

Electronic Supplementary Information

**Doping-Induced Evolutions of PbWO₄ Mesocrystals in
Morphology and Optical Properties**

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EXPERIMENTAL SECTION

Materials: All chemicals were of analytical grade and were used as received without further purification. Deionized water was used throughout. Sodium tungstate dehydrate ($\text{Na}_2\text{WO}_4 \cdot \text{H}_2\text{O}$), lead acetate trihydrate ($\text{Pb}(\text{NO}_3)_2 \cdot 3\text{H}_2\text{O}$), yttrium nitrate hexahydrate ($\text{Y}(\text{NO}_3)_3 \cdot 6\text{H}_2\text{O}$) and ethylene glycol were all supplied by Sinopharm Chemical Reagent Company.

Preparation of Y-doped PbWO_4 Mesocrystals: In a typical procedure, x mmol of yttrium nitrate hexahydrate and $5-x$ mmol of lead acetate trihydrate were dissolved in a mixed solvent with 70 ml ethylene glycol (EG) and 30 ml distilled water to form solution *A*. Meanwhile, solution *B* was obtained by dissolving 5 mmol of sodium tungstate dehydrate in the same EG-water mixture with a total volume of 100 mL. Afterwards, solution *B* was slowly added into the solution *A* to obtain milky precipitation at room temperature. After continuous stirring for 1 hour, the as-obtained milky precipitation was kept at a constant temperature ($25 \pm 2^\circ\text{C}$) in order to naturally settle on the bottom of beaker. Then, as-prepared samples were washed twice using the same EG-water mixed solvent, and further cleaned three times with water and absolute alcohol respectively, and finally dried in a vacuum at 60°C for 4 hours.

Characterization: X-ray powder diffraction (XRD) patterns of as-synthesized samples were performed using a Rigaku D/max-RB diffractometer with $\text{Cu K}\alpha$ radiation ($\lambda = 1.5406\text{\AA}$). Morphology of the products was acquired on a JEOL-6300F and Zeiss-Ultra 55 field-emission scanning electron microscopy (FE-SEM). High-resolution transmission electron microscopy (HRTEM) images and selective area electron diffraction (SAED) were recorded with a JEOL-2010 and Zeiss Liber 200 transmission electron microscopy. The atomic ratios of Pb^{2+} and Y^{3+} ions of as-prepared samples were recorded by X-ray fluorescence (XRF, Axios) and the ratio of each sample was the average value after three measurements. Raman spectra were carried out on a LABRAM-HR Confocal Laser Micro-Raman spectrometer using an Ar^+ laser with 514.5 nm at room temperature. UV-Vis diffuse reflection spectra of samples were obtained from Shimadzu UV-3150. Photoluminescence of as-obtained

samples were recorded on a Fluorolog-3 Jobin Yvon spectrophotometer using a Xe lamp as the excitation source at room temperature.

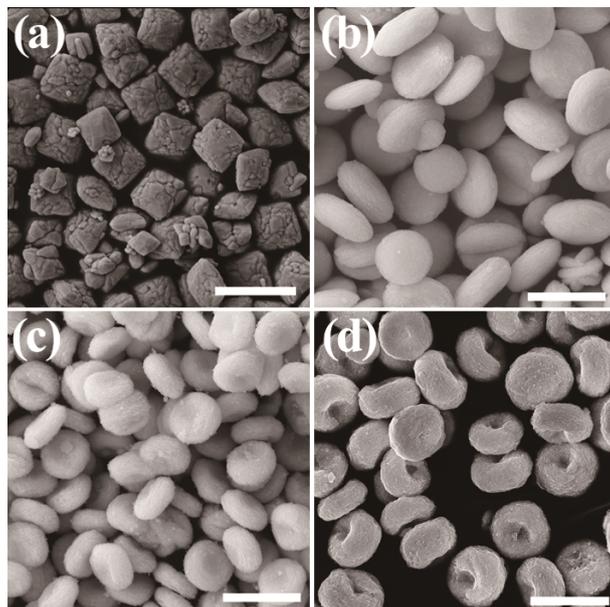


Fig. S1 Overview FESEM images of Y^{3+} -doped $PbWO_4$ mesocrystals with different Y^{3+} doping concentrations. (a) 0 mol%, (b) 5 mol%, (c) 10 mol%, (d) 15 mol%. The scale bar in all images corresponds to 2 μm .

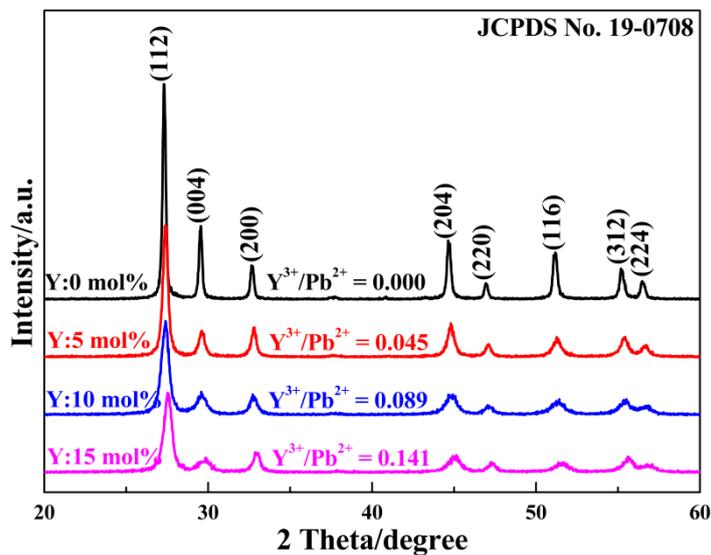


Fig. S2 Power X-ray diffraction (XRD) patterns of Y-doped $PbWO_4$ mesocrystals with different Y^{3+} doping amounts. The atomic ratios of Y^{3+} to Pb^{2+} were average values after three XRF measurements.

Table S1. Various parameters such as peak position and calculated coherent length of D_{hkl} of XRD peaks of Y-doped PbWO_4 mesocrystals shown in Figure 1.

Samples	(112)		(004)		(200)	
	2 Theta	D_{112} (nm)	2 Theta	D_{004} (nm)	2 Theta	D_{200} (nm)
Y-0	27.31	36.1	29.54	36.3	32.68	31.5
Y-5	27.39	21.4	29.57	20.2	32.72	24.4
Y-10	27.41	15.3	29.62	12.7	32.81	17.9
Y-15	27.55	12.6	29.83	11.5	32.95	16.4

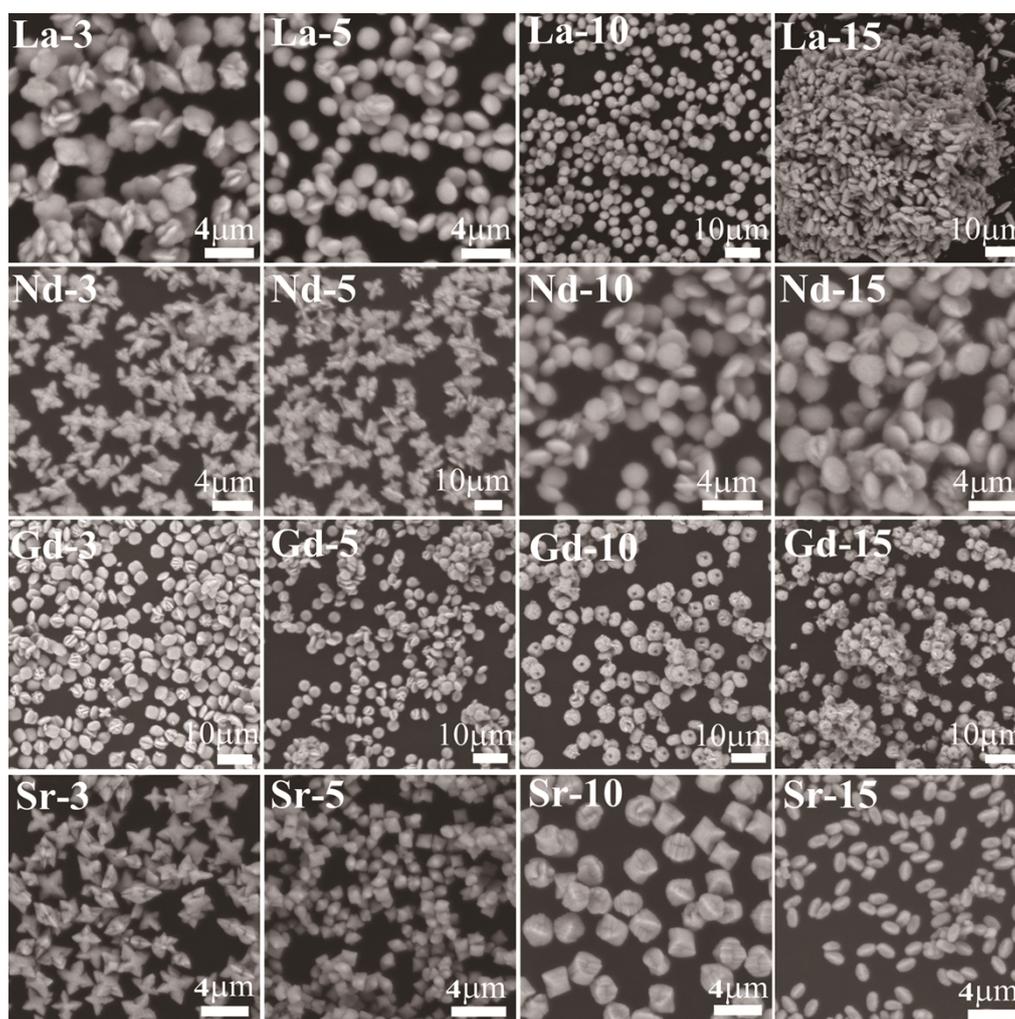


Fig. S3. Low-magnification TEM images of PbWO_4 mesocrystals doped with trivalent rare-earth ions and divalent alkaline-earth ions.

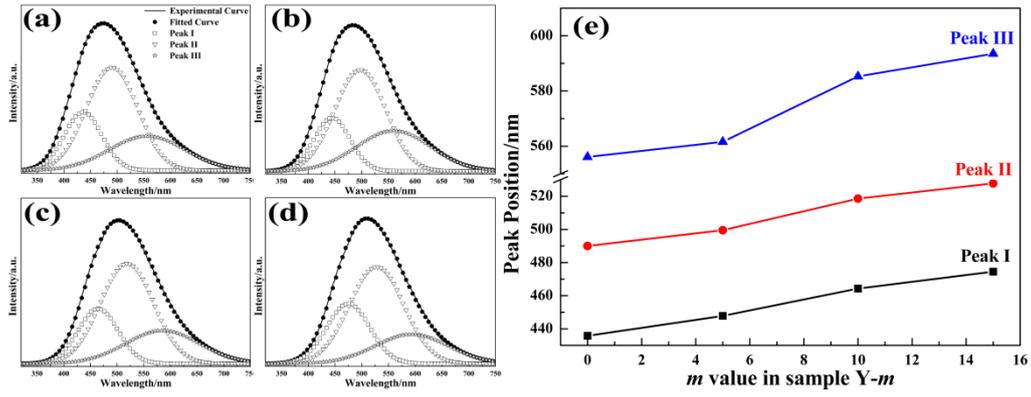


Fig. S4 Three fitted Gaussian emission curves (a-d) of Y-doped PbWO₄ mesocrystals with different Y³⁺ concentrations: (a) 0 mol%, (b) 5 mol%, (c) 10 mol%, (d) 15 mol%. (e) the position of three fitted emission peaks as a function of Y³⁺ concentrations.