

SUPPLEMENTARY MATERIAL

Does Ce³⁺ Ions Doping in CaF₂:Tb³⁺ Exhibit More Luminescence Than CeF₃:Tb³⁺?

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TABLE S1. The d-spacing calculated values of SITE-2 of the above HRTEM is compared with the standard ICDD data of CaF₂ (#ICDD: 00-035-0816) and CeF₃ (#ICDD: 00-008-0045).

Sl. No.	Positions	d calculated (Å)	CaF ₂		CeF ₃	
			d (Å)	(h k l)	'd' (Å)	(h k l)
1.	E	2.72	2.73	(2 0 0)		
2.	D	2.53	-	-	2.55	(1 1 2)
3.	B	2.52				
4.	C	2.01	1.93	(2 2 0)	2.05	(3 0 0)
5.	A	1.75	-	-	1.79	(3 0 2)
6.	F	1.73	1.65	(3 1 1)	1.73	(2 2 1)

TABLE S2. The calculated d-spacing values of SAED of SITE-2 compared with the standard ICDD data of CaF₂ (#ICDD: 00-035-0816) and CeF₃ (#ICDD: 00-008-0045)

Calculated radius (Å)	CaF ₂		CeF ₃	
	d (Å)	(h k l)	d (Å)	(h k l)
3.45	-	-	3.55	(1 1 0)
3.43				
3.22			3.19	(1 1 1)
2.08	1.93	(1 1 1)	2.05	(3 0 0)
2.01				
2.02	-	-	2.00	(1 1 3)
1.73	-	-	1.73	(2 2 1)
1.34	-	-	1.34	(4 1 0)
1.11	1.12	(4 2 2)	1.13	(3 3 2)

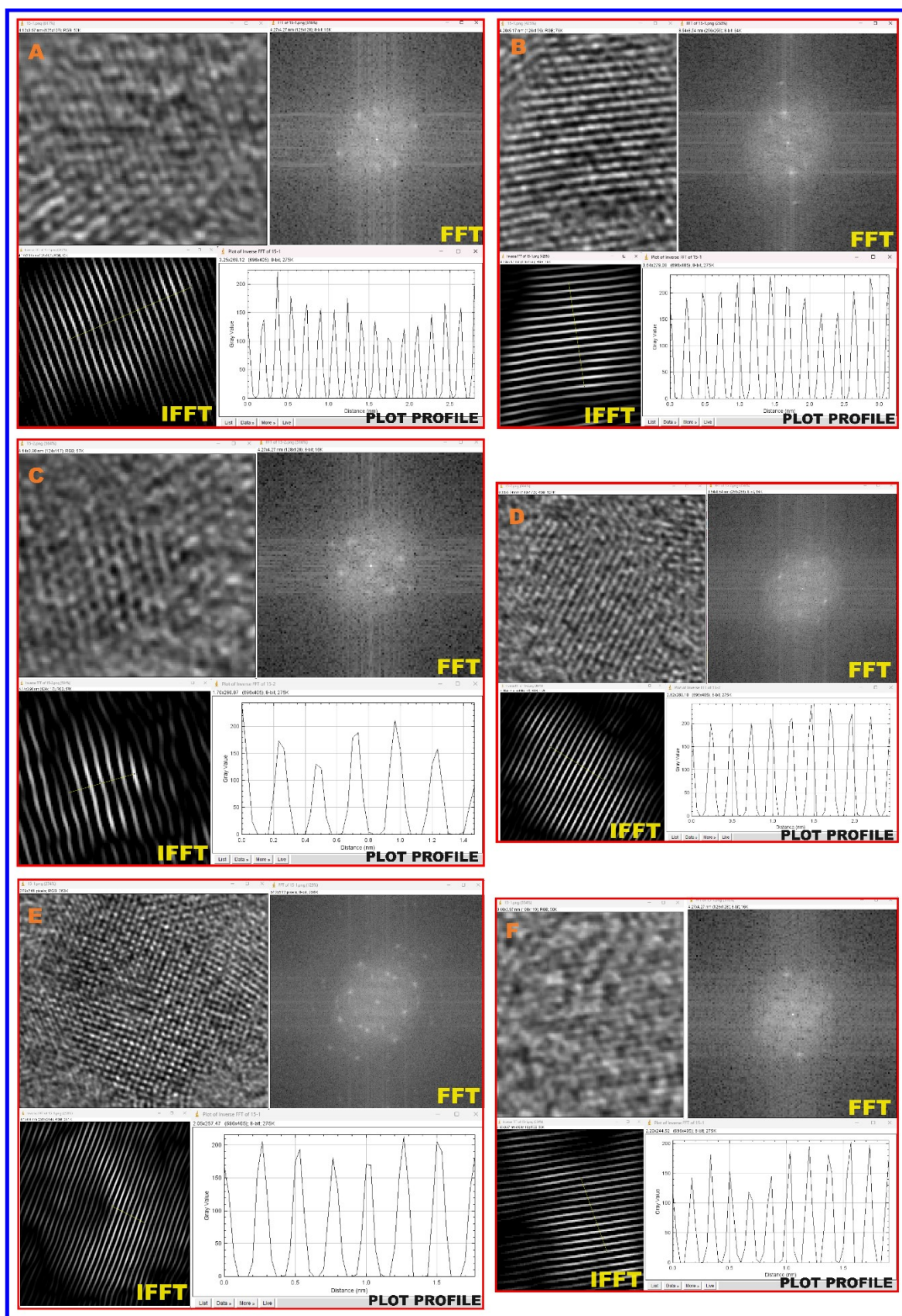


FIGURE S1. HRTEM analysis images of SITE-2 of 15 at.% Ce^{3+} doped with CaF_2 : 5 at.% Tb^{3+} using imageJ software illustrating the Fast Fourier Transform (FFT), Inverse Fast Fourier Transform (IFFT) and the plot profile of IFFT for each position (A, B, C, D, E, F).

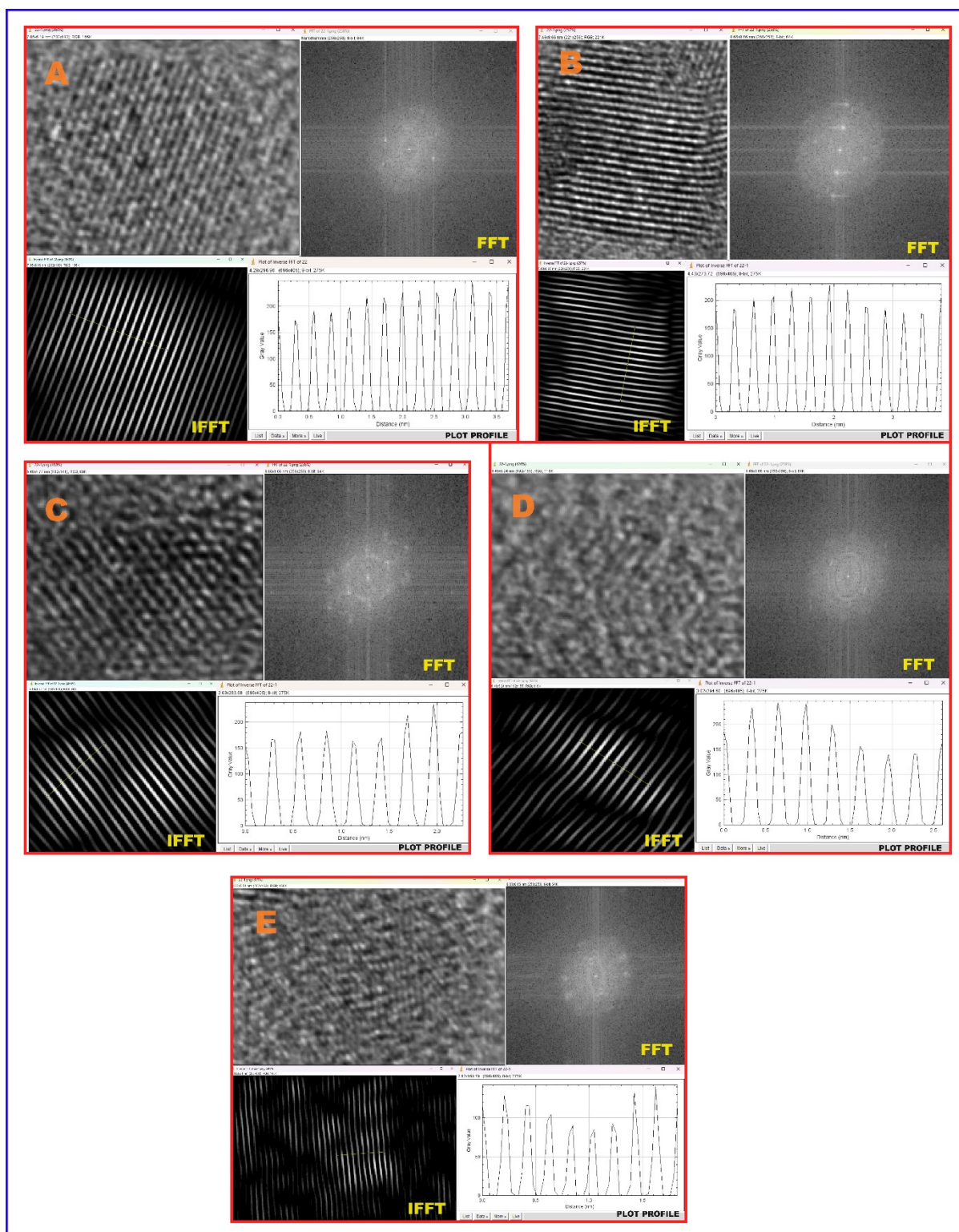


FIGURE S2. HRTEM analysis images of SITE-3 of 15 at.% Ce^{3+} doped with CaF_2 : 5 at.% Tb^{3+} using imageJ software illustrating the Fast Fourier Transform (FFT), Inverse Fast Fourier Transform (IFFT) and the plot profile of IFFT for each position (A, B, C, D, E).

TABLE S3. The d-spacing calculated values of SITE-3 of the above HRTEM is compared with the standard ICDD data of CaF₂ (#ICDD: 00-035-0816) and CeF₃ (#ICDD: 00-008-0045).

Sl. No.	Positions	d calculated (Å)	CaF ₂		CeF ₃	
			d (Å)	(h k l)	d (Å)	(h k l)
1.	D	3.21	-	-	3.2	(1 1 1)
2.	B	3.18	3.15	(1 1 1)		
3.	A	2.75	2.73	(2 0 0)	-	-
4.	C	2.74			-	-
5.	E	2.01	1.93	(2 2 0)	2.05	(3 0 0)

TABLE S4. The calculated d-spacing values of SAED of SITE-3 is compared with the standard ICDD data of CaF₂ (#ICDD: 00-035-0816) and CeF₃ (#ICDD: 00-008-0045)

Calculated radius (Å)	CaF ₂		CeF ₃	
	d (Å)	(h k l)	d (Å)	(h k l)
3.50	-	-	3.64	(0 0 2)
3.38	-	-	3.55	(1 1 0)
2.01	1.93	(2 2 0)	2.05	(3 0 0)
2.02				
2.03				
2.05				
1.78	-	-	1.79	(3 0 2)
1.78				
1.42	1.37	(4 0 0)	1.43	(2 1 4)
1.38			1.36	(3 0 4)
1.22	1.25	(3 3 1)	1.21	(0 0 6)

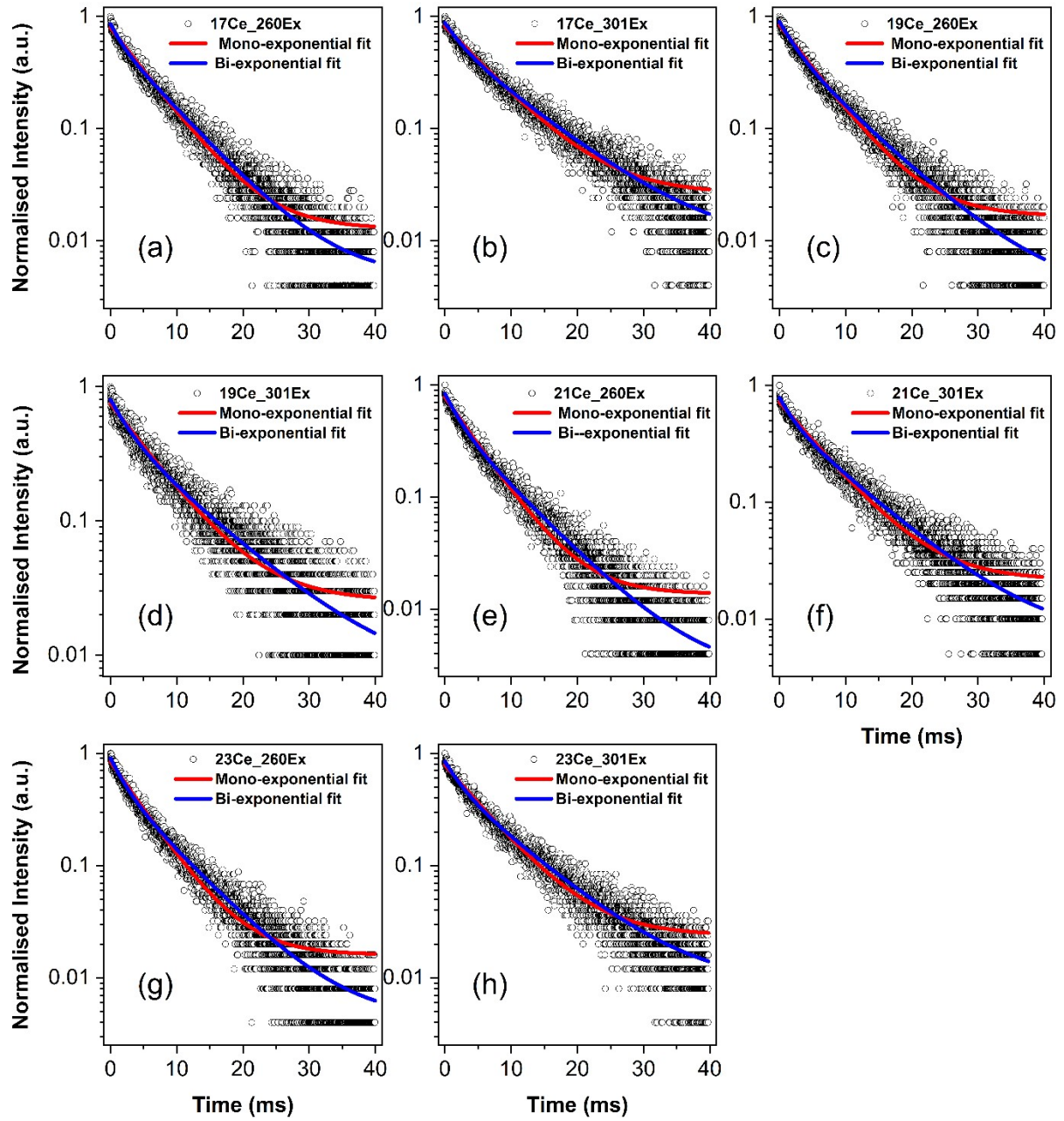


FIGURE S3. A typical fit using mono-exponential and bi-exponential for the decay profile excited at $\lambda_{\text{ex}} = 265$ nm and $\lambda_{\text{ex}} = 301$ nm with the emission monitoring at $\lambda_{\text{em}} = 541$ nm for CaF₂:5 at.% Tb³⁺, xCe³⁺; x at.% = 17 (a,b), 19 (c,d), 21 (e,f), 23 (g,h) samples, respectively.

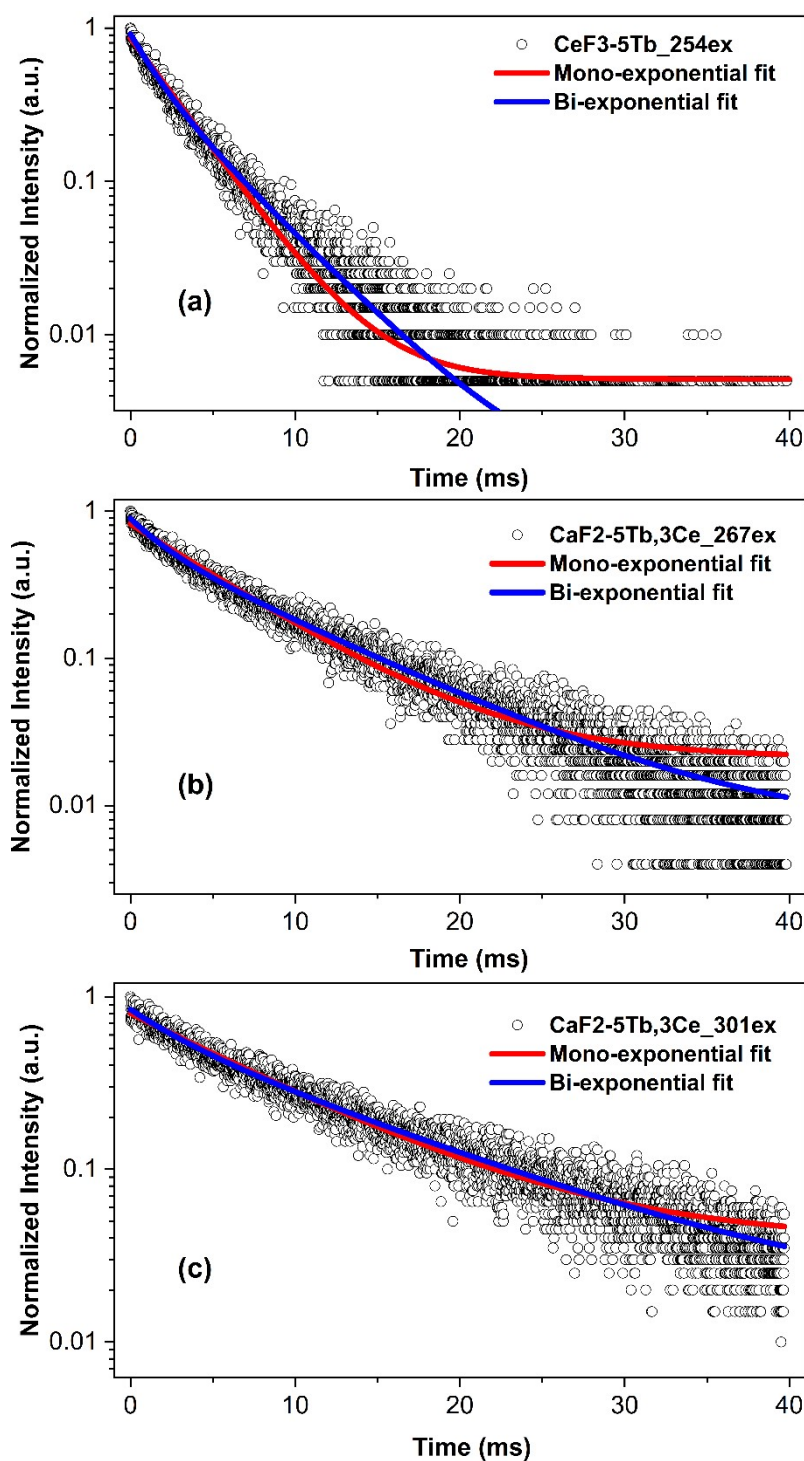


FIGURE S4. A typical fit and fitting values using mono-exponential and bi-exponential for the decay profile of (a) $\text{CeF}_3:5 \text{ at.}\% \text{ Tb}^{3+}$ sample excited at $\lambda_{\text{ex}} = 254 \text{ nm}$, (b) $\text{CaF}_2:5 \text{ at.}\% \text{ Tb}^{3+}$, 3 at.% Ce^{3+} sample excited at $\lambda_{\text{ex}} = 267 \text{ nm}$, and (c) $\text{CaF}_2:5 \text{ at.}\% \text{ Tb}^{3+}$, 3 at.% Ce^{3+} sample excited at $\lambda_{\text{ex}} = 301 \text{ nm}$ with the emission monitoring at $\lambda_{\text{em}} = 541 \text{ nm}$, respectively.

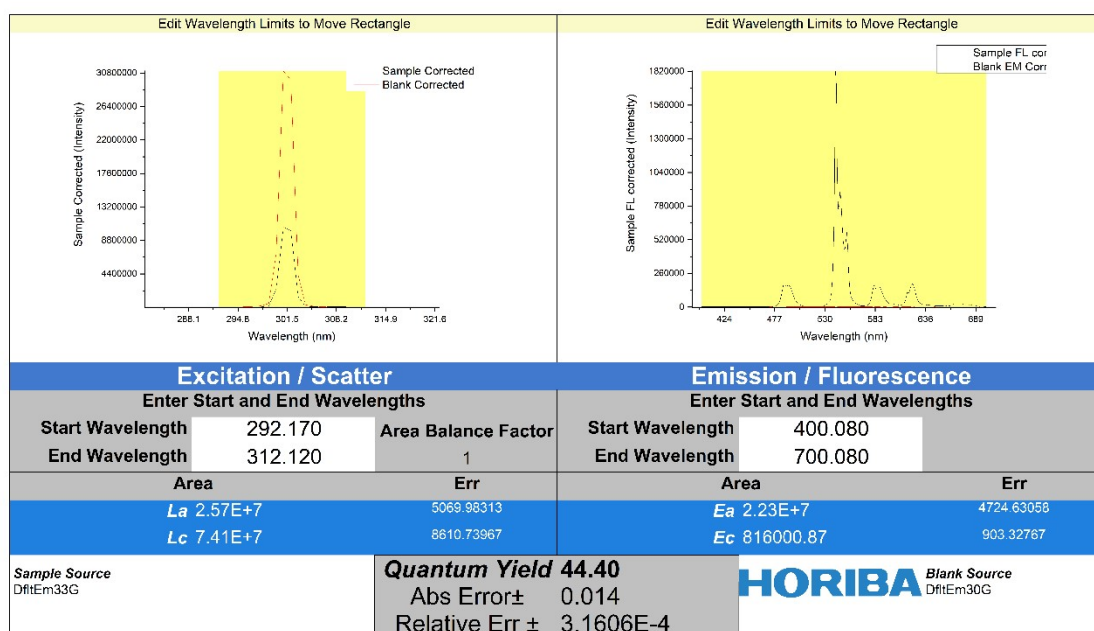


FIGURE S5. Calculated value of quantum yield for Ce^{3+} (3 at.%) sensitized $\text{CaF}_2\text{:Tb}^{3+}$ (5 at.%) using FluorEssence™ software in Horiba Fluoromax-4CP spectrofluorometer.

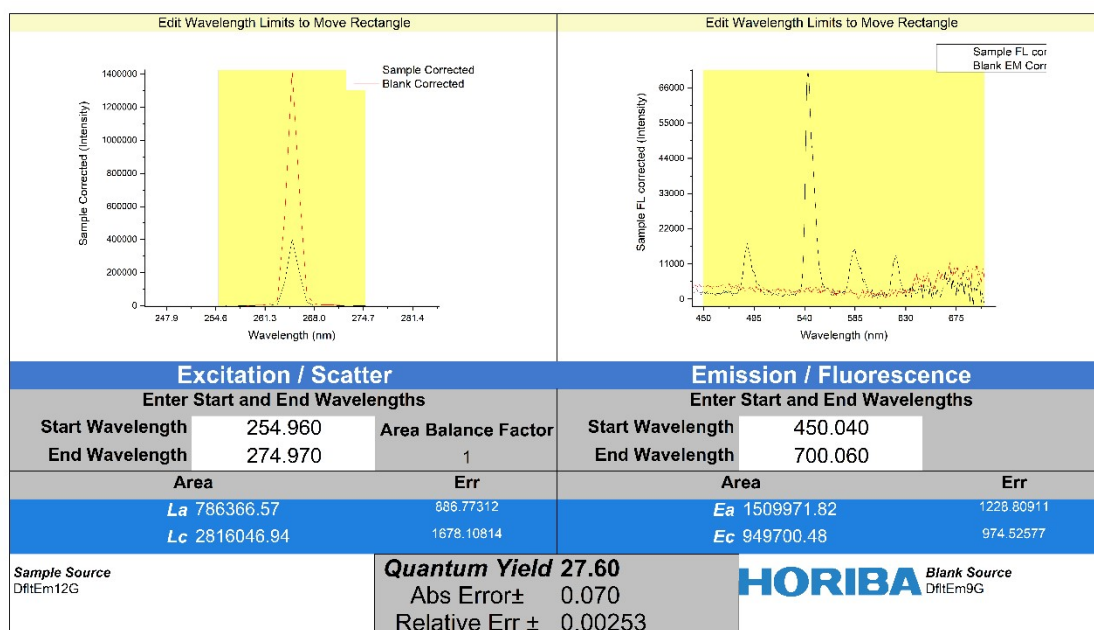


FIGURE S6. Calculated value of quantum yield for Tb^{3+} (5 at.%) doped in CeF_3 using FluorEssence™ software in Horiba Fluoromax-4CP spectrofluorometer