Supplementary Material (ESI) for New Journal of Chemistry

Electronic Supplementary Information

Synthesis of Mesoporous $LaPO_4$ Nanostructures with Controllable Morphologies

Zhanli Chai,[a,b] Li Gao,[a] Cheng Wang,[*a] Hongjie Zhang,[a] Rongkun Zheng,[c] Paul A. Webley,[b] and Huanting Wang[*b]

[a] State Key Laboratory of Rare Earth Resource Utilization, Changchun Institute of Applied Chemistry, Chinese Academy of Sciences, Changchun 130022, P. R. China

[b] Department of Chemical Engineering, Monash University, Clayton, Victoria 3800, Australia

[c] Australian Key Center for Microscopy and Microanalysis, The University of Sydney, Sydney, NSW 2006 Australia

Preparation of La-TOPO

10.0 mmol of $La(NO_3)_3 \cdot nH_2O$ was dissolved in 10.0 ml of deioned water. After dissolution, lanthanum ions were extracted from the $La(NO_3)_3 \cdot nH_2O$ aqueous solution by 3.89 g of TOPO (~10 mmol). To reduce the viscosity of the organic phase containing TOPO and extracted lanthanum species, 7.0 ml of cyclohexane was added to dilute the organic phase, facilitating the separation of two phases and later transference by syringe. The extraction yield of lanthanum ions was about 60.0% in TOPO, and the final concentration of lanthanum was around 0.35 mol L^{-1} in the TOPO-cyclohexane (denoted La-TOPO).

Preparation of H_3PO_4-EG

10.0 ml of 85% H_3PO_4 solution was mixed with 10.0 ml of EG, followed by stirring and heating at 100 ^oC for 10 h to remove water. As a result, a clear solution with a high concentration of around 7.0 mol L^{-1} was obtained (denoted H_3PO_4-EG).

Synthesis of Eu^{3+} doped and Ce^{3+}/Tb^{3+} codoped $LaPO_4$ nanostructures

$LaPO_4$:Ce,Tb: The synthetic procedure for the $LaPO_4$:Ce,Tb nanostructures was the same as that used for the synthesis of undoped $LaPO_4$ nanostructures, except that 1.14 ml of La-TOPO (0.35 M, ~0.4 mmol), 1.67 ml of Ce-TOPO (0.27 M, ~0.45 mmol), and 0.40 ml of Tb-TOPO (0.38 M, ~0.15 mmol) were used as the precursors in EG.

$LaPO_4$:Eu: The synthetic procedure for the $LaPO_4$:Eu nanostructures was also same as that used for the synthesis of undoped $LaPO_4$ nanostructures, except that 1.14 ml of La-TOPO (0.35 M, ~0.4 mmol) and 0.08 ml of Eu-TOPO (0.25 M, ~0.02 mmol) were used as the precursors in EG.

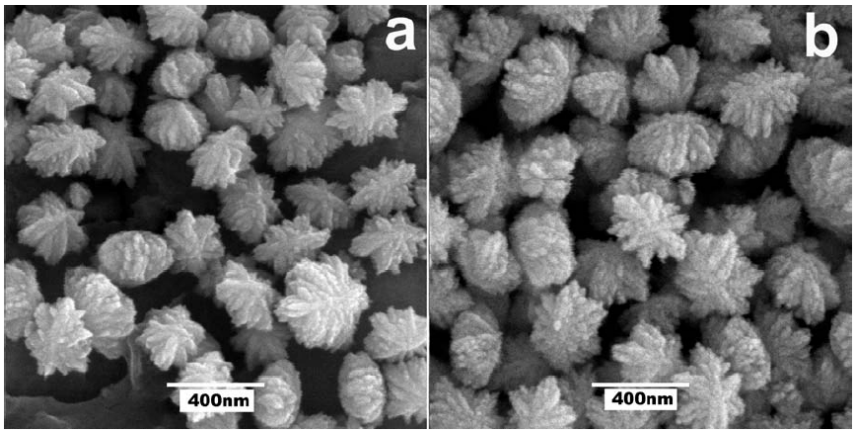

Fig. S1 SEM images of the obtained $LaPO_4$ nanostructures in a typical synthesis with different reaction time. a) 10 min b) 3 h

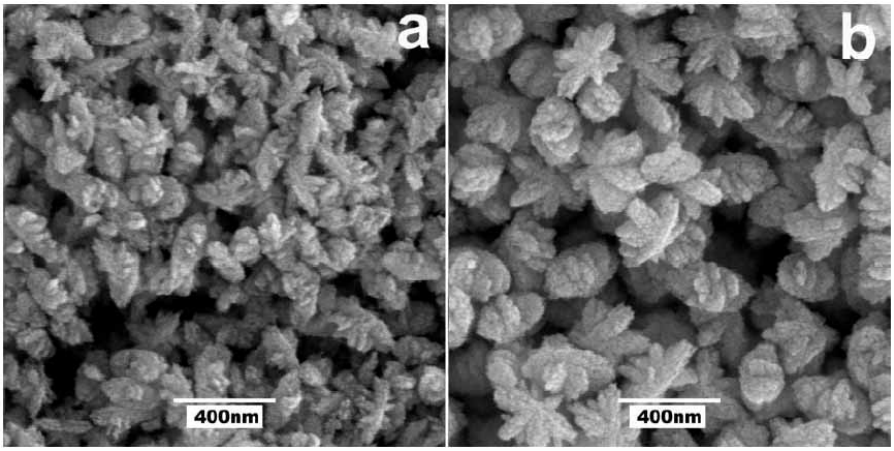

Fig. S2 SEM images of the obtained $LaPO_4$ nanostructures in a typical synthesis with different reaction temperature. a) 120 ^{o}C c) 180 ^{o}C

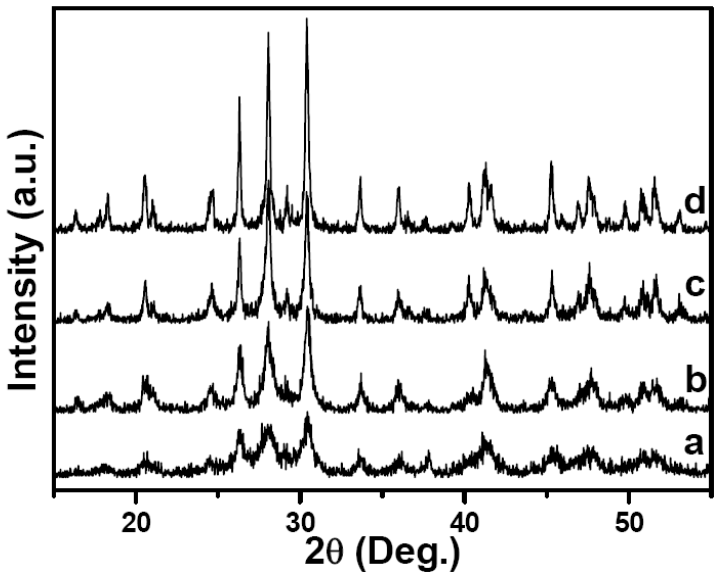

Fig. S3 XRD patterns of $LaPO_4$ nanostructures obtained in a typical synthesis with different molar ratio of La^{3+}/H_3PO_4. (a) 1/2 (b) 1/20 (c) 1/100 (d) 1/200.

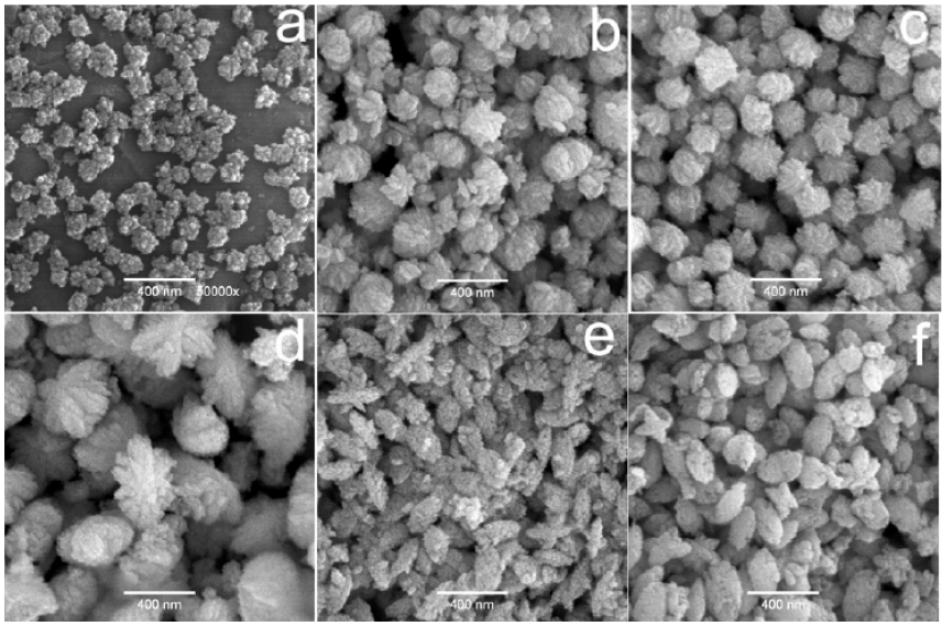

Fig. S4 SEM images obtained $LaPO_4$ nanostructures in a typical synthesis with different molar ratio of La^{3+}/H_3PO_4: (a) 5/1 (b) 1/4 (c) 1/10 (d) 1/30 (e) 1/40 (f) 1/60.

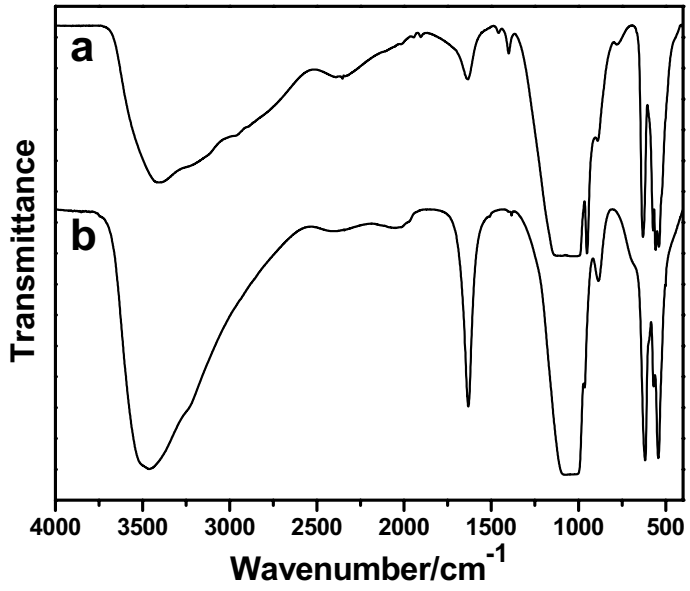

Fig. S5 Fourier Transform Infrared spectra (FT-IR) of (a) as-obtained $LaPO_4$ nanostructures in a typical synthesis and (b) $LaPO_4$ nanoparticles prepared by adding phosphate acid (85%) into $La(NO_3)_3$ aqueous solution at room temperature.

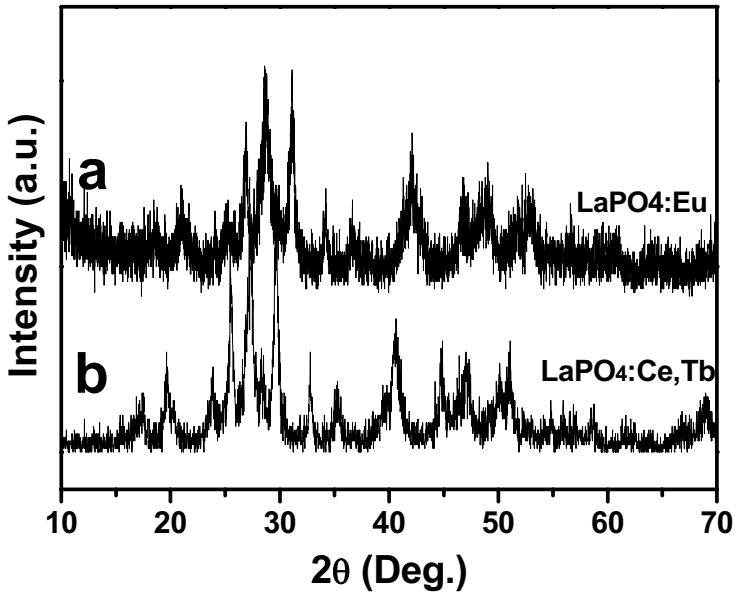

Fig. S6 XRD patterns of doped $LaPO_4$ nanostructures obtained in a typical synthesis. a) $LaPO_4$:Eu, b) $LaPO_4$:Ce,Tb.

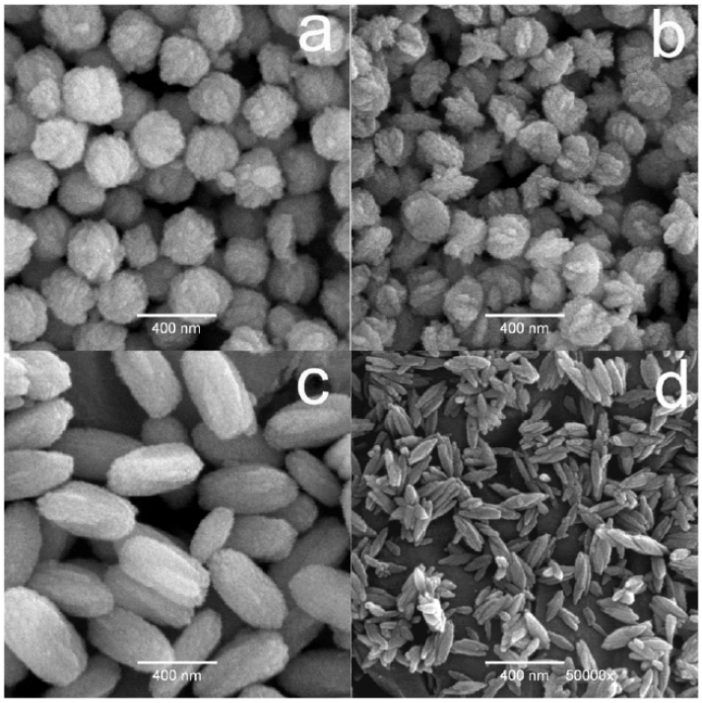

Fig. S7 SEM images of $LaPO_4$:Ce,Tb nanostructures synthesized in a typical synthesis with different molar ratio of La^{3+}/H_3PO_4: a) 1/2 b) 1/20 c) 1/100 d) 1/200

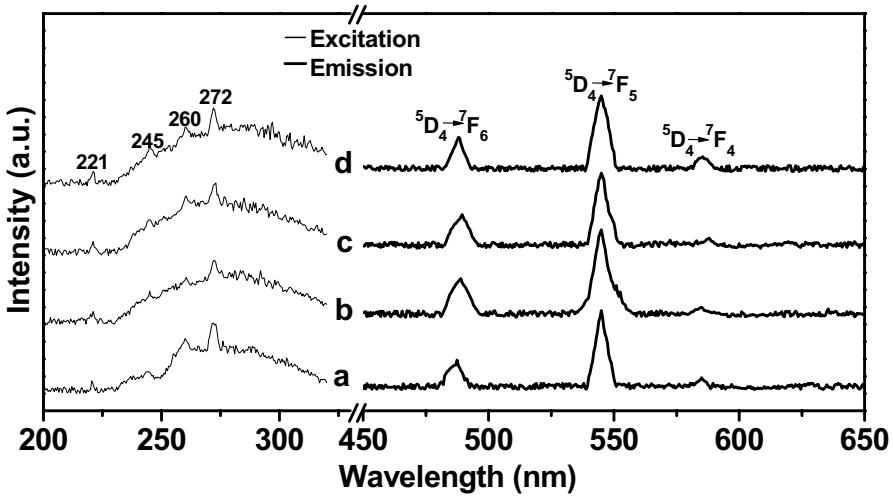

Fig. S8 Room-temperature excitation and emission spectra of $LaPO_4$:Ce,Tb nanostructures synthesized in a typical synthesis with different molar ratio of La^{3+}/H_3PO_4 a) 1/2 b) 1/20 c) 1/100 d) 1/200 (λ_{ex} = 273 nm and λ_{em} = 546 nm).