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Lanthanide-doped Sr_2ScF_7 nanocrystals: controllable hydrothermal synthesis, growing mechanism and tunable up/down conversion luminescence properties

Bei Zhao,[a] Dingyi Shen,[a] Jun Yang,*[a] Shanshan Hu,[a] Xianju Zhou[b] and Jianfeng Tang[c]

[a]*School of Chemistry and Chemical Engineering, Southwest University, Chongqing 400715, China.* [b]*School of Mathematics and Physics, Chongqing University of Posts and Telecommunications, Chongqing 400065, China.*
[c]*Faculty of Materials and Energy, Southwest University, Chongqing 400715, China.*

Table S1 Crystallographic data for Sr_2ScF_7.

Formula	Sr_2ScF_7
Formula weight	353.18
Crystal system	monoclinic
Space group	P21/c (#14)
a/Å	5.450
b/Å	12.190
c/Å	8.236
α/°	90
β/°	89.53
γ/°	90
V/Å^3	547.1
Z	4
ρ_{calc}/gcm^{-3}	4.287
μ/cm^{-1}	201.32
Sinθmax/λ	0.8071
Rint	0.051
Rw(F_0)	0.048
R(F_0) for $F_{02} > 3a(F_{02})$	0.045

Table S2 Length and diameter of the obtained products from the SEM images in Fig. 2.

doped Ln^{3+}(30%)	Length (nm)	Width (nm)
no	120	50
Lu	80	40
Yb	50	38
Tm	35	30
Dy	33	29
Tb	31	26
Eu	24	23
Sm	20	20
La	15	15

Table S3 Summary of the photoluminescence properties of $Sr_2ScF_7:Ln^{3+}$ (Ln = Ce, Tb, Eu, Sm, Dy, Er, Ho, and Tm) nanocrystals.

	Excitation peaks(nm)/transition	Emission peaks(nm)/transition		Excitation peaks(nm)/transition	Emission peaks(nm)/transition
Sr_2ScF_7:6%Ce^{3+}	259,294/4f-5d	354/5d-4f	Sr_2ScF_7:12%Tb^{3+}	222,265,284,351, 367/$4f_8$-$4f_75d^1$	489/$^5D_4$-$^7F_6$ 546/$^5D_4$-$^7F_5$ 586/$^5D_4$-$^7F_4$ 624/$^5D_4$-$^7F_3$
Sr_2ScF_7:9%Eu^{3+}	328/$^7F_0$-$^5H_6$ 362/$^7F_0$-$^5D_4$ 381/$^7F_0$-$^5G_2$ 394/$^7F_0$-$^5L_6$ 465/$^7F_0$-$^5D_2$	594/$^5D_0$-$^7F_1$ 619/$^5D_0$-$^7F_2$	Sr_2ScF_7:1%Sm^{3+}	359/$^6H_{5/2}$-$^4K_{17/2}$ 372/$^6H_{5/2}$-$^4D_{15/2}$ 399/$^6H_{5/2}$-$^4K_{11/2}$	562/$^4G_{5/2}$-$^6H_{5/2}$ 603/$^4G_{5/2}$-$^6H_{7/2}$ 651/$^4G_{5/2}$-$^6H_{9/2}$
Sr_2ScF_7:1%Dy^{3+}	294/$^6H_{5/2}$-$^4D_{7/2}$ 324/$^6H_{5/2}$-$^6P_{3/2}$ 348/$^6H_{5/2}$-$^6P_{7/2}$ 364/$^6H_{5/2}$-$^6P_{7/2}$ 384/$^6H_{5/2}$-$^4M_{21/2}$	482,492/$^4F_{9/2}$-$^6H_{15/2}$ 577/$^4F_{9/2}$-$^6H_{13/2}$	Sr_2ScF_7:1%Er^{3+}	364/$^4I_{15/2}$-$^4G_{7/2}$ 378/$^4I_{15/2}$-$^4G_{11/2}$ 405/$^4I_{15/2}$-$^2H_{9/2}$	524/$^2H_{11/2}$-$^4I_{15/2}$ 547,558/$^4S_{3/2}$-$^4I_{15/2}$
Sr_2ScF_7:2%Ho^{3+}	361/$^5I_8$-$^5G_2$ 384/$^5I_8$-$^5G_4$ 417/$^5I_8$-$^5G_5$ 452/$^5I_8$-$^5F_1$,$^5G_6$ 485/$^5I_8$-$^5G_2$	540,548/$^5F_4$,$^5S_2$-$^5I_8$	Sr_2ScF_7:2%Er^{3+}	357/$^3H_6$-$^1D_2$	451/$^1D_2$-$^3F_4$

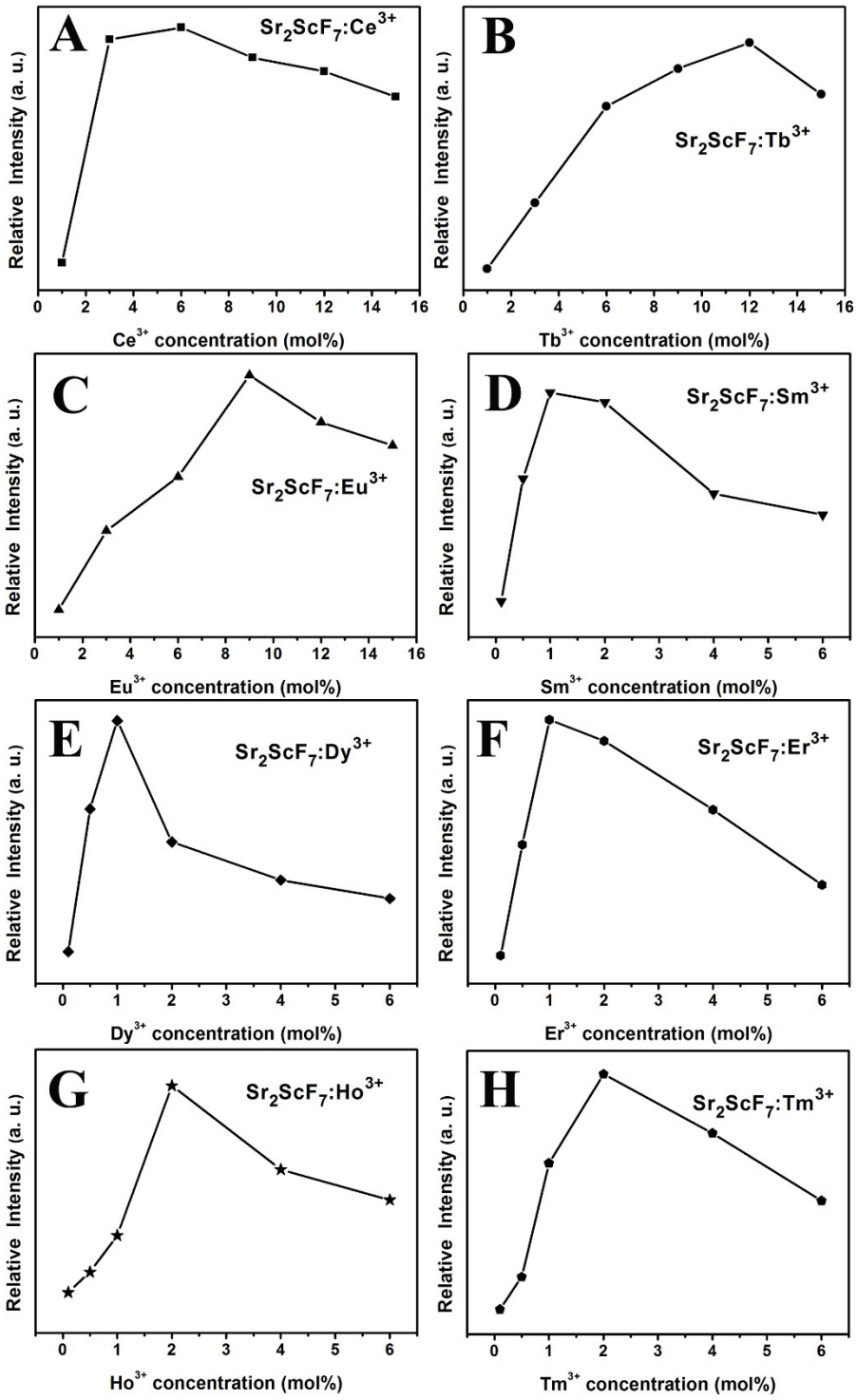

Fig. S1 The photoluminescence emission intensity of Ln^{3+} ions as a function of their doping concentrations in Sr_2ScF_7 nanocrystals, respectively. The optimum concentrations of Ln^{3+} are determined to be as 6% (Ce^{3+}), 12% (Tb^{3+}), 9% (Eu^{3+}), 1% (Sm^{3+}), 1% (Dy^{3+}), 1.0 (Er^{3+}), 2% (Ho^{3+}), 2% (Tm^{3+}), respectively.

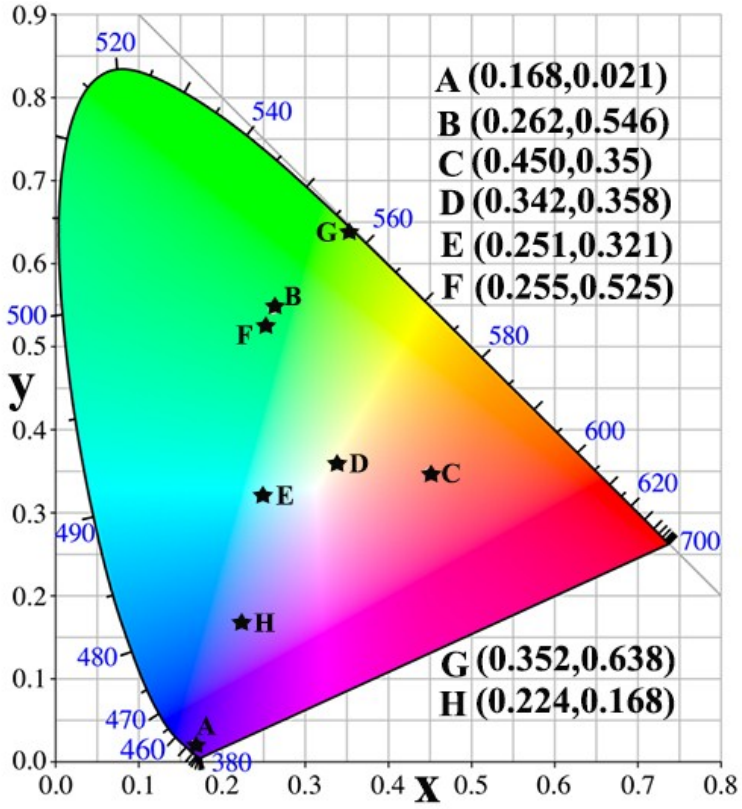

Fig. S2 The CIE chromaticity coordinates of Sr_2ScF_7: (A) 6% Ce^{3+}, (B)12% Tb^{3+}, (C) 9% Eu^{3+}, (D) 1% Sm^{3+}, (E) 1% Dy^{3+}, (F) 1% Er^{3+}, (G) 2% Ho^{3+}, (H) 2% Tm^{3+}, respectively.

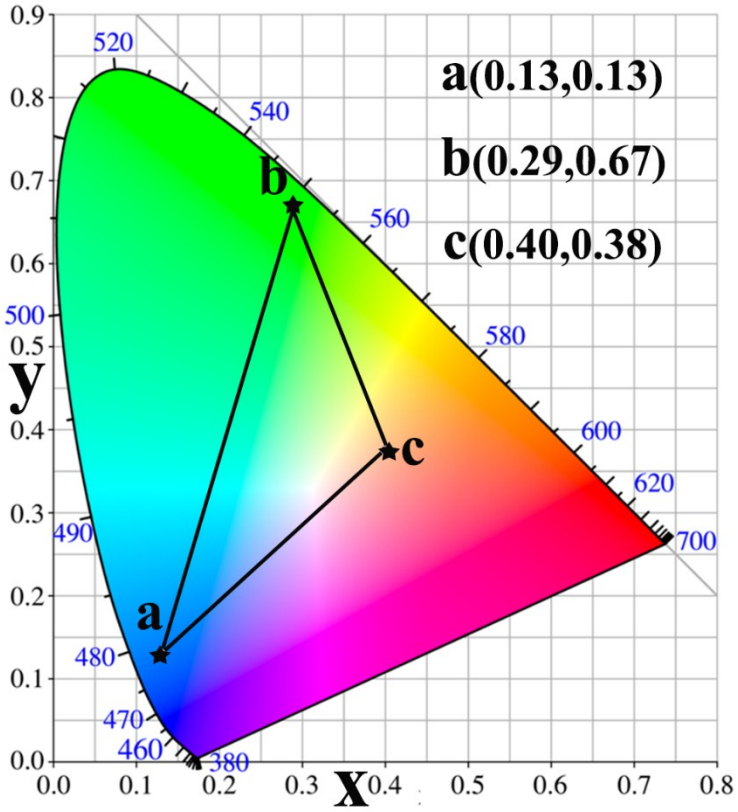

Fig. S3 The CIE chromaticity coordinates of (a) Sr_2ScF_7:10%Yb^{3+}, 2%Tm^{3+}, (b) Sr_2ScF_7:1%Er^{3+}, (c) Sr_2ScF_7:10%Yb^{3+}, 1%Er^{3+} nanocrystals.

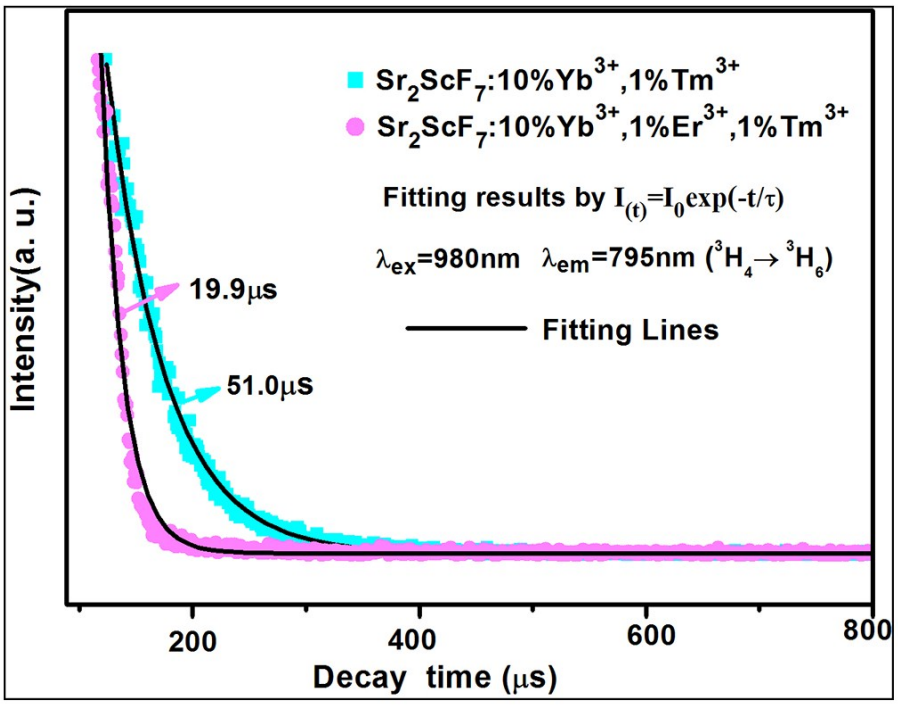

Fig. S4 The decay curves of $^3H_4 \rightarrow {}^3H_6$ of Tm^{3+} in the Sr_2ScF_7:10%Yb^{3+},1%Tm^{3+} and $S_{r2}ScF_7$:10%Yb^{3+},1%Er^{3+},1%Tm^{3+} nanocrystals.