

(Supplementary Information)

Efficient Down Conversion Luminescent Probe Based on NaGdF₄:Eu³⁺/Ce³⁺ Nanophosphor for Chemical Sensing of Heavy Metal Ions (Cd²⁺, Pb²⁺ and Cr³⁺) in Waste Water

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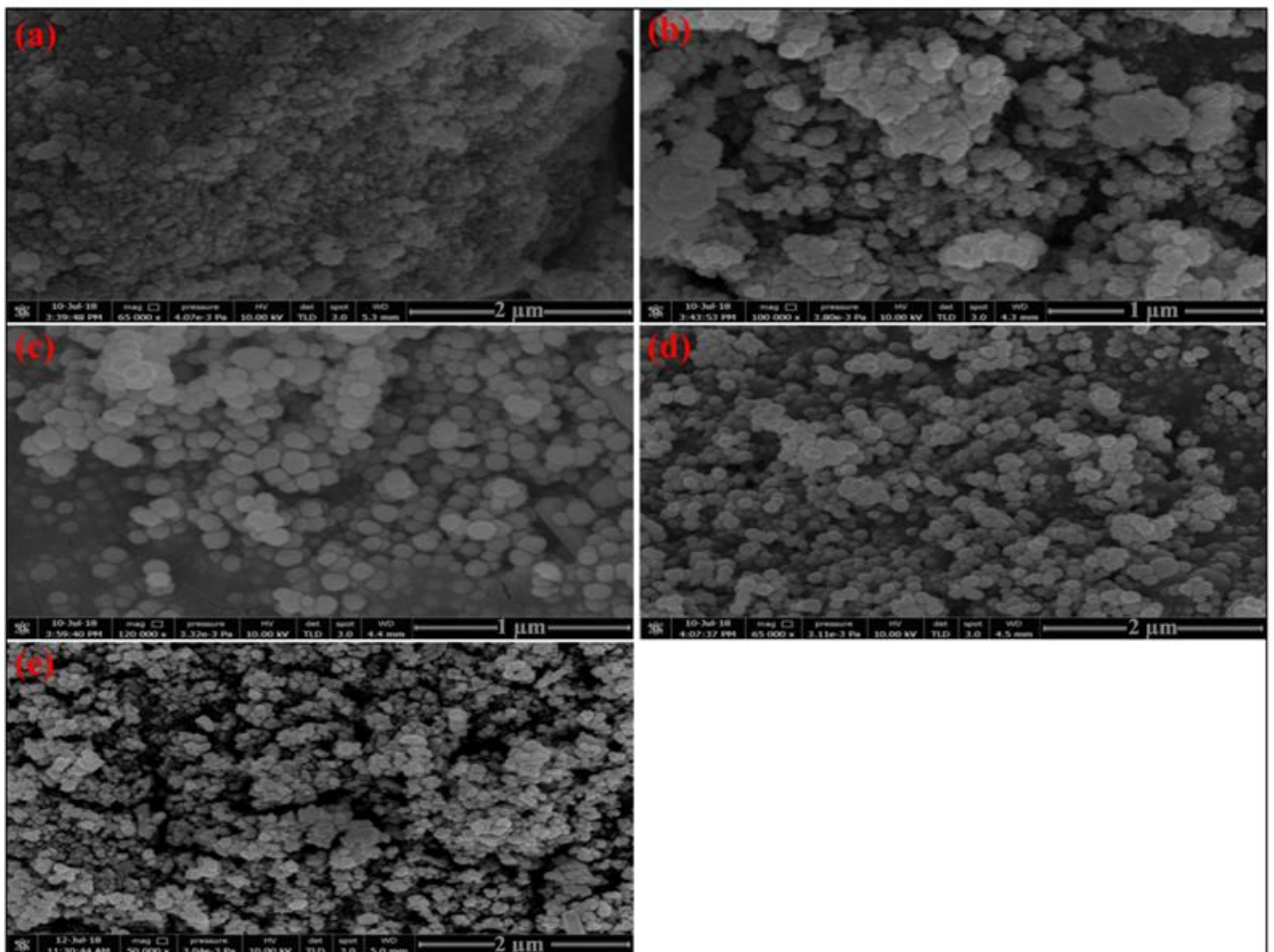


Figure S1. FESEM Images of NaGdF₄:Eu³⁺; (a) 3 hrs (b) 6 hrs (c) 12 hrs (d) 18 hrs (e) 24 hrs.

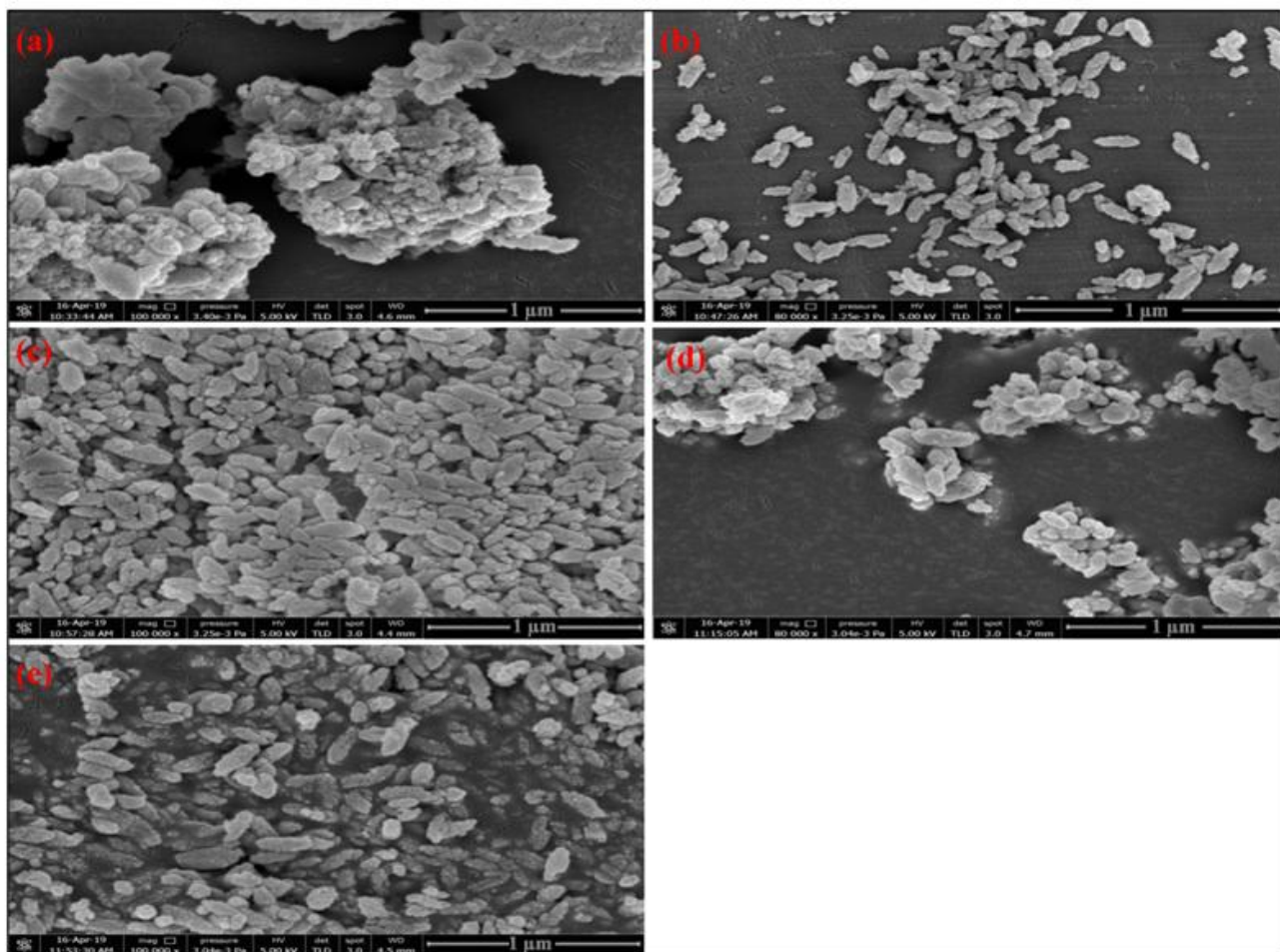


Figure S2. FESEM Images of NaGdF₄: Eu³⁺/ Ce³⁺; (a) 3 hrs (b) 6 hrs (c) 12 hrs (d) 18 hrs (e) 24 hrs.

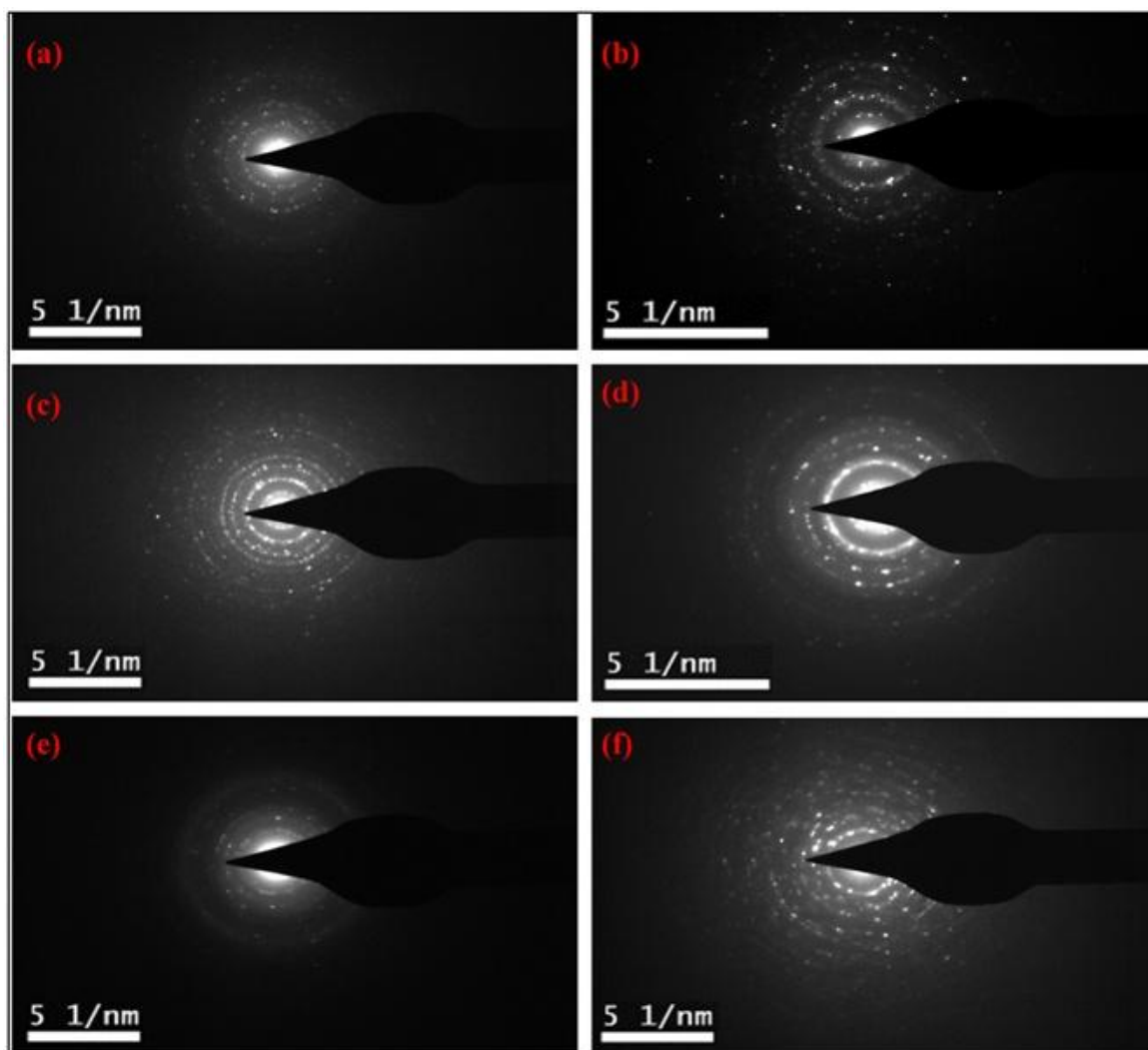


Figure S3. SEAD pattern of $\text{NaGdF}_4:\text{Eu}^{3+}$; (a-d) and $\text{NaGdF}_4:\text{Eu}^{3+}/\text{Ce}^{3+}$; (e and f) (a) 3 hrs (b) 6 hrs (c) 12 hrs (d) 18 hrs and (e) 3 hrs (f) 24 hrs.

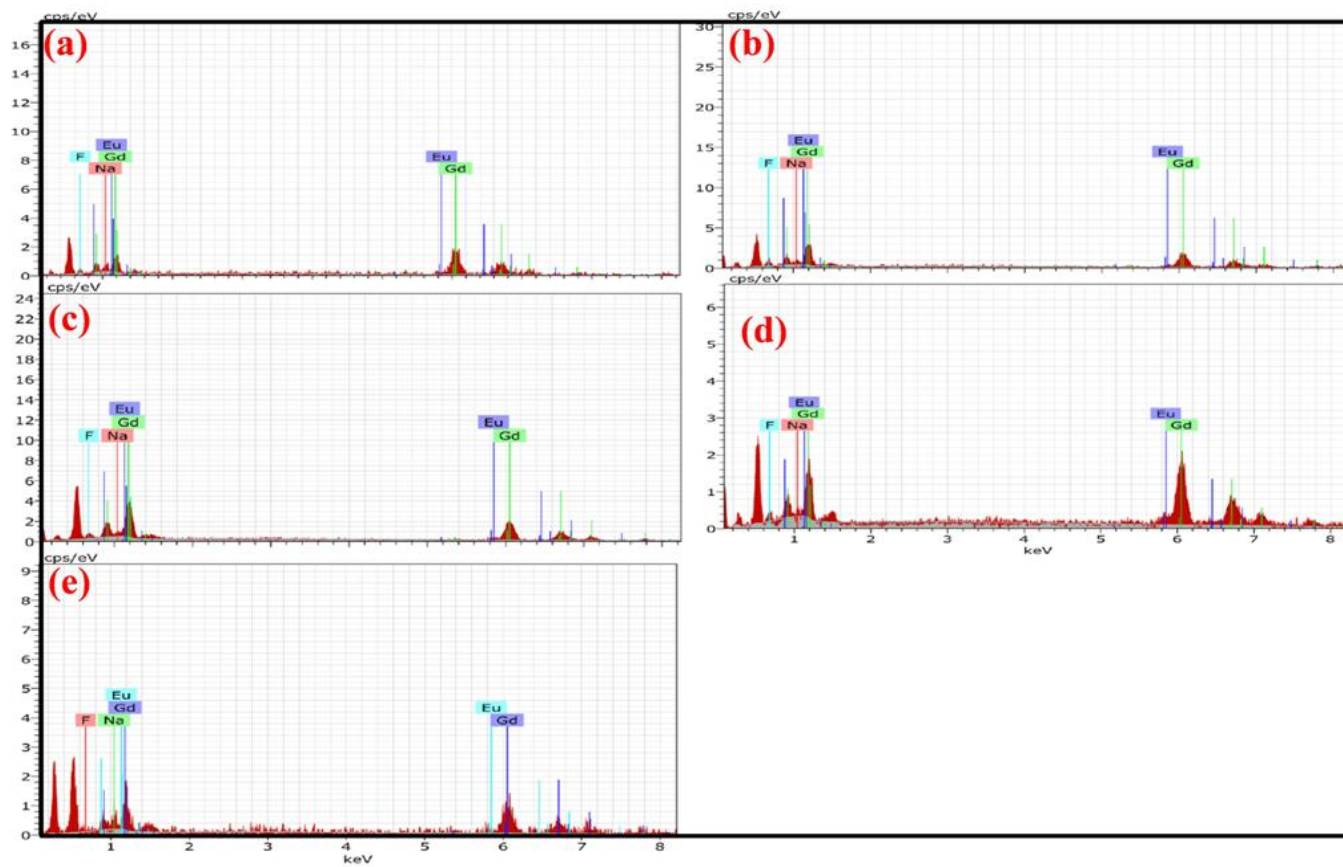


Figure S4. EDS spectra of $\text{NaGdF}_4:\text{Eu}^{3+}$; (a) 3 hrs (b) 6 hrs (c) 12 hrs (d) 18 hrs and (e) 24 hrs.

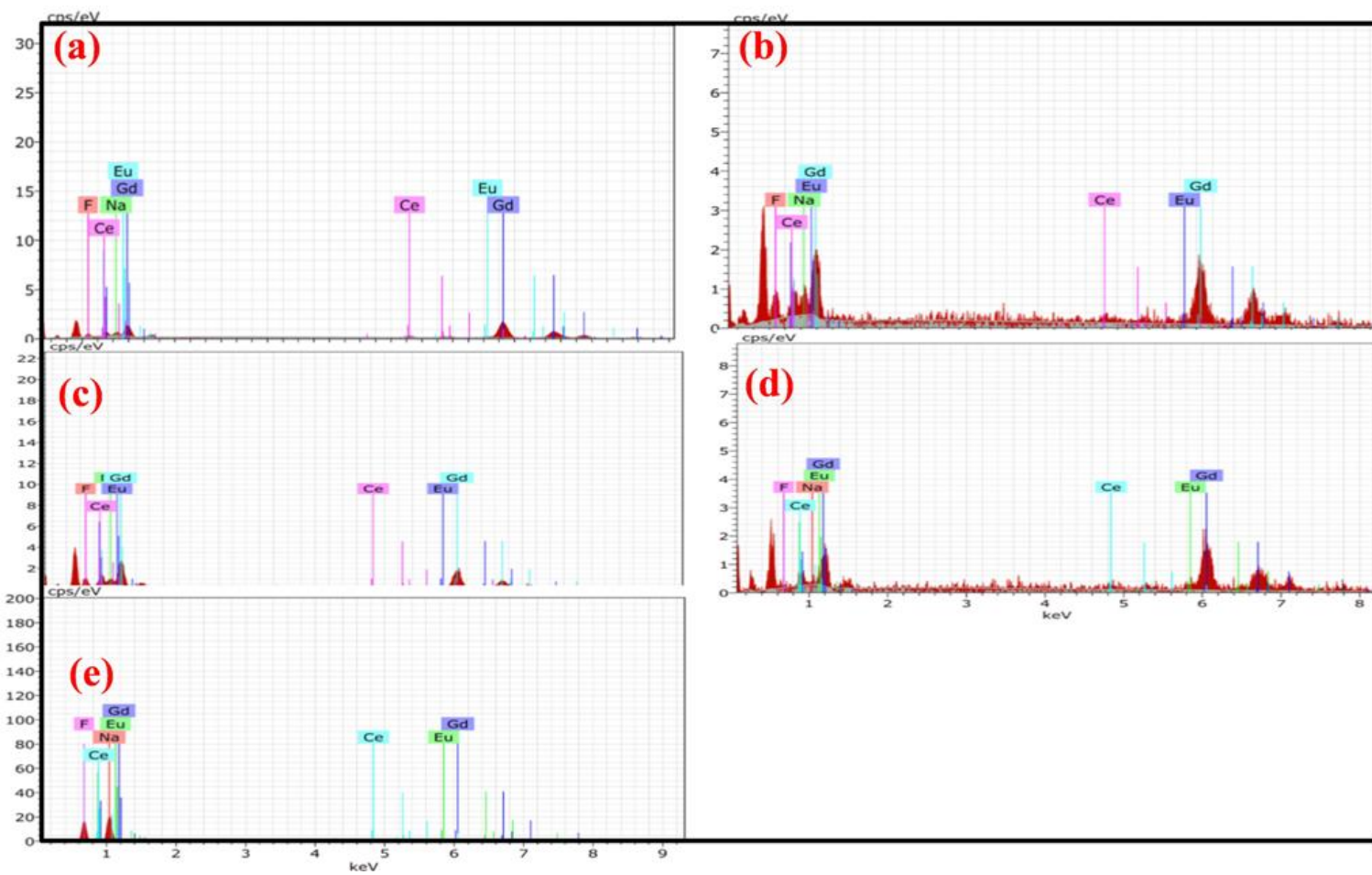


Figure S5. EDS spectra of as synthesized NaGdF₄: Eu³⁺/Ce³⁺; (a) 3 hrs (b) 6hrs (c) 12hrs (d) 18 hrs (e) 24 hrs.

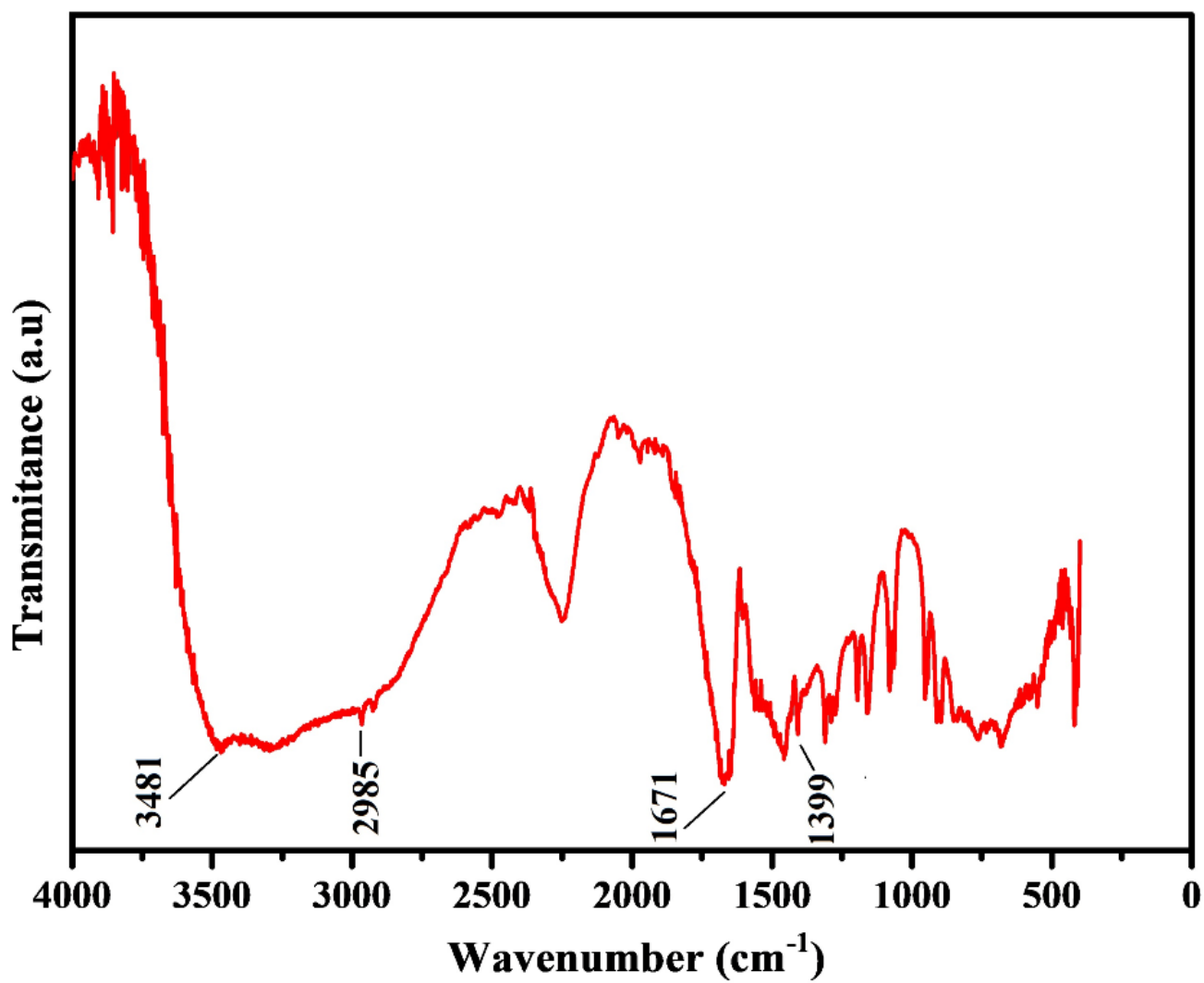


Figure S6. FTIR spectra of trisodium citrate (capping agent).

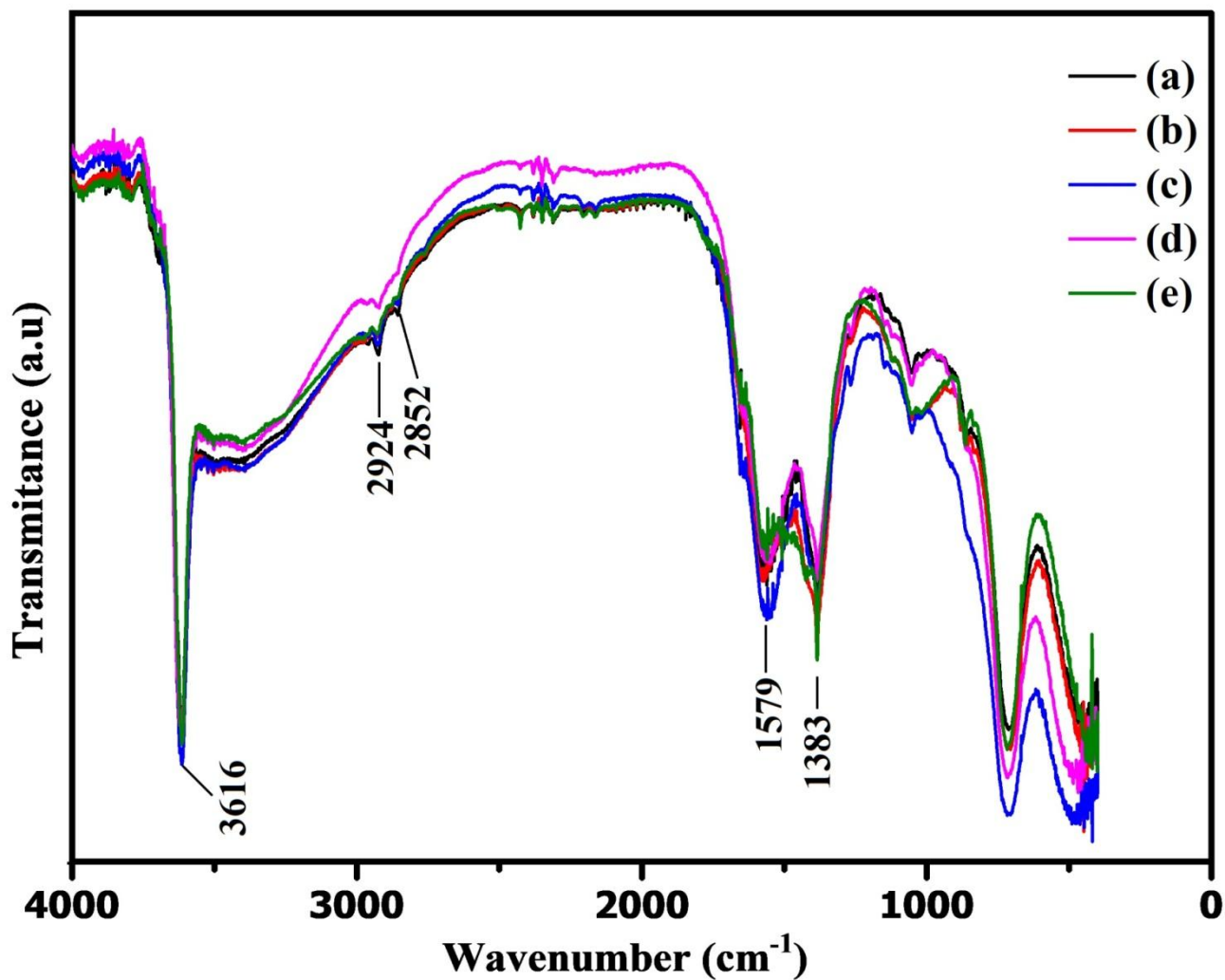


Figure S7. FTIR spectra of NaGdF₄:Eu³⁺; (a) 3 hrs (b) 6 hrs (c) 12 hrs (d) 18 hrs (e) 24 hrs.

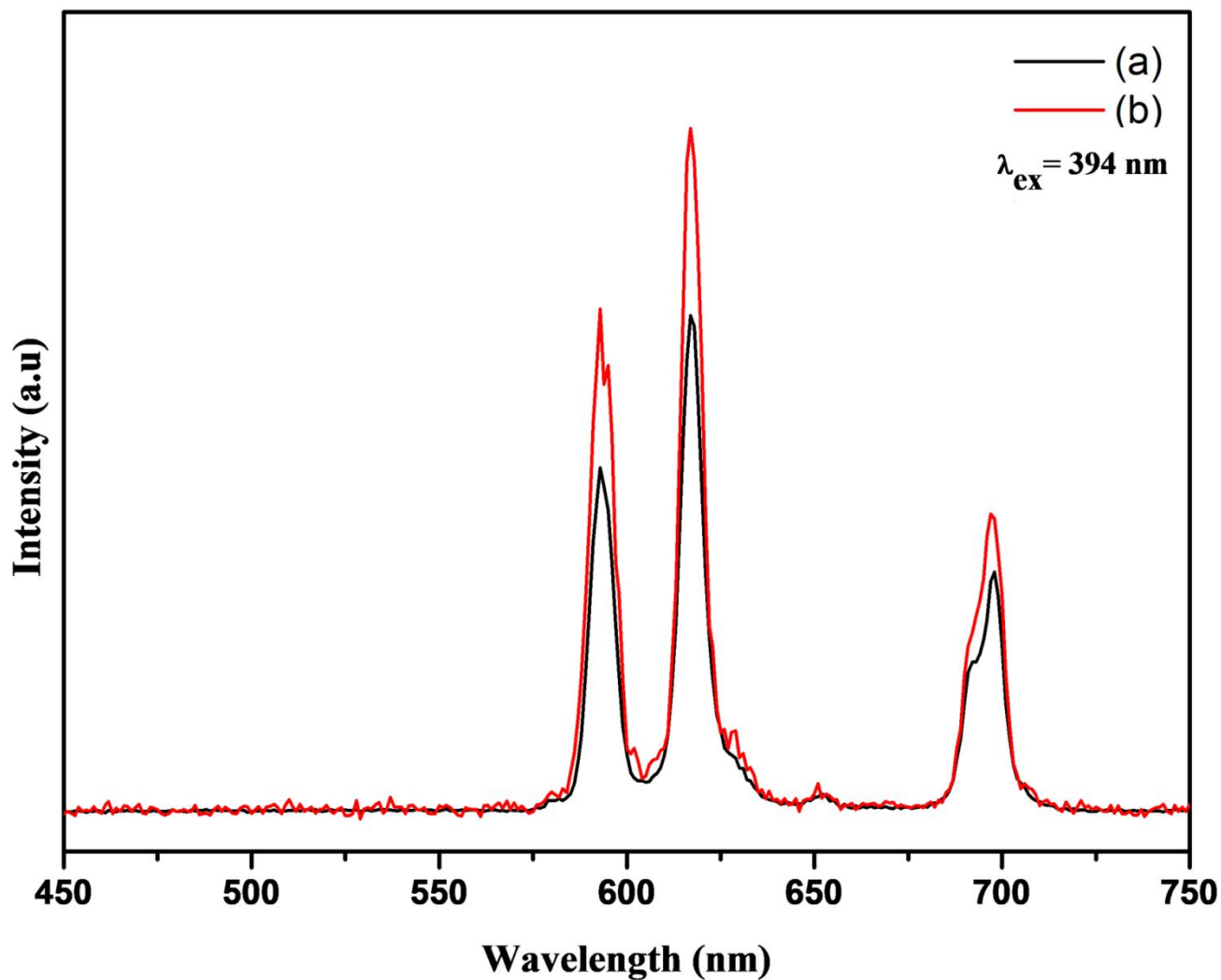


Figure S8. Solid state photoluminescence spectra of as synthesized nanostructures; (a) $\text{NaGdF}_4:\text{Eu}^{3+}$ and (b) $\text{NaGdF}_4:\text{Eu}^{3+}/\text{Ce}^{3+}$

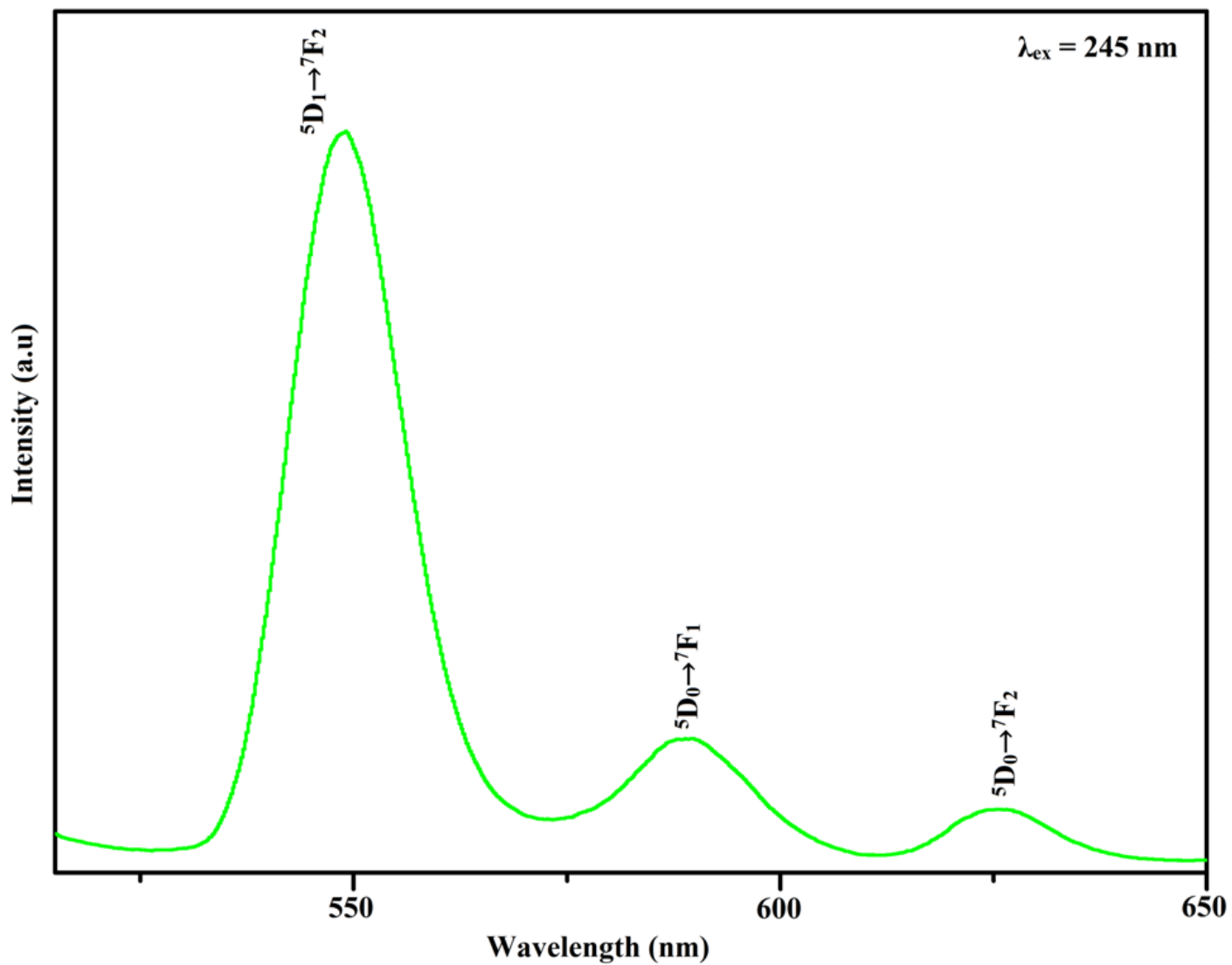


Figure S9. Photoluminescence spectra of NaGdF₄:Eu³⁺/Ce³⁺ on exciting at 245 nm

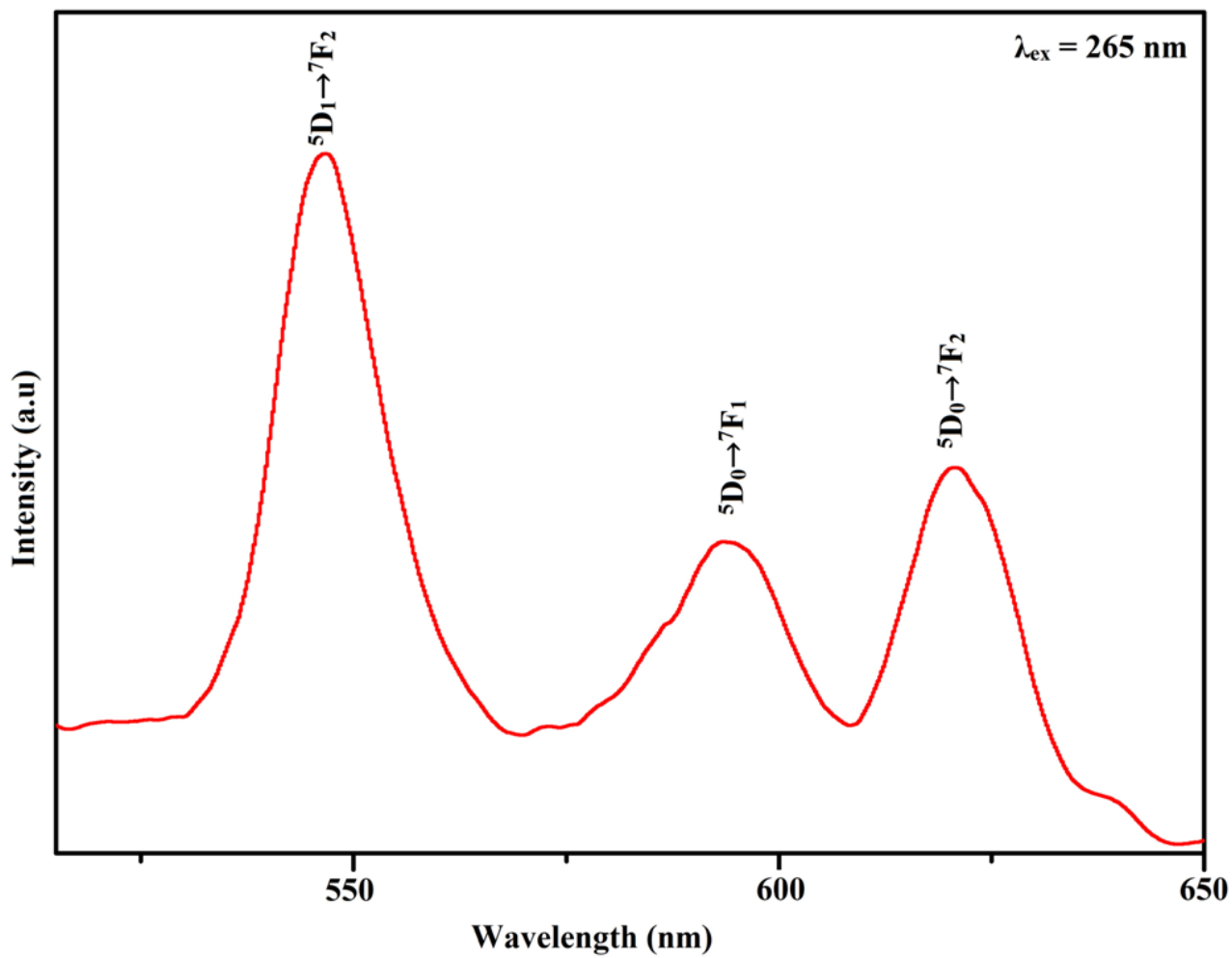


Figure S10. Photoluminescence spectra of NaGdF₄:Eu³⁺/Ce³⁺ on exciting at 265 nm

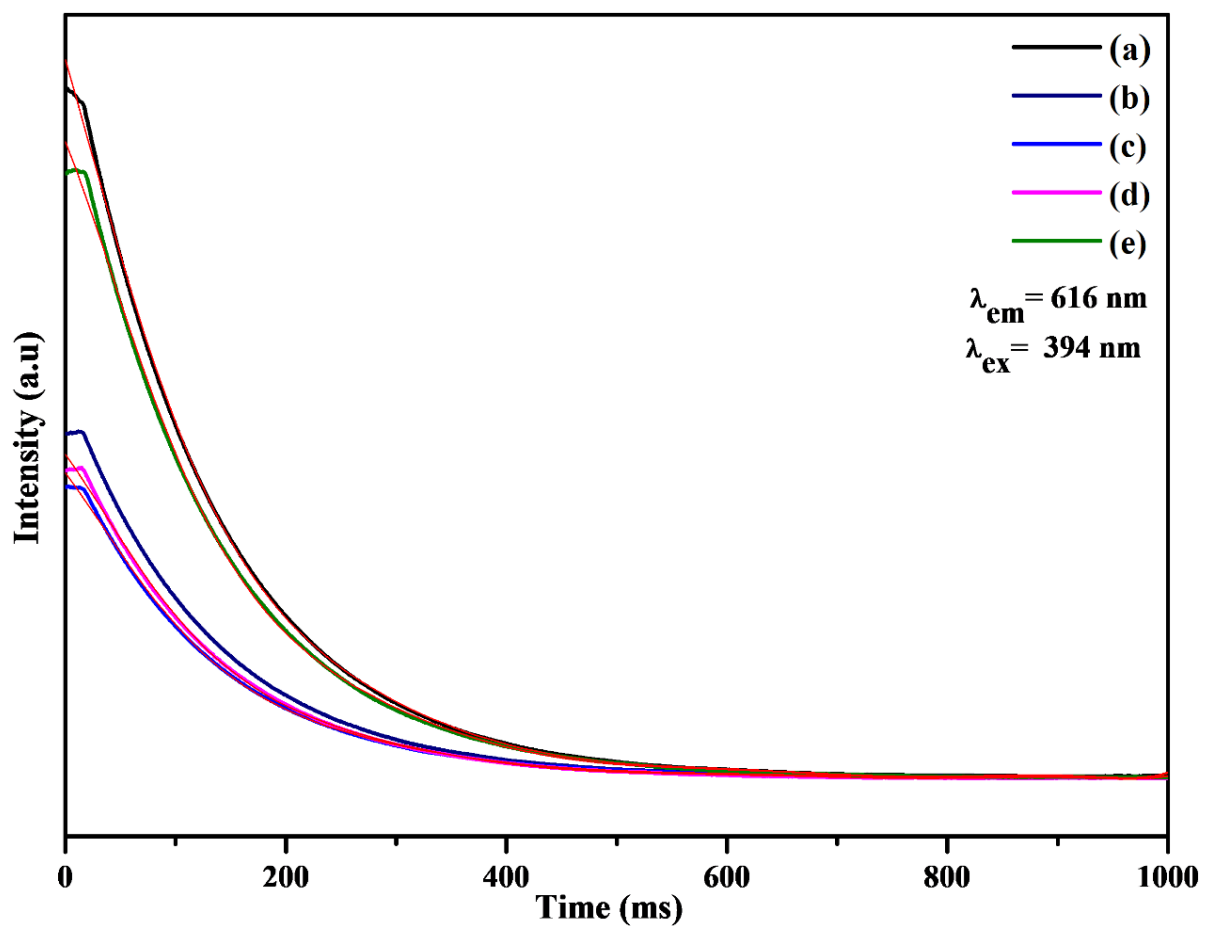


Figure S11. photoluminescence decay curves of NaGdF₄: Eu³⁺/Ce³⁺; (a) 3 hrs (b) 6 hrs (c) 12 hrs (d) 18 hrs (e) 24 hrs

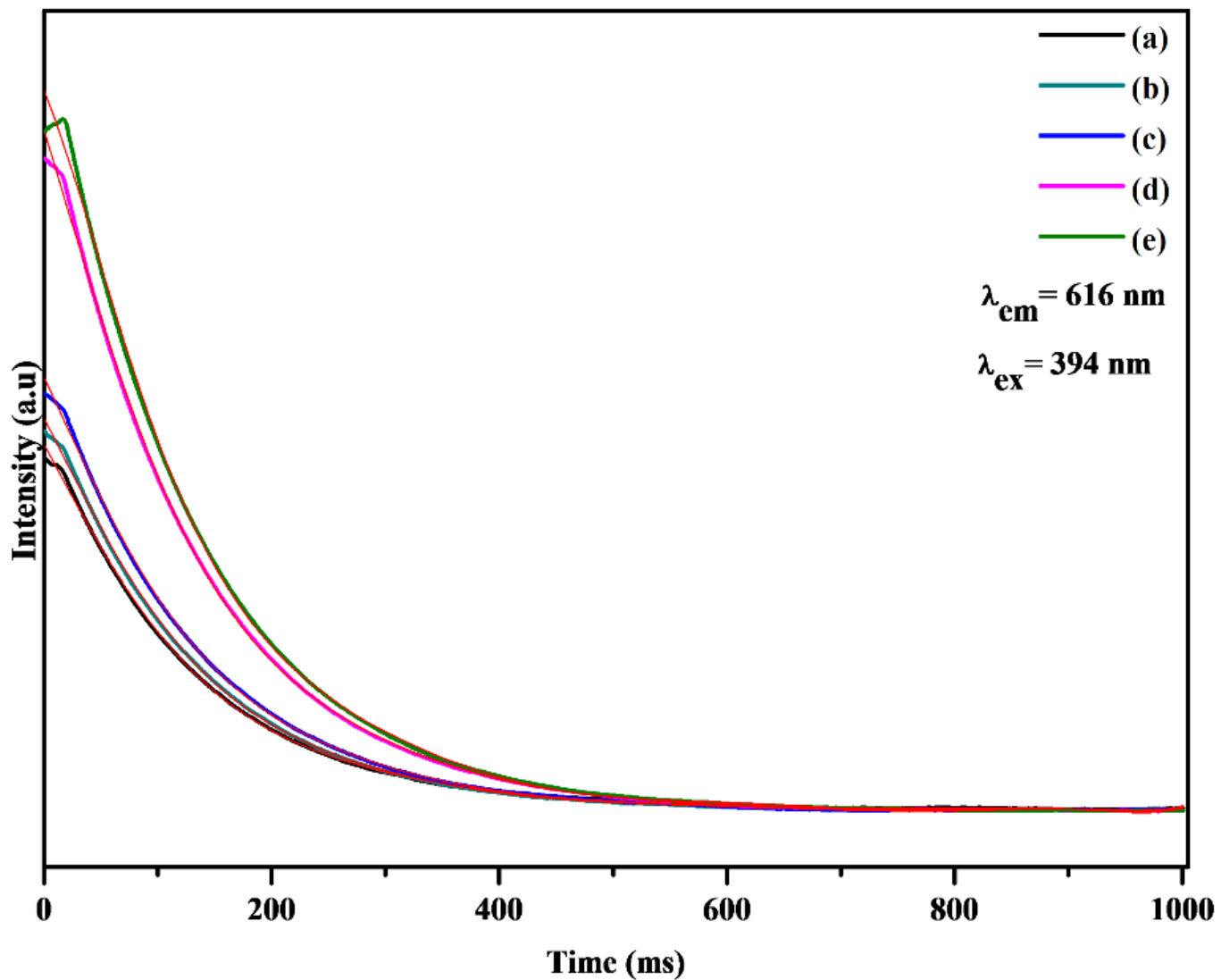


Figure S12. photoluminescence decay curves of NaGdF₄: Eu³⁺/Ce³⁺; (a) 3 hrs (b) 6 hrs (c) 12 hrs (d) 18 hrs (e) 24 hrs

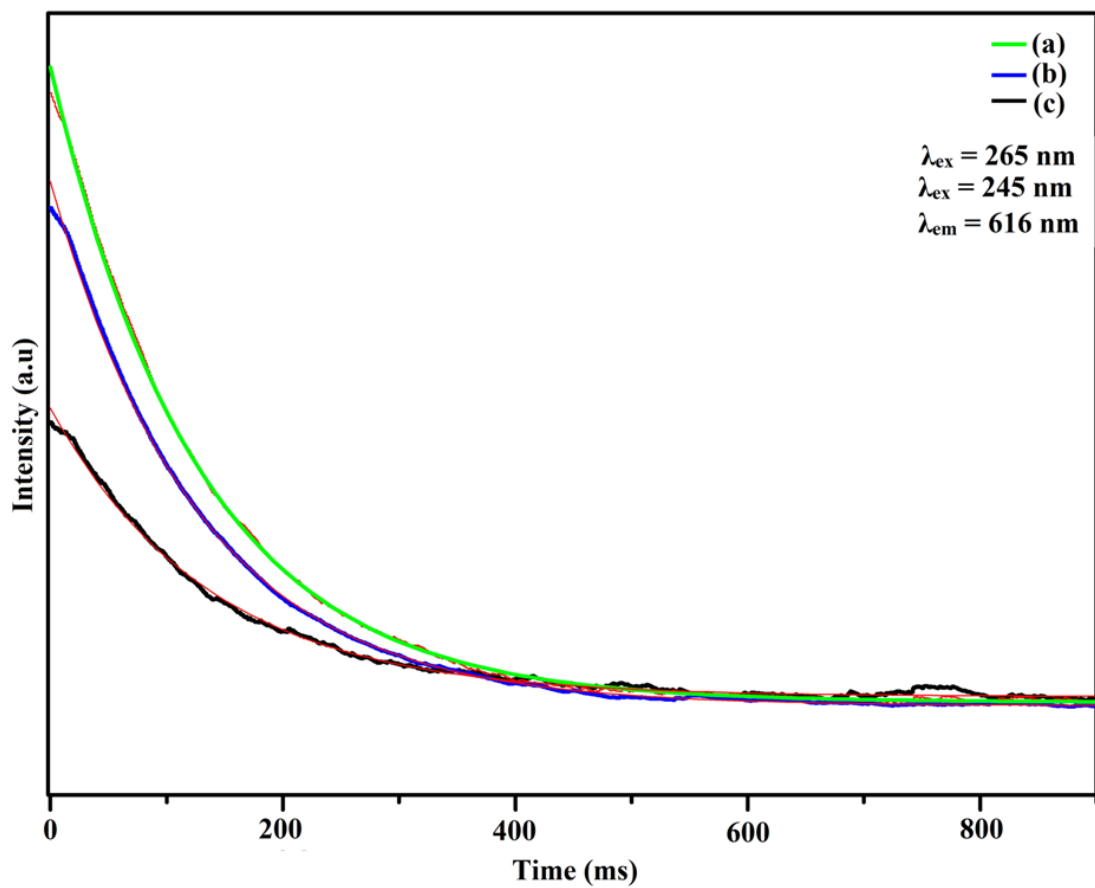


Figure S13. Photoluminescence decay curves of NaGdF₄: Eu³⁺/Ce³⁺ in presence of heavy metal ions: (a) Pb²⁺, (b) Cr³⁺, (c) Cd²⁺.

Table S1. Atomic and Weight % of elements present in NaGdF₄:Eu³⁺.

Elements	3 hrs		6hrs		12 hrs		18 hrs		24 hrs	
	Wt%	At%	Wt%	At%	Wt%	At%	Wt%	At%	Wt%	At%
Gadolinium	92.24	81.49	87.61	65.80	89.23	69.95	88.74	82.45	93.73	79.24
Europium	5.69	5.20	7.60	5.91	6.75	5.47	10.20	9.81	3.28	2.87
Sodium	1.44	8.70	1.41	7.27	1.37	7.36	0.33	2.07	2.51	14.49
Fluorine	0.63	4.61	3.38	21.03	2.65	17.22	0.74	5.68	0.48	3.39

Table S2. Atomic and Weight % of elements present in NaGdF₄:Ce³⁺/Eu³⁺.

Elements	3 hrs		6hrs		12 hrs		18 hrs		24 hrs	
	Wt%	At%	Wt%	At%	Wt%	At%	Wt%	At%	Wt%	At%
Gadolinium	86.99	72.59	84.77	61.50	87.06	62.87	87.09	83.97	15.39	2.43
Europium	5.33	4.60	5.01	3.76	4.16	3.11	9.06	9.04	1.38	0.23
Cerium	4.82	4.51	4.70	3.83	3.16	2.56	3.40	3.68	1.16	0.21
Sodium	1.28	7.28	2.17	10.76	2.09	10.3	0.16	1.08	44.66	48.24
Fluorine	1.59	11.01	3.35	20.14	3.54	21.13	0.28	2.24	37.41	48.90