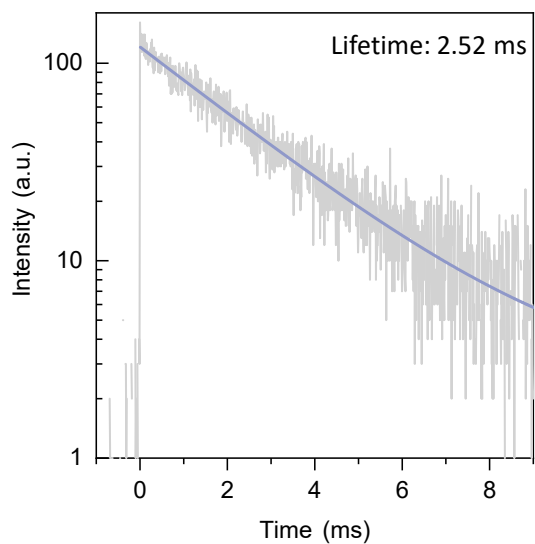
**Fig. S1.** X-ray diffraction patterns of  $\text{Gd}_{3-x}\text{Tb}_x\text{Ga}_5\text{O}_{12}$  ( $x=0.01-0.4$ ) phosphors, showing that there is no impurity phase in the resulting phosphors. These patterns are acquired on an X-ray diffractometer using Cu  $K\alpha_1$  radiation (PANalytical X'Pert Pro).

Supplementary material

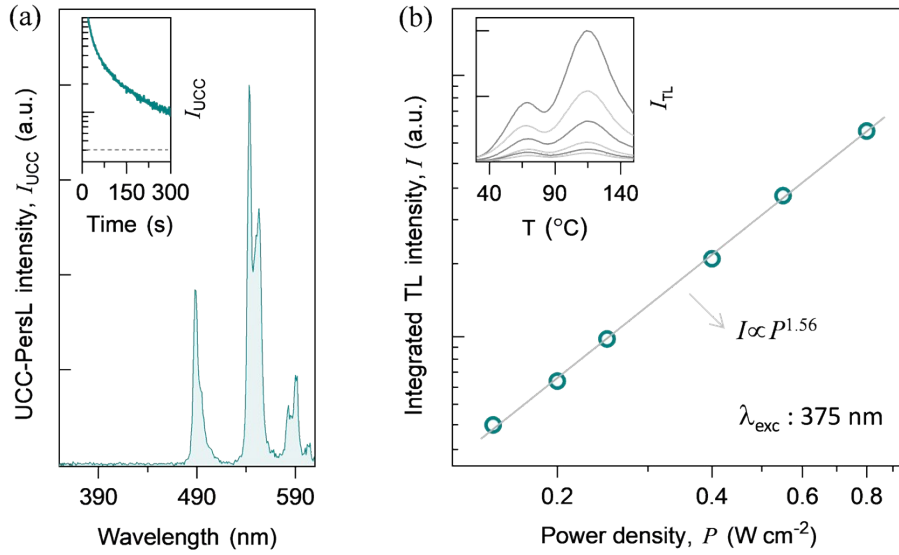


**Fig. S2.** (a) Conventional persistent luminescence (PersL) decay curves for the 310 nm emission recorded after illumination with monochromatic lights over 260–340 nm (from a filtered xenon arc lamp with power densities of 0.11-0.48 mW cm<sup>-2</sup>). (b) PersL excitation spectrum obtained by plotting the PersL intensities as a function of illumination wavelength. The spectrum is the same as the one in Fig. 1(b).

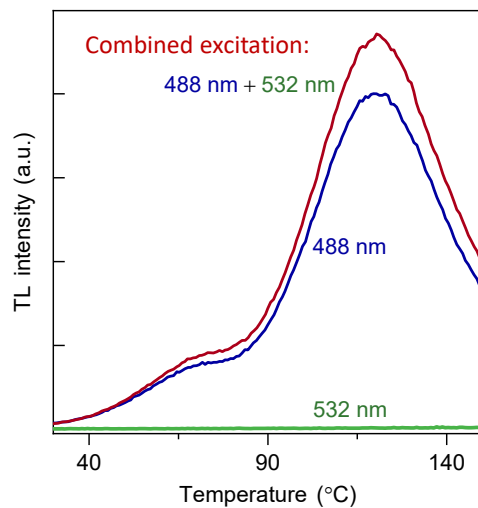
*Supplementary material*



**Fig. S3.** Fluorescence decay of the  $Tb^{3+} \ ^5D_4 \rightarrow \ ^7F_5$  emission (543 nm) in  $Gd_{2.7}Tb_{0.3}Ga_5O_{12}$  upon excitation at 375 nm. The solid line is a fit of the decay, which is exponential with a decay time of 2.52 ms. The decay curve was measured on a Quantaaurus-Tau fluorescence lifetime spectrometer (C11367-34, Hamamatsu Photonics).



**Fig. S4.** Up-conversion charging-induced persistent luminescence (UCC-PersL) and thermoluminescence (TL) of Gd<sub>2.7</sub>Tb<sub>0.3</sub>Ga<sub>5</sub>O<sub>12</sub> phosphor. (a) UCC-PersL emission spectrum recorded at 10 s after the end of 375 nm laser illumination (0.4 W cm<sup>-2</sup> for 10 s). Inset is UCC-PersL decay curve. (b) Laser power density ( $P$ ) vs. integrated TL intensity ( $I$ ). The straight line is a quadratic fit of the data. Inset shows the corresponding TL curves, which are recorded after illuminating the phosphor for 10 s by the laser at different power densities (0.15–0.8 W cm<sup>-2</sup>).



**Fig. S5.** TL curves recorded after illuminating the  $\text{Gd}_{2.7}\text{Tb}_{0.3}\text{Ga}_5\text{O}_{12}$  phosphor by a combined excitation with 488 and 532 nm lasers. The power densities of the 488 and 532 nm lasers are  $0.5$  and  $2 \text{ W cm}^{-2}$ , respectively. The present result confirms that the UCC excitation involves an excited-state absorption process.