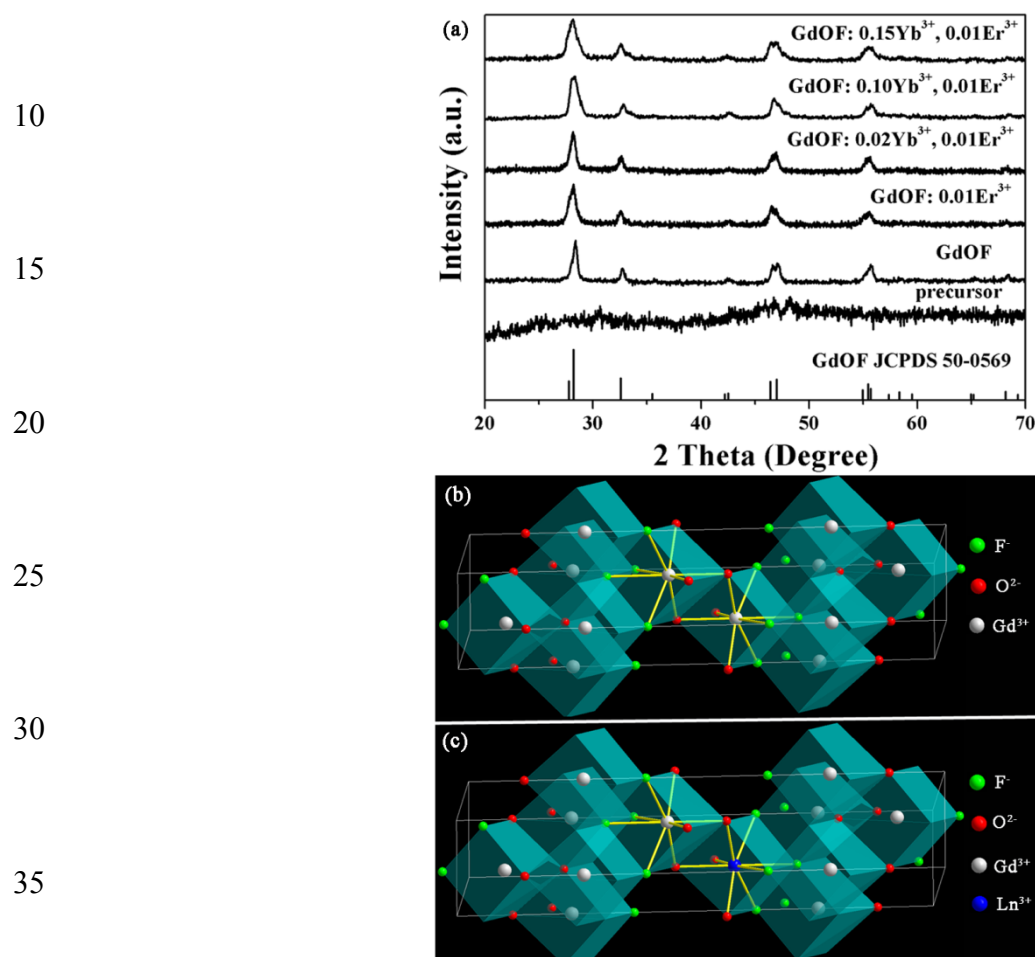


## Electronic Supplementary Information (ESI)

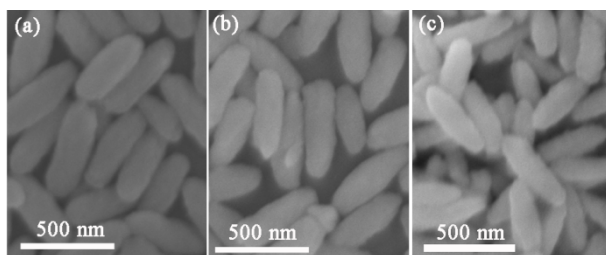
5



40 **Fig. S1** (a) The XRD patterns of as-prepared precursor samples, annealed at 700 °C, RE<sup>3+</sup> doped samples and the standard data of GdOF (JCPDS No.50-0569). Scheme of the rhombohedral phase GdOF structures (b) un-doped and (c) doped with RE<sup>3+</sup> ions.

5

10



**Fig. S2** SEM images of the GdOF:  $x\text{Yb}^{3+}$ ,  $0.01\text{Er}^{3+}$  samples prepared at  $\text{pH} = 2$  with NaF as  $\text{F}^-$  source with different  $\text{Yb}^{3+}$  concentrations (a)  $x = 0.02$ , (b)  $x = 0.10$  and (c)  $x = 0.20$ .

15

**Table S1** Crystallographic details of GdOF: 0.01Er<sup>3+</sup>, GdOF: 0.02Yb<sup>3+</sup>, 0.01Er<sup>3+</sup> and GdOF: 0.10Yb<sup>3+</sup>, 0.01Er<sup>3+</sup>.

Formula	GdOF: 0.01Er <sup>3+</sup>	GdOF: 0.02Yb <sup>3+</sup> , 0.01Er <sup>3+</sup>	GdOF: 0.10Yb <sup>3+</sup> , 0.01Er <sup>3+</sup>
Crystal system	rhombohedral	rhombohedral	rhombohedral
Space group	R3	R3	R3
<i>a</i> (Å)	3.873	3.869	3.846
<i>b</i> (Å)	3.873	3.869	3.846
<i>c</i> (Å)	19.282	19.228	19.168
<i>V</i> (Å <sup>3</sup> )	250.475	249.258	245.535
$\alpha$ (deg)	90	90	90
$\beta$ (deg)	90	90	90
$\gamma$ (deg)	120	120	120
$\chi^2$	3.07	3.08	3.24
<i>R</i> <sub>p</sub> (%)	1.92	2.31	2.12
<i>R</i> <sub>wp</sub> (%)	2.62	3.25	2.84