Electronic Supplementary Information

Tunable photoluminescence and room temperature ferromagnetism of In_2S_3:Dy^{3+}, Tb^{3+} nanoparticles

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The doping concentrations y = 2%, 4%, 6%, and 8% refer to Tb^{3+} ions concentration of reactive solution in synthetic process. The real values of concentrations of dopants in the sample after growth of the sample have been measured by EDX testing and statistical calculations. The corresponding new data are depicted in Supplementary Table S1.

Samples (the molar concentration ratios)	**atomic percentage**	
	Tb	**Dy**
y = 2%	0.18	0.37
y = 4%	0.26	0.34
y = 6%	0.31	0.33
y = 8%	0.43	0.31

Table S1. Comparison of different doping concentrations in In_2S_3:6%Dy^{3+}, yTb^{3+} nanoparticles after growth by the EDX method.

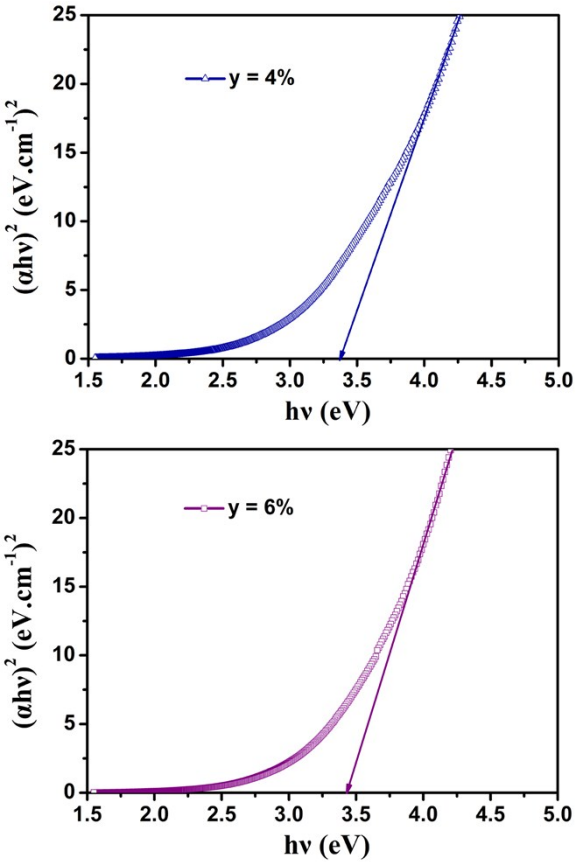

Fig. S2 Variation of $(\alpha h\nu)^2$ versus photon energy for those nanoparticles which are overlapping. Solid lines represent the extrapolation of the linear part of the curve to energy axis.

The excitation spectrum of In_2S_3 and In_2S_3:6%Dy^{3+}, yTb^{3+} nanoparticles monitored at 469 nm emission is shown in Figure S3 of the Supporting Information. The strongest excitation peak is observed at 370 nm. The excitation peaks of co-doped nanoparticles between 300 nm and 400 nm are similar to that of pure indium sulfide, which should be determined by the excitonic-type luminescence of the host (indium sulfide).

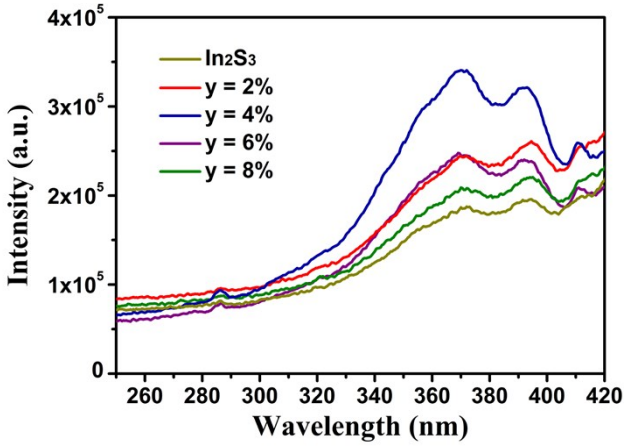

Fig. S3 The excitation spectrum of In_2S_3 and In_2S_3:6%Dy^{3+}, yTb^{3+} nanoparticles monitored at 469 nm emission.

The particle sizes were calculated by Scherrer formula for high intensity peaks from the X-ray diffraction patterns (Figure 1). The results demonstrate that the particle size increases from 2.91 nm to 3.55 nm as doping concentration increases gradually. The effect of doping concentration on particle sizes can be found in Supplementary Table S2. There are not important differences in the size of the nanoparticles. Therefore, the observed variation of band gap energy with doping concentration could not be explained by the grain size. Doping can indeed introduce a large modification in the electronic structure of the host crystalline materials. The increasing band gap energy can be attributed to the increasing electron concentration that provides more energy for photon to jump from the valance band to the conduction band.

Samples (the molar concentration ratios)	particle sizes
In_2S_3	**2.91**
y = 2%	**3.13**
y = 4%	**3.35**
y = 6%	**3.42**
y = 8%	**3.55**

Table S2. The effect of doping concentration on the particle sizes of In_2S_3 and In_2S_3:6%Dy^{3+}, yTb^{3+} nanoparticles.