Electronic Supplementary Material (ESI) for New Journal of Chemistry.

(Supplementary Information)

Down Converting Serine-functionalised $NaYF_4:Ce^{3+}/Gd^{3+}/Eu^{3+}@NaGdF_4:Tb^{3+}$ Photoluminescent Probe for Chemical Sensing of Explosive Nitroaromatic Compounds

Table of Contents

CONTENTS **Pages**

1. Rietveld refinement plots of $NaYF_4:Ce^{3+}/Gd^{3+}/Eu^{3+}$ ……**S2**
2. HR-TEM……....**S3**
3. EDS…….....**S4-S6**
4. FT-IR spectra……..**S7-S8**
5. Life time decay curve……....**S9-S10**
6. quenching efficiency……..**S11**
7. Crystallographic data information (Tables)……...**S12**
8. EDS data Tables……...**S13-S14**

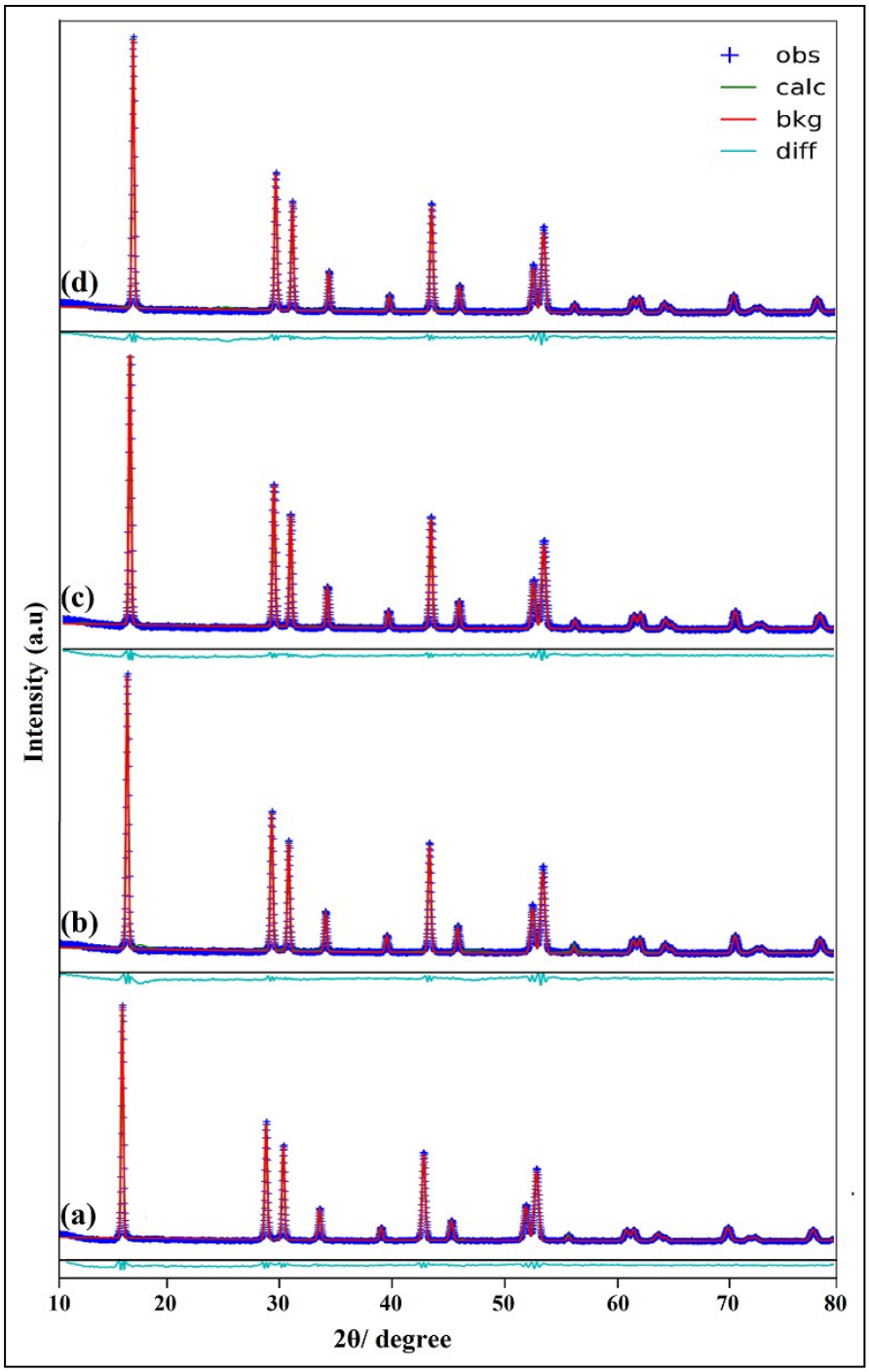

Fig. S1 Rietveld refinement plots of $NaYF_4:Ce^{3+}/Gd^{3+}/Eu^{3+}$ nanostructure with different Eu^{3+} contents; (a) 10% (b) 15% (c) 20% (d) 25%

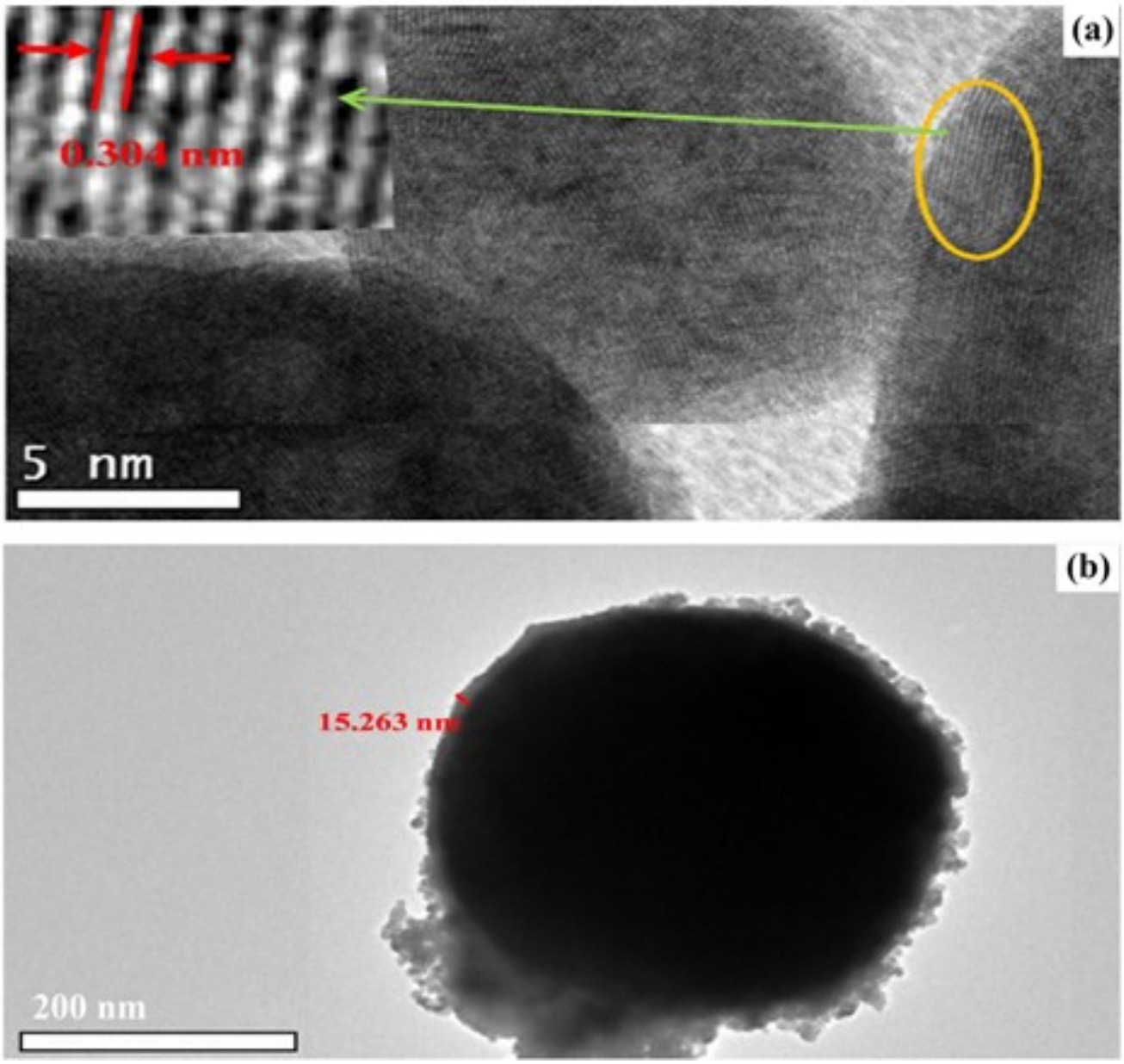

Fig. S2 (a) HR-TEM image of Serine-functionalised core shell nanocrystal and (b) TEM image of Core shell nanostructure.

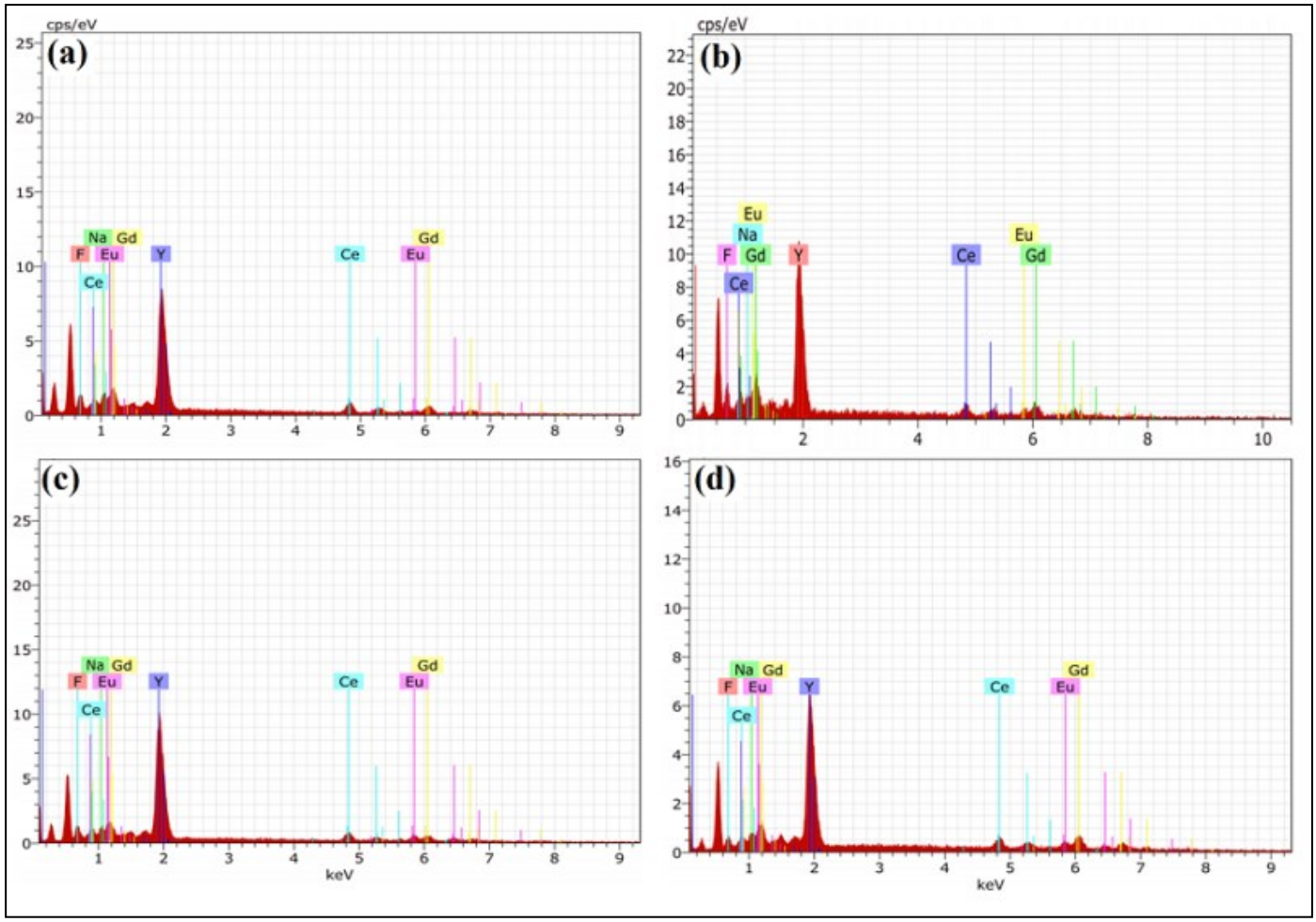

Fig. S3 EDS spectra of $NaYF_4$:Ce^{3+}/Gd^{3+}/Eu^{3+} nanophosphors with different Eu^{3+} contents: (a) 3% (b) 5% (c) 7% (d) 10%

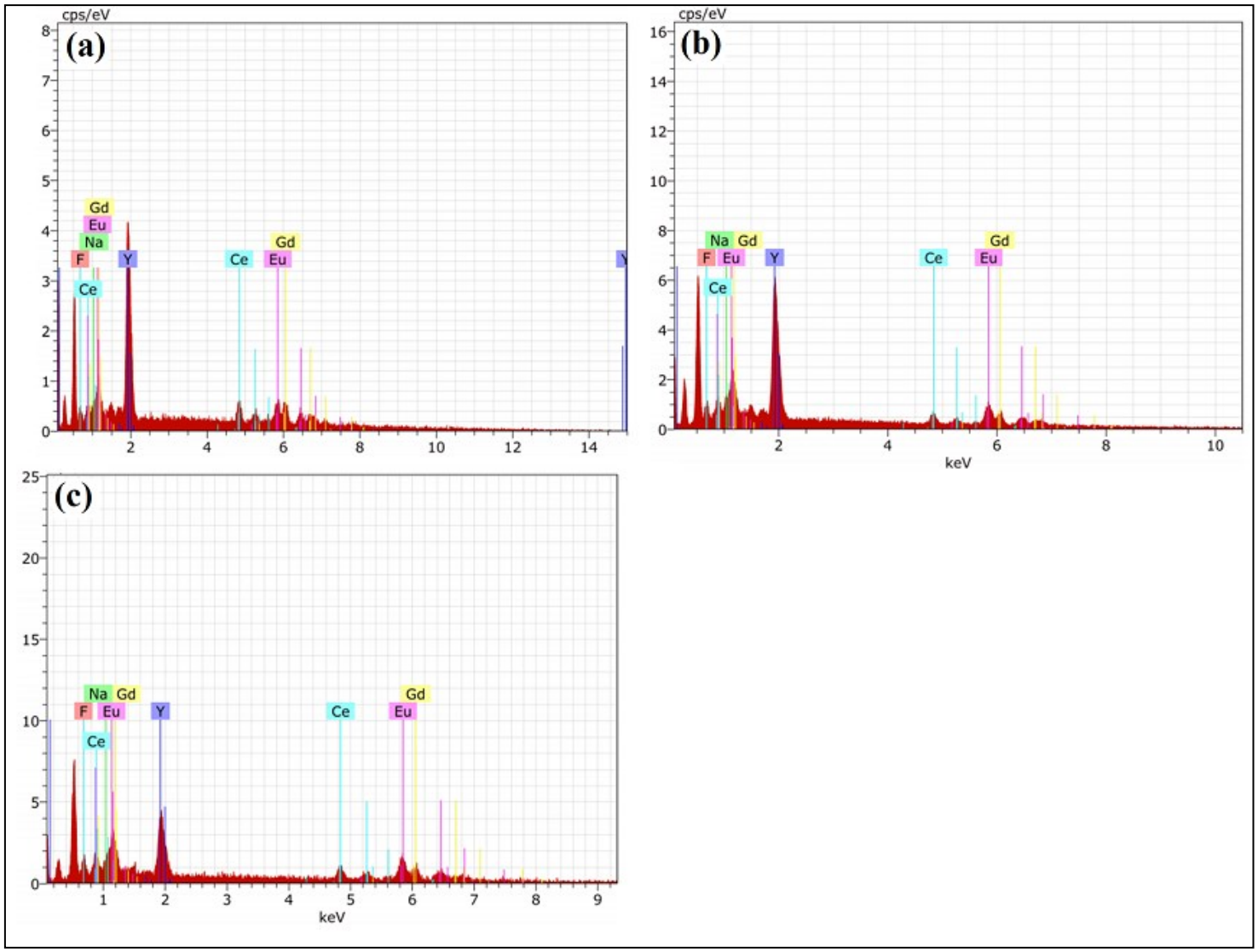

Fig. S4 EDS spectra of as synthesized $NaYF_4$:Ce^{3+}/Gd^{3+}/Eu^{3+} nanocrystals with different Eu^{3+} contents: (a) 15 % (b) 20 % (c) 25%

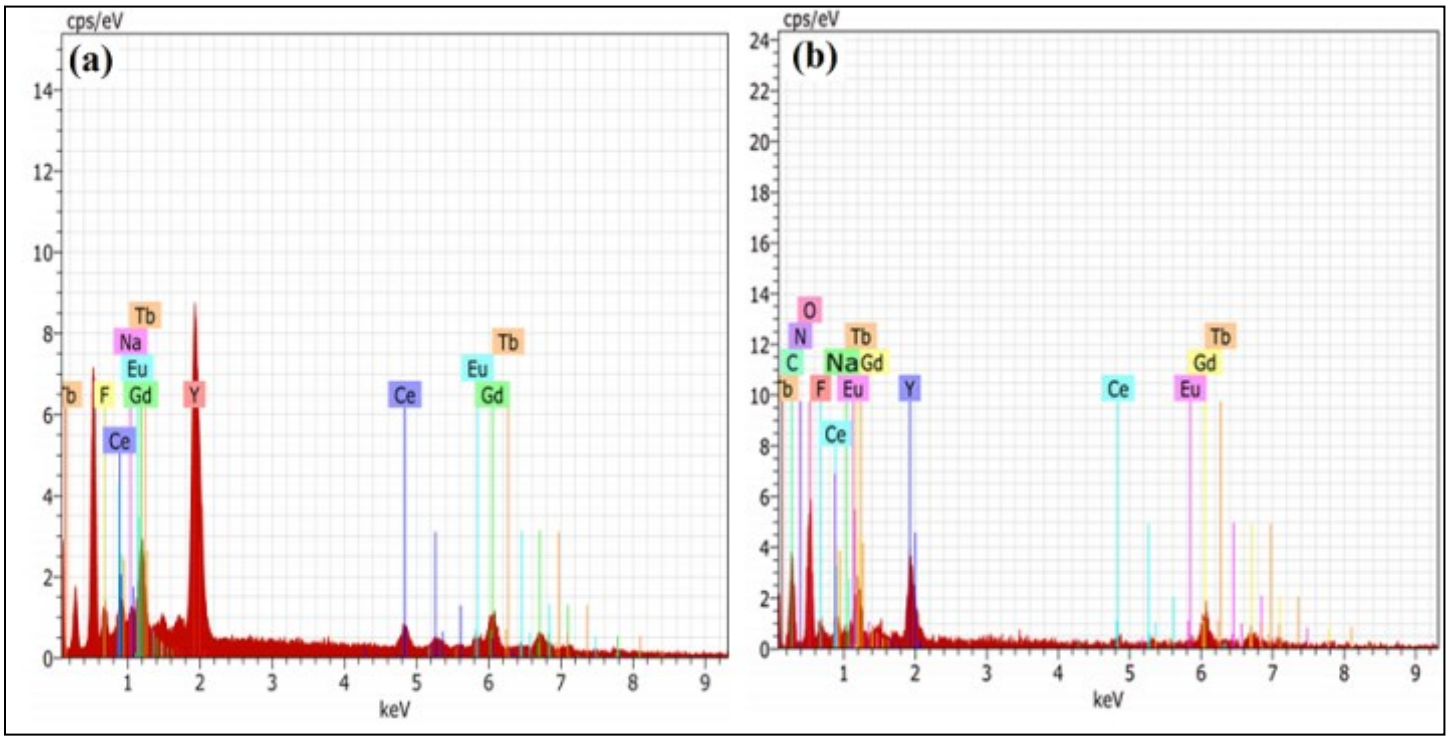

Fig. S5 EDS spectra of nanophosphors: (a) $NaYF_4:Ce^{3+}/Gd^{3+}/Eu^{3+}@NaGdF_4:Tb^{3+}$ core shell

(b) Serine functionalised $NaYF_4:Ce^{3+}/Gd^{3+}/Eu^{3+}@NaGdF_4:Tb^{3+}$ core shell

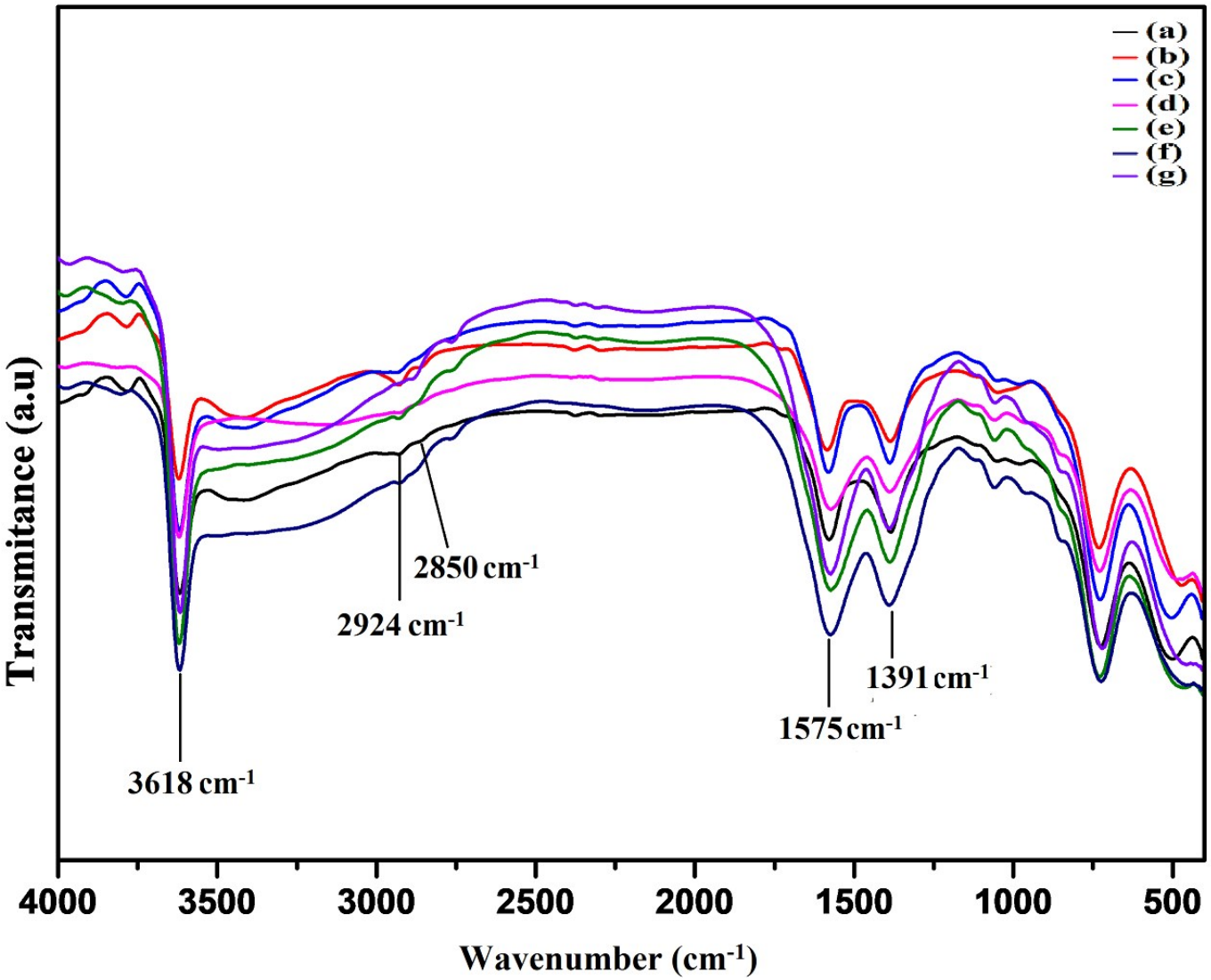

Fig. S6 FTIR spectra of $NaYF_4:Ce^{3+}/Gd^{3+}/Eu^{3+}$ with different Eu^{3+} contents; (a) 3% (b) 5% (c) 7% (d) 10% (e) 15% (f) 20% (g) 25%

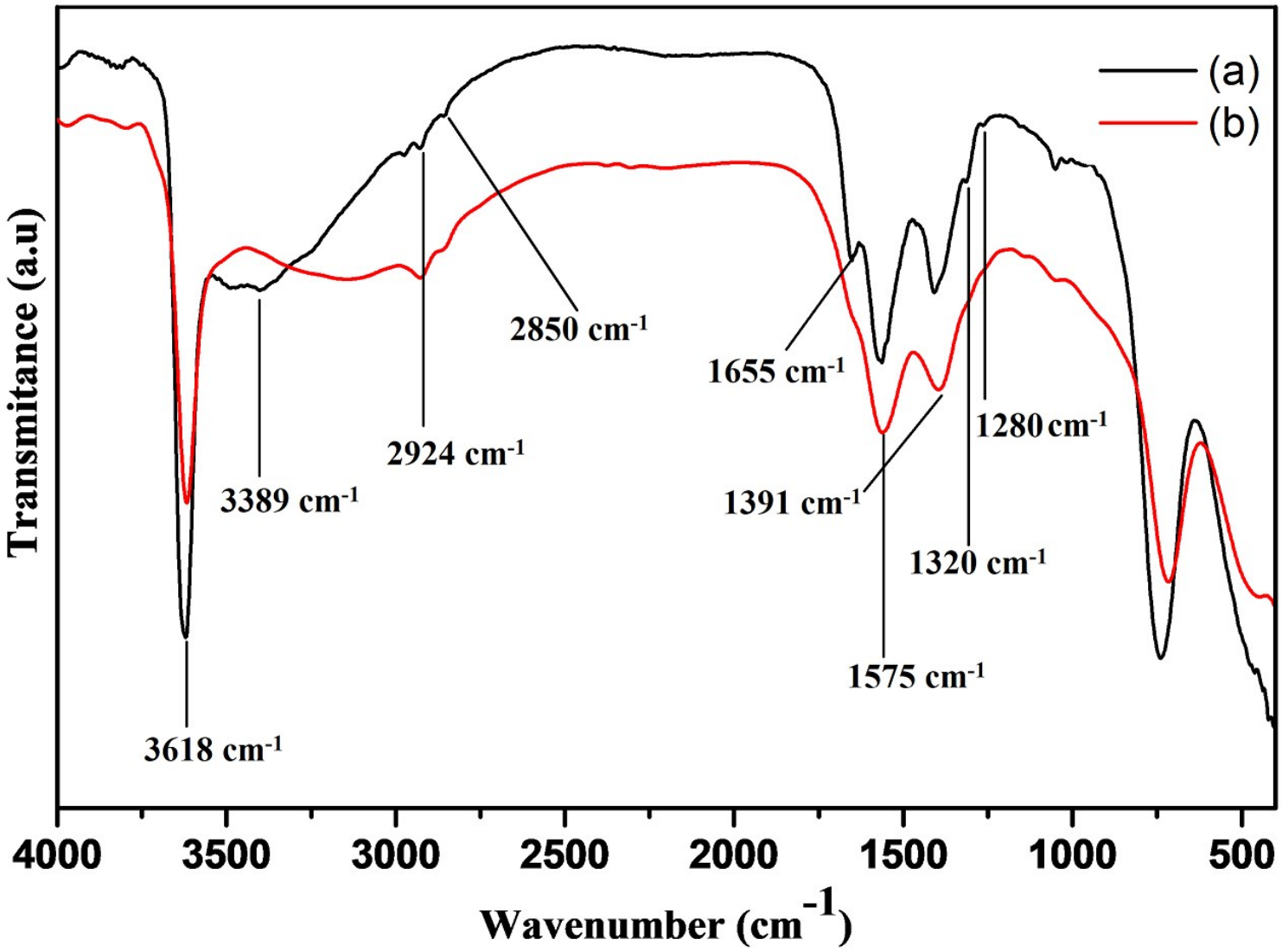

Fig. S7 FTIR spectra of synthesized nanostructure; (a) core shell (b) Serine-functionalized core shell

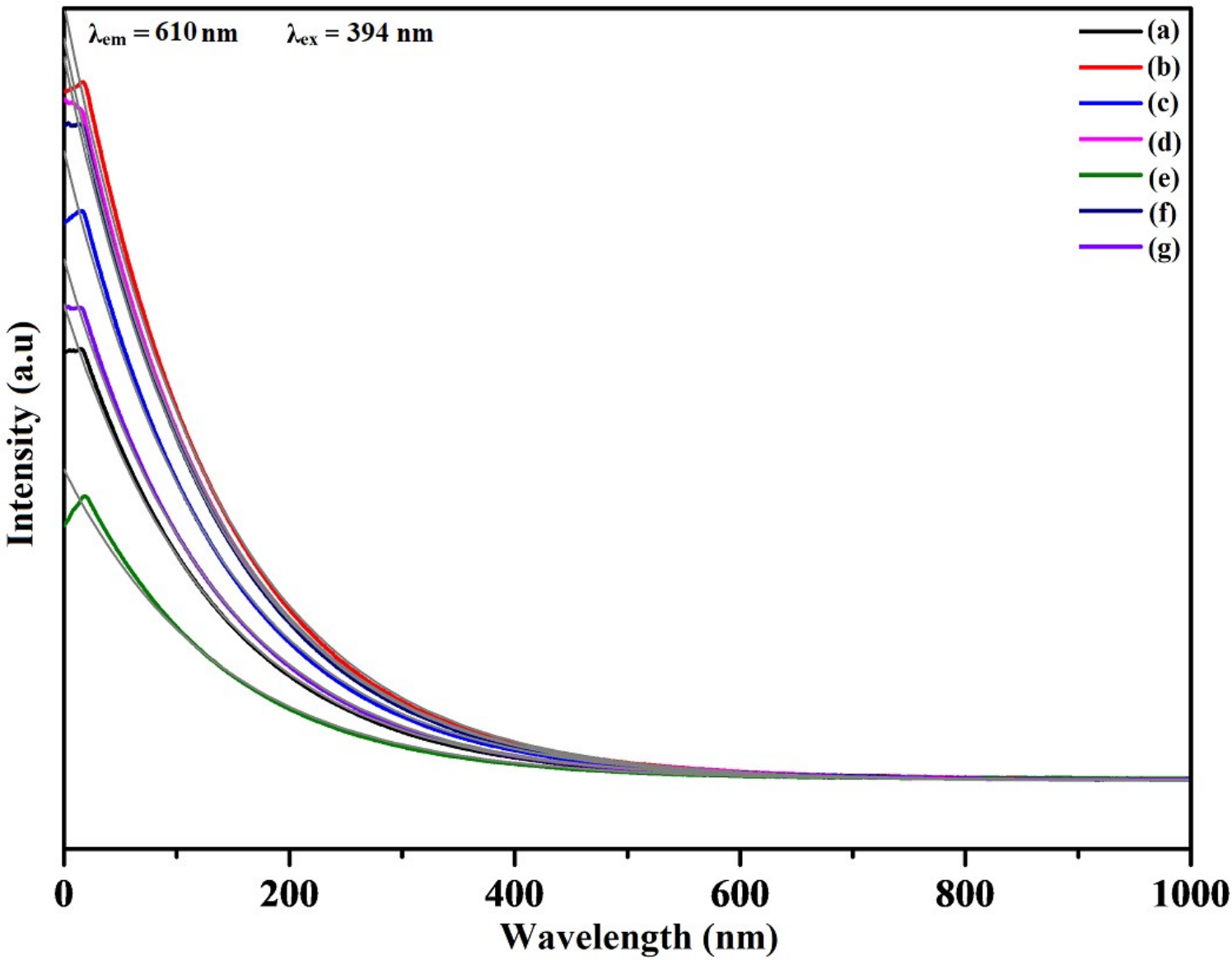

Fig. S8 Photoluminescence decay curves of $NaYF_4:Ce^{3+}/Gd^{3+}/Eu^{3+}$ with different Eu^{3+} contents; (a) 3% (b) 5% (c) 7% (d) 10% (e) 15% (f) 20% (g) 20%

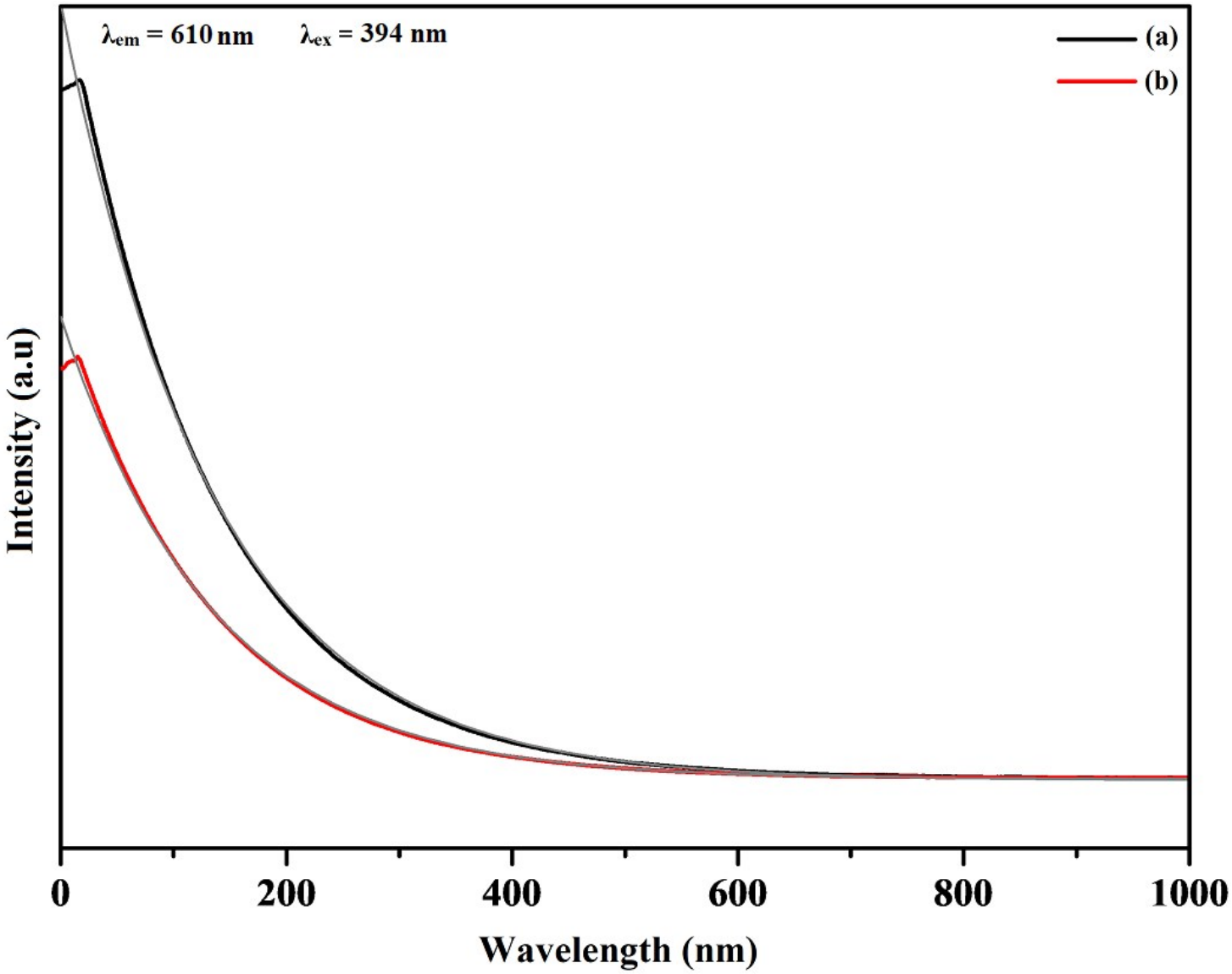

Fig. S9 Photoluminescence decay curves of nanophosphors; (a) Core shell (b) serine-functionalized core shell nanomaterials.

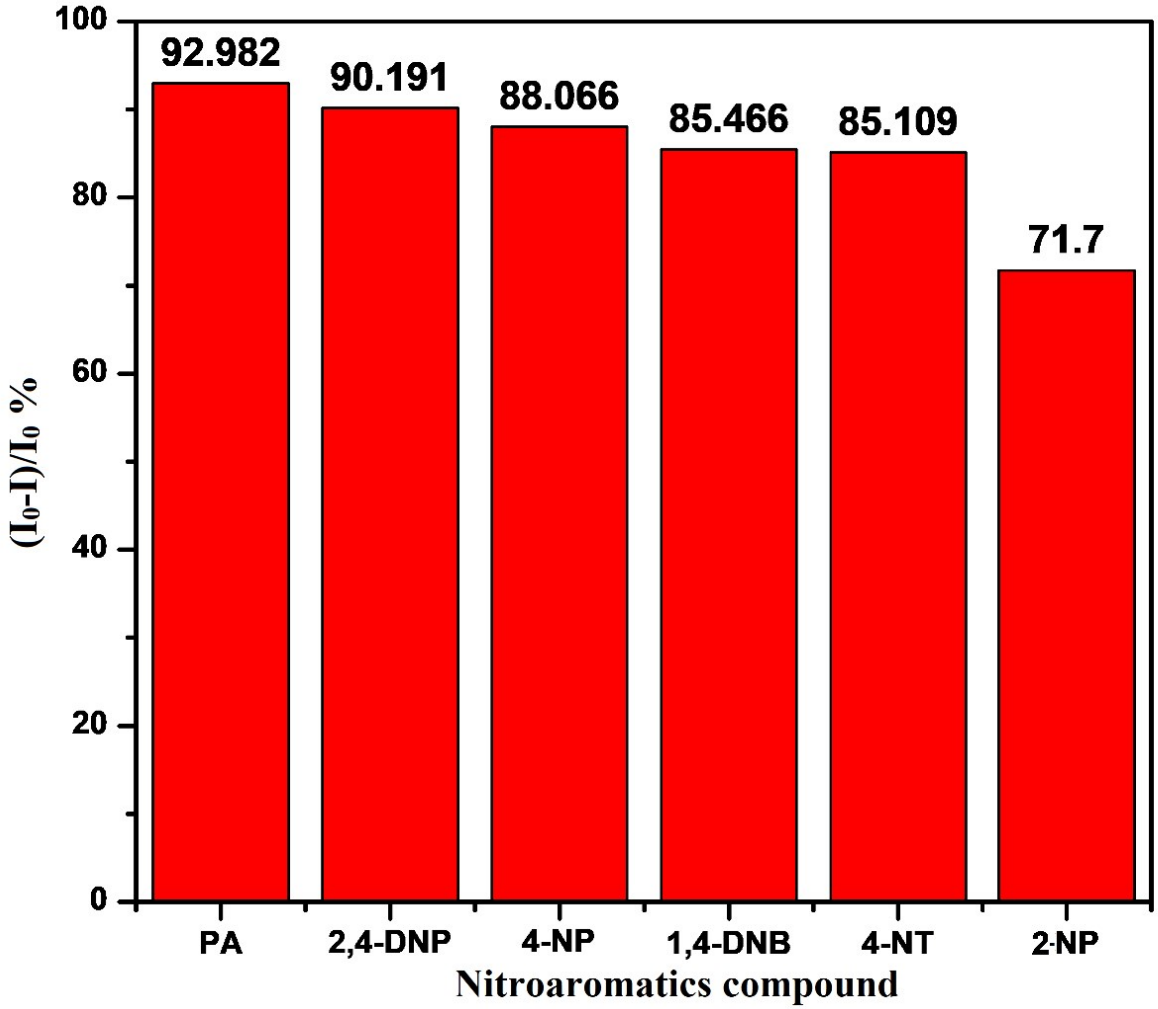

Fig. S10 Quenching efficiency of the samples containing serine-functionalized $NaYF_4:Ce^{3+}/Gd^{3+}/Eu^{3+}@NaGdF_4:Tb^{3+}$ core shell and different nitro-compounds (100 ppm) in aqueous sol

Table S1. Crystallographic data of hexagonal $NaYF_4:Ce^{3+}/Gd^{3+}/Eu^{3+}$ nanostructures synthesized with different Eu^{3+} contents; 3%, 5%, 7%, 10%, 15%, 20% and 25%.

Sample	3 %	5 %	7 %	10 %	15 %	20 %	25 %
Space Group	P -6	P -6	P -6	P -6	P -6	P -6	P -6
Symmetry	Hexagonal	Hexagonal	Hexagonal	Hexagonal	Hexagonal	Hexagonal	Hexagonal
2θ interval (º)	20-80	20-80	20-80	20-80	20-80	20-80	20-80
Lattice parameters							
a (Å)	5.96236	5.87754	6.40764	11.14293	6.09353	5.88150	9.38186
b (Å)	5.96236	5.87754	6.40764	11.14293	6.09353	5.88150	9.38186
c (Å)	3.06273	3.70879	3.59470	2.95871	3.50211	3.15020	3.25801
V ($Å^3$)	94.292	110.957	127.817	318.150	112.615	94.372	248.348
R_w	4.98%	4.59%	4.62%	5.01%	4.23%	5.00%	4.49%

Table S2 Atomic and Weight % of elements present in $NaYF_4:Ce^{3+}/Gd^{3+}/Eu^{3+}$ with different Eu^{3+} contents

Elements	**Eu^{3+} 3 %**		**Eu^{3+} 5 %**		**Eu^{3+} 7 %**		**Eu^{3+} 10 %**		**Eu^{3+} 15 %**		**Eu^{3+} 20 %**		**Eu^{3+} 25 %**	
	W%	**At%**	**Wt %**	**At%**	**Wt %**	**At %**	**Wt %**	**At %**	**Wt %**	**At %**	**Wt %**	**At %**	**Wt %**	**At %**
Yttrium	55.77	48.94	55.02	49.83	58.69	53.12	52.74	55.99	42.49	49.95	42.37	42.64	25.98	28.33
Gadolinium	16.28	8.08	19.74	10.11	11.80	6.04	22.14	13.29	21.49	14.28	15.84	9.01	17.91	11.04
Europium	4.87	2.50	7.83	4.15	11.18	5.92	10.12	6.28	21.14	14.54	27.53	16.20	38.24	24.39
Cerium	2.50	8.14	9.96	5.72	11.25	6.46	11.39	7.67	12.60	9.40	8.15	5.20	12.01	8.31
Sodium	3.40	11.53	1.91	6.68	2.10	7.36	1.37	5.61	0.75	3.40	2.21	8.60	2.25	9.50
Fluorine	5.07	20.82	5.55	23.51	4.98	21.10	2.25	11.16	1.53	8.43	3.90	18.34	3.61	18.43

Table S3 Atomic and Weight (%) of elements present in core shell and Serine functionalised core shell nanostructure

Elements	**Core shell**		**Serine functionalized core shell**	
	Wt%	**At%**	**Wt%**	**At%**
Yttrium	48.53	49.30	12.07	3.56
Gadolinium	27.99	16.08	29.98	5.00
Europium	7.96	4.73	2.04	0.35
Terbium	1.29	0.73	4.71	0.78
Cerium	9.08	5.86	3.02	0.56
Sodium	1.38	5.44	0.22	0.25
Fluorine	3.76	17.86	2.67	3.68
Carbon			20.65	45.07
Nitrogen			1.53	2.87
Oxygen			23.11	37.87