Electronic Supplementary Information for

Fluorescent-magnetic nanocrystals: synthesis and property of YP$_x$V$_{1-x}$O$_4$:Eu@GdPO$_4$ core/shell structure

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Determination of photoluminescence quantum yield.[S1,S2] Steady-state room-temperature UV absorption spectra were recorded on a Hitachi U-3010 UV-vis spectrophotometer with the same instrument parameters at a scan speed of 60 nm/min. Steady-state room-temperature photoluminescence (PL) spectra were recorded on a Hitachi F-4500 spectrophotometer equipped with a 150 W Xenon lamp under the same instrument parameters (5.0 nm for excitation split, 2.5 nm for emission split and 700 V for PMT voltage, 60 nm/min for scan speed, using 355 nm filter). The PL quantum yield (QY) of as-prepared samples was determined using Rhodamine 6G as the reference fluorescent dye. All the samples and Rhodamine 6G were dispersed in H$_2$O and the concentrations of these solutions were at a certain range to keep their UV absorbance at the excitation wavelength less than 0.1, to avoid self-absorption effect. Briefly, the absorption and fluorescence spectra (excitation wavelength: 260 nm) of water solutions of Rhodamine 6G at different concentrations were recorded. Then use the UV absorbance at the 260 nm as abscissas and the fluorescence area integrated from 570 to 720 nm as ordinates (Figure S1). These series of points were linear-fitted and the fit straight line should have intercept zero (in this work, about 2% of the slope) and the slope S_{dye}. And one-point method was used to estimate the QY of the as-prepared samples. That is, we get a photoluminescence area F_{RE} and UV absorbance A_{RE} of the sample, and the PL QY was calculated using the following equation:

$$QY_{RE} = \frac{F_{RE}}{A_{RE}} \cdot \frac{1}{S_{dye}} \qquad (S1)$$

where QY_{RE} is the QY of as-prepared samples. In equation (S1), it is hypothesized that the QY of Rhodamine 6G at excitation wavelength 260 nm is 100%.
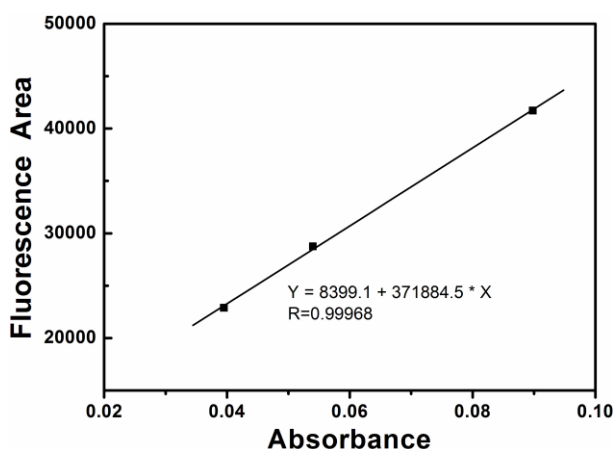

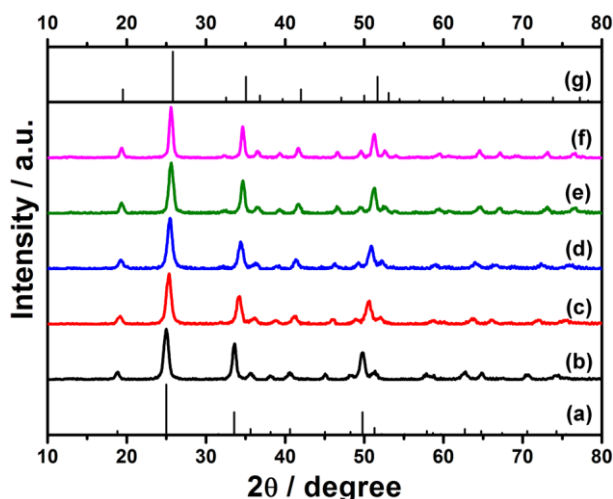**Figure S1**. Linear fit or fluorescence area versus UV absorbance of Rhodamine 6G.

Figure S2. XRD patterns of $YP_xV_{1-x}O_4$:Eu NPs with different P/V molar ratios: 0 (b); 0.5 (c); 1.0 (d); 1.5 (e); 2.0 (f). All the P/V molar ratios are feed ratios. The lines indicate the patterns of bulk YVO_4 with tetragonal phase (JCPDS no.: 17-0341) (a) and bulk YPO_4 with tetragonal phase (JCPDS no.: 11-0254) (g).

Table S1. Particle diameter of as-prepared samples determined by the XRD and DLS data.

Sample	D_{XRD} / nm*	D_{DLS} / nm**
$YP_xV_{1-x}O_4$:Eu	14.5	28.1
Y@Gd1	16.8	--
Y@Gd2	17.3	--
Y@Gd3	17.5	31.3 (94%), 96.4 (6%)
Y@Gd2@SiO_2	--	51.2 (87%), 165 (13%)

*: D_{XRD} represents particle diameter calculated through the Scherrer formula.
**: D_{DLS} represents particle diameter determined by the peaks of the size distribution curve. In the bracket shows the weight of peaks.

Table S2. The element molar ratio Gd/(Y+Eu) of as-prepared samples calculated by the ICP-AES and XPS data.

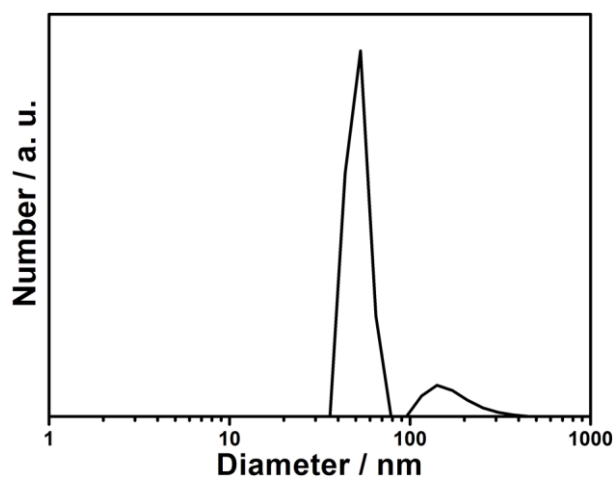| Sample	Nominal ratio	ICP-AES	XPS
Y@Gd2	0.3	0.46	0.92
Y@Gd3	0.5	0.64	2.2

Figure S3. Typical DLS curve of size distribution of the sample **Y@Gd2**@SiO$_2$.
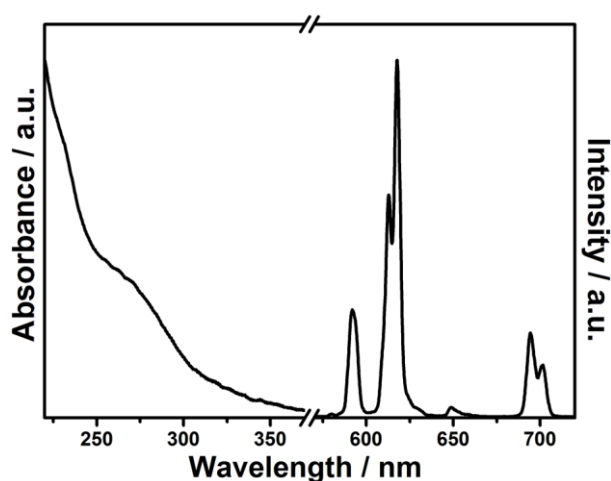

Figure S4. Steady-state room-temperature UV absorption spectra (left) and emission spectra (right) of the sample **Y@Gd2**@SiO$_2$. The sample was re-dispersed in water and excited at 260 nm, where locates the absorption peak.

References

S1   J. R. Lakowicz, *Principles of Fluorescence Spectroscopy*; Plenum: New York, 2006.

S2   S. Deka, A. Quarta, M. G. Lupo, A. Falqui, S. Boninelli, C. Giannini, G. Morello, M. De Giorgi, G. Lanzani, C. Spinella, R. Cingolani, T. Pellegrino and L. Manna, *J. Am. Chem. Soc.*, 2009, **131**, 2948.