Electronic Supplementary Material (ESI) for Journal of Materials Chemistry C

Supporting Information for:

Syntheses, crystal structure and multicolour up-conversion fluorescence of lanthanide doped orthorhombic lutetium oxyfluoride nanocrystals

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Table S1 Lattice parameters for the orthorhombic Vernier phases $Lu_nO_{n-1}F_{n+2}$ (n = 5-10) reported in *ref.* 44 and refined lattice parameters for the present samples.

Sample	Space group	*a* (Å)	*b* (Å)	*c* (Å)	*V*(Å^3)	*Rp*, *Rwp*
$Lu_5O_4F_7$ (*ref.*44)	*Abm*2	5.2983(8)	5 × 5.456(2)	5.4547(8)	5 × 157.67(4)	
$Lu_6O_5F_8$ (*ref.*44)	*Pbcm*	5.3057(3)	6 × 5.4427(3)	5.4542(2)	6 × 157.50(1)	
$Lu_7O_6F_9$ (*ref.*44)	*Abm*2	5.3114(3)	7 × 5.4327(3)	5.4510(2)	7 × 157.29(1)	
$Lu_8O_7F_{10}$ (*ref.*44)	*Pbcm*	5.3174(3)	8 × 5.4248(4)	5.4498(4)	8 × 157.20(1)	
$Lu_9O_8F_{11}$ (*ref.*44)	*Abm*2	5.3215(3)	9 × 5.4217(2)	5.4502(3)	9 × 157.25(1)	
$Lu_{10}O_9F_{12}$ (*ref.*44)	*Pbcm*	5.3225(7)	10 × 5.4158(6)	5.450(1)	10 × 157.09(2)	
Uncodped $Lu_nO_{n-1}F_{n+2}$	*Abm*2	5.3055(3)	5 × 5.4464(4)	5.4545(5)	5 × 157.61(4)	4.96, 6.90
$Lu_nO_{n-1}F_{n+2}$: 20%Yb, 0.2%Ho	*Abm*2	5.3083(9)	5 × 5.4424(9)	5.4544(9)	5 × 157.54(9)	5.35, 7.54
$Lu_nO_{n-1}F_{n+2}$: 30%Yb, 0.2%Ho	*Abm*2	5.3055(9)	5 × 5.4503(9)	5.4597(9)	5 × 157.69(8)	4.62, 6.65
$Lu_nO_{n-1}F_{n+2}$: 40%Yb, 0.2%Ho	*Abm*2	5.3108(9)	5 × 5.4553(2)	5.4653(9)	5 × 157.55(9)	4.82, 7.06

Fig. S1 LeBail fitting plots of *V*-LuOF samples codoped by x%Yb^{3+}/0.2%Ho^{3+} (x = 20, 30, 40).

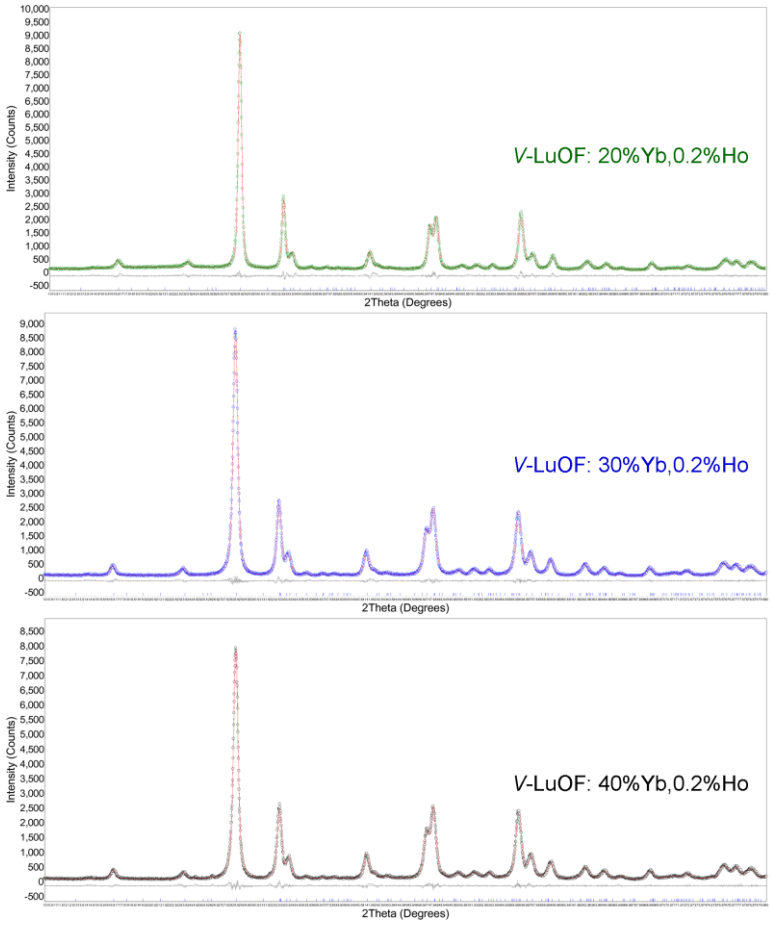

Fig. S2 TEM images of *V*-LuOF annealed at different temperatures (400 and 600 ^{o}C) for 24 hours.

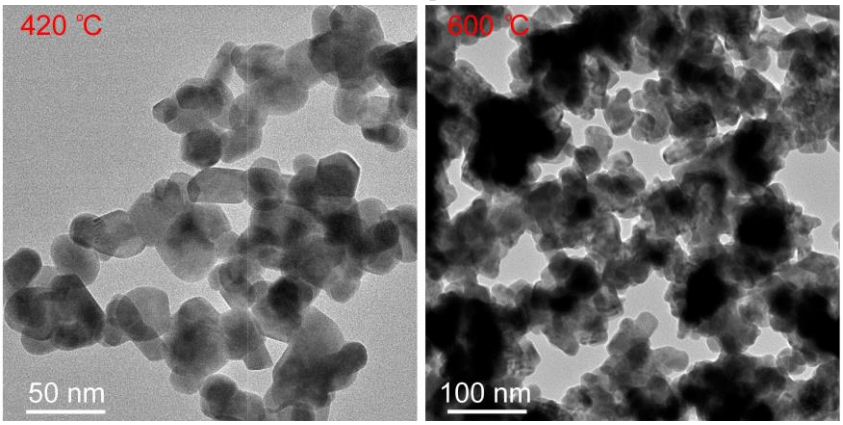

Fig. S3 HRTEM images of *V*-LuOF samples annealed at 420 ^{o}C.

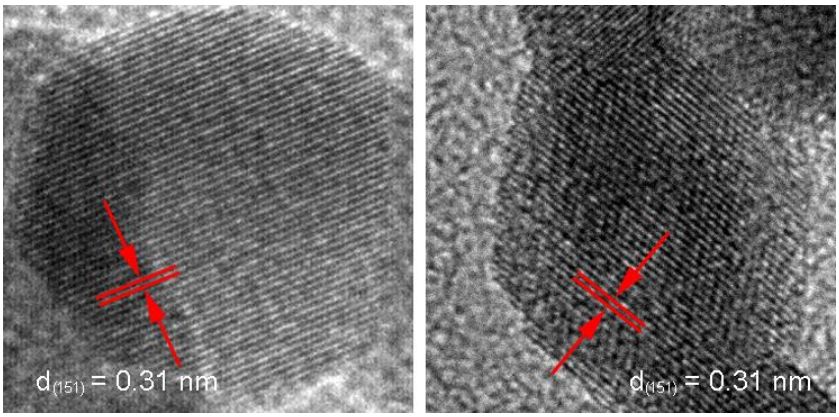

Fig. S4 Schematic energy level diagrams of Yb^{3+}/Ln^{3+} (*Ln* = Ho, Er, Tm) codoped *V*-LuOF. The weak green transition of Er^{3+} ($^{5}S_{3/2}\rightarrow{}^{4}I_{15/2}$) is denoted as light green.