Orderly-Aligned and Highly-Luminescent Monodisperse Rare Earth Orthophosphate Nanocrystals Synthesized by a Limited Anion Exchange Reaction

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Table S1: Crystal structures, space group, JCPDS number and calculated lattice constants^a of the as-obtained REX_n nanocrystals.

	Structure	Space Group	JCPDS No.	Lattice constants
LaPO₄	Monoclinic	<i>P</i> 2 ₁ /n	32-493	<i>a</i> = 6.88 (5) Å <i>b</i> = 7.09 (3) Å <i>c</i> = 6.56 (1) Å <i>β</i> = 103.1° (1)
EuPO₄	Monoclinic	<i>P</i> 2 ₁ /n	46-1330	<i>a</i> = 6.68 (2) Å <i>b</i> = 6.83 (3) Å <i>c</i> = 6.33 (2) Å <i>β</i> = 103.5° (3)
TbPO₄	Monoclinic	<i>P</i> 2 ₁ /n	45-40	<i>a</i> = 6.63 (5) Å <i>b</i> = 6.83 (4) Å <i>c</i> = 6.33 (2) Å <i>β</i> = 103.7° (2)
TbPO₄	Tetragonal	<i>I</i> 4 ₁ /amd	32-1292	<i>a</i> = 6.94 (5) Å <i>c</i> = 6.01 (1) Å
YPO₄	Tetragonal	<i>I</i> 4 ₁ /amd	11-254	<i>a</i> = 6.97 (2) Å <i>c</i> = 5.97 (3) Å
HoPO₄	Tetragonal	<i>I</i> 4 ₁ /amd		<i>a</i> = 6.95 (3) Å <i>c</i> = 5.99 (3) Å
La_{0.4}Ce_{0.45}Tb_{0.15}PO₄	Monoclinic	<i>P</i> 2 ₁ /n	-	<i>a</i> = 6.79 (2) Å <i>b</i> = 7.00 (2) Å <i>c</i> = 6.46 (2) Å <i>β</i> = 103.5° (1)
La_{0.95}Eu_{0.05}PO₄	Monoclinic	<i>P</i> 2 ₁ /n	-	<i>a</i> = 6.87 (6) Å <i>b</i> = 7.09 (1) Å <i>c</i> = 6.55 (3) Å <i>β</i> = 102.8° (3)
Y_{0.95}Eu_{0.05}PO₄	Tetragonal	<i>I</i> 4 ₁ /amd	-	<i>a</i> = 6.97 (1) Å <i>c</i> = 5.96 (6) Å
YVO₄	Tetragonal	<i>I</i> 4 ₁ /amd	16-250	<i>a</i> = 6.6 (3) Å <i>c</i> = 6.9 (7) Å
α-NaYF₄	Cubic	<i>F</i> m-3m	6-342	<i>a</i> = 5.530 (1) Å
β-NaYF₄	Hexagonal	<i>P</i> -6	-	<i>a</i> = 6.01 (1) Å <i>c</i> = 3.54 (2) Å

[a] The lattice parameters were calculated with the least-squares method.

Figure S1: XRD patterns of LaPO_4 nanopolyhedra (a), EuPO_4 and TbPO_4 nanopolyhedra (c) and TbPO_4 , YPO_4 and HoPO_4 nanowires (d); Energy-dispersive X-ray analysis (EDAX) spectrum of LaPO_4 nanopolyhedra, from which the atomic ratio of La:P was determined as 1.01:1 (b).

Figure S2: XRD pattern of $\text{LaPO}_4\text{:Ce,Tb}$ nanopolyhedra (a); Energy-dispersive X-ray analysis (EDAX) spectrum of $\text{LaPO}_4\text{:Ce,Tb}$ nanopolyhedra, from which the atomic ratio of RE:P was determined as 0.9:1, and the atomic ratio of La:Ce:Tb was determined as 0.39:0.43:0.18 (b).

Figure S3: XRD patterns of $\text{La}_{0.4}\text{Ce}_{0.45}\text{Tb}_{0.15}\text{PO}_4$ quasi-nanorods, nanorods and wormlike nanowires (a) and $\text{La}_{0.95}\text{Eu}_{0.05}\text{PO}_4$ nanopolyhedra, $\text{La}_{0.95}\text{Eu}_{0.05}\text{PO}_4$ nanorods and $\text{Y}_{0.95}\text{Eu}_{0.05}\text{PO}_4$ nanowires (b). EDAX spectrum of $\text{LaPO}_4\text{:Eu}$ nanopolygons (from which the atomic ratio of RE:P was determined as 0.96:1, and the atomic ratio of La:Eu was determined as 0.95:0.05) (c) and $\text{YPO}_4\text{:Eu}$ nanowires (d).

Figure S4: FTIR spectra (Nicolet Magna 750) of the reaction mixture taken at different stages in 2000–1400 cm^{-1} spectrum window (a) and 1300–450 cm^{-1} spectrum window (b). V: 10 mmol of OA mixed with 30 mmol of OM; VI: 10 mmol of OA mixed with 30 mmol of OM and 1 mmol of H_3PO_4 was injected.

Figure S5: XRD patterns of YVO₄, α -NaYF₄, and β -NaYF₄ nanocrystals (a). EDAX spectra of YVO₄ cubes (b), α -NaYF₄ polyhedra (c) and β -NaYF₄ hexagonal plates (d).

Figure S6: TEM images of LaPO_4 (a), NdPO_4 (b) and EuPO_4 (c) nanorods.

Figure S7: TEM images of $\text{LaPO}_4\text{:Ce,Tb}$ nanocrystals obtained under $\text{DA:OM} = 1:3$ (e), $\text{HA:OM} = 1:3$ (f) at 180°C for 5 h.

Figure S8: TEM image and the FFT analysis (inset) of the 3D superlattice of the $\text{LaPO}_4\text{:Ce,Tb}$ nanopolyhedra.

Figure S9. TEM images of LaPO_4 nanopolyhedra deposited from different dispersion concentrations: 0.025 mol L^{-1} (highlighted: upper, wheel like nanoarray with one core; lower: with two cores) (a), 0.015 mol L^{-1} (highlighted: hexagonal arrangements) (b).