

(Supplementary Information)

**PEI Functionalized NaCeF₄:Tb³⁺/Eu³⁺ For Photoluminescence
Sensing of Heavy Metal Ions and Explosive Aromatic Nitro
Compounds**

Richa Singhaal, LobzangTashi, Zaib ul Nisa, Nargis Akhter Ashashi,
Charanjeet Sen, Swaita Devi, Haq Nawaz Sheikh^a

^aDepartment of Chemistry, University of Jammu, Baba Sahib Ambedkar Road, Jammu-
180006, India

hnsheikh@rediffmail.com

Table of Contents

CONTENTS	Pages
1. PXRD.....	S2
2. EDS	S3-S4
3. TEM	S5
4. HR-TEM	S6
5. FT-IR spectra.....	S7-S10
6. PL spectra.....	S11
7. Life time decay curve.....	S12-13
8. Quenching efficiency.....	S14-S15
9. EDS data Tables.....	S16-S17

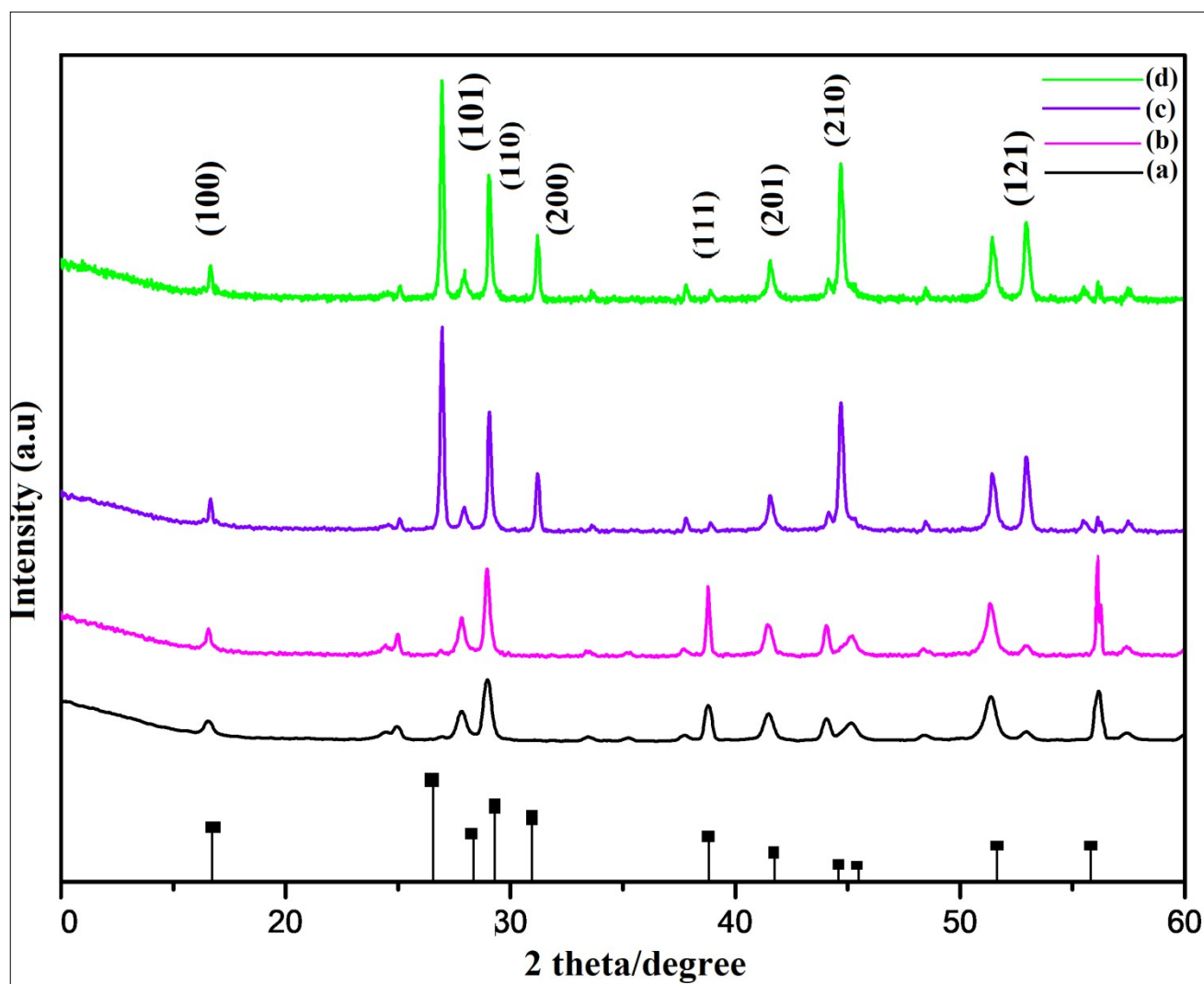


Fig. S1 PXR D plots of $\text{NaCeF}_4:\text{Tb}^{3+}$ (Tb-5%) nanophosphors fabricated at different heating temperatures **(a)** 120 °C **(b)** 140 °C **(c)** 160 °C **(d)** 180 °C

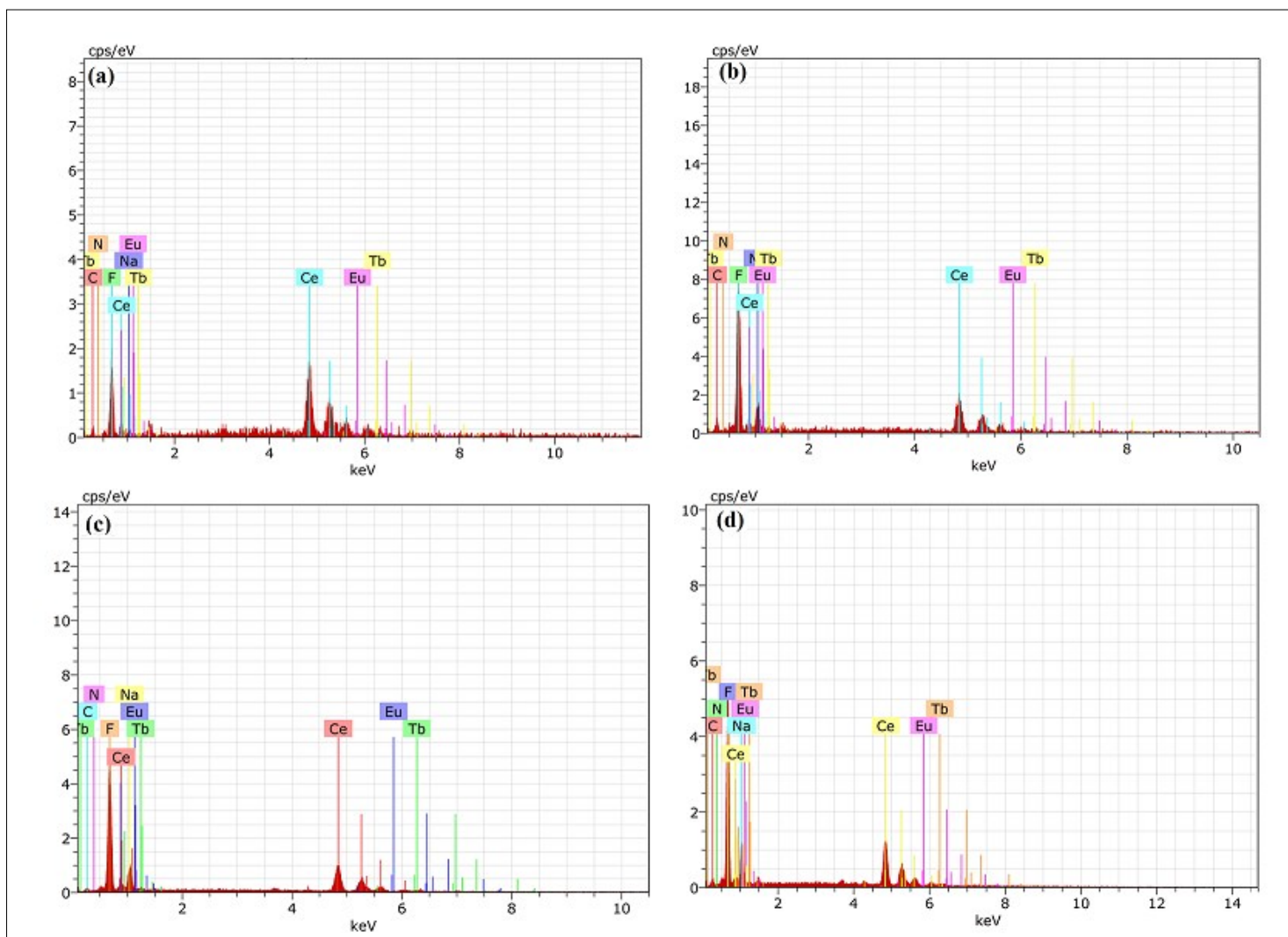


Fig.S2 EDS spectra of Tb³⁺ (5%) doped NaCeF₄ nanocrystals synthesized at different heating temperatures (a) 120 °C (b) 140 °C (c) 160 °C (d) 180 °C

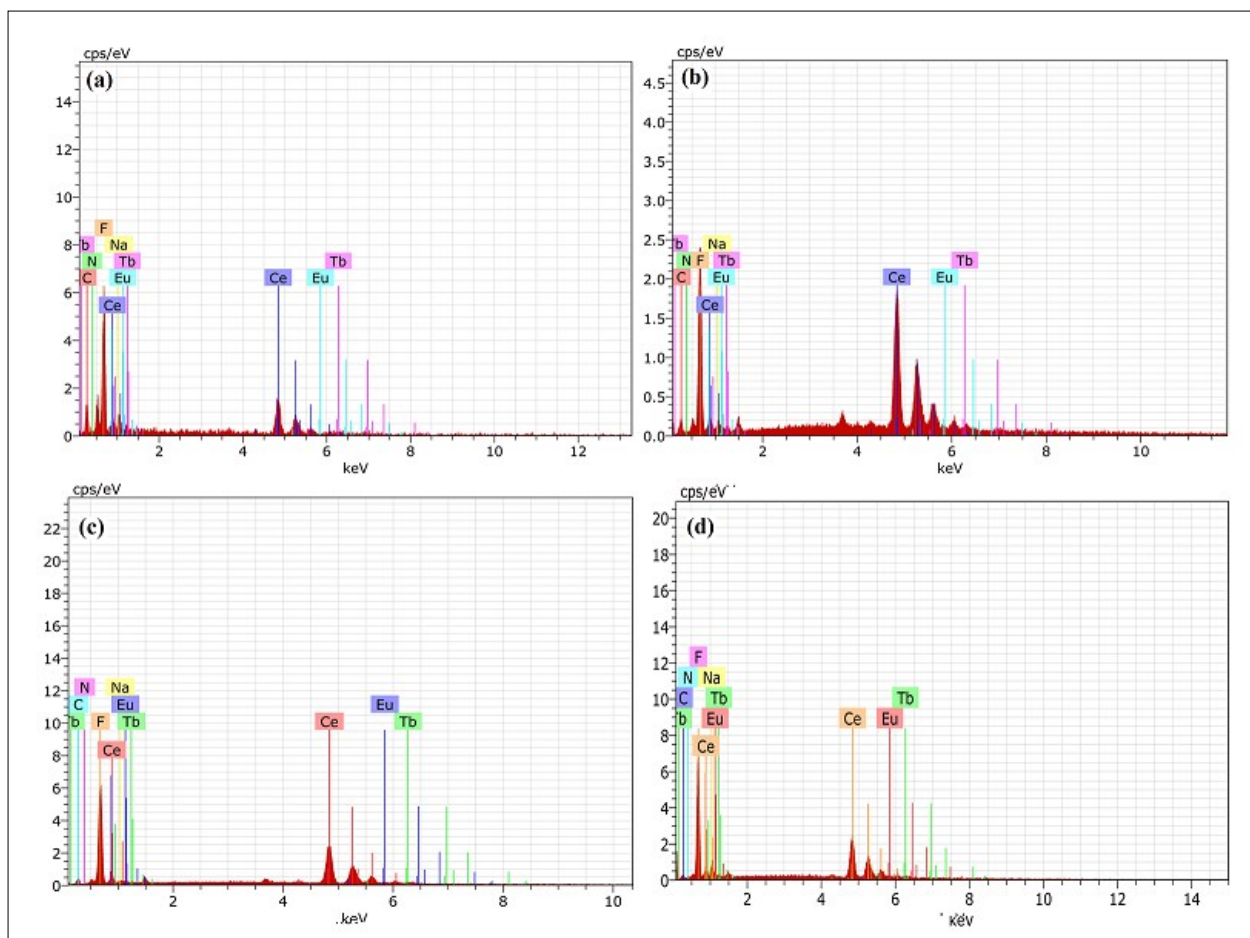


Fig. S3 EDS spectra of fabricated $\text{NaCeF}_4:\text{Tb}^{3+}/\text{Eu}^{3+}$ nanophosphors with varying Eu^{3+} molar concentrations: (a) 1% (b) 3% (c) 5% (d) 7%

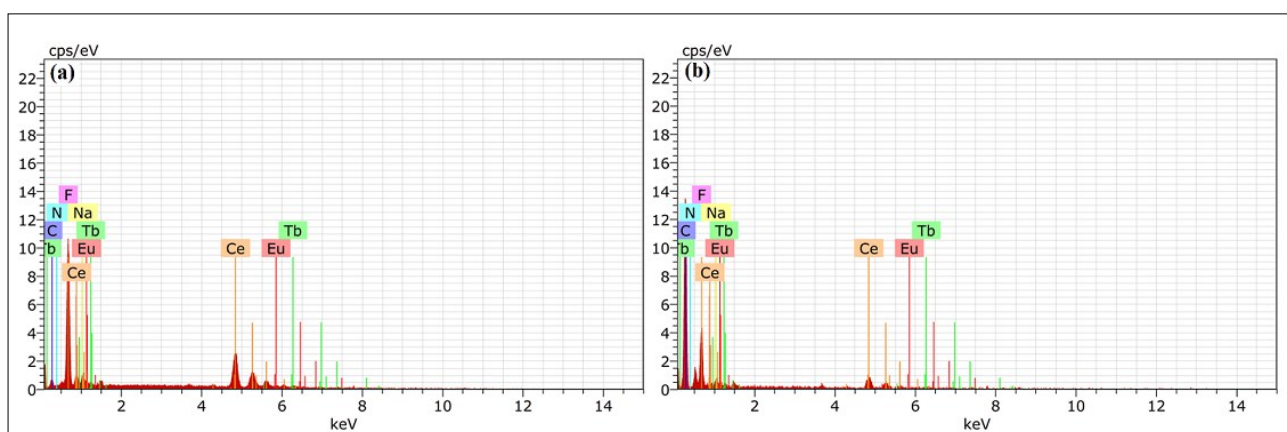


Fig. S4 EDS spectra of (a) PEI functionalized $\text{NaCeF}_4:\text{Tb}^{3+}/\text{Eu}^{3+}$ (Eu-7%) nanophosphors (b) $\text{RGO}@PEI@NaCeF_4:\text{Tb}^{3+}/\text{Eu}^{3+}$ (Eu-7%) nanocomposite

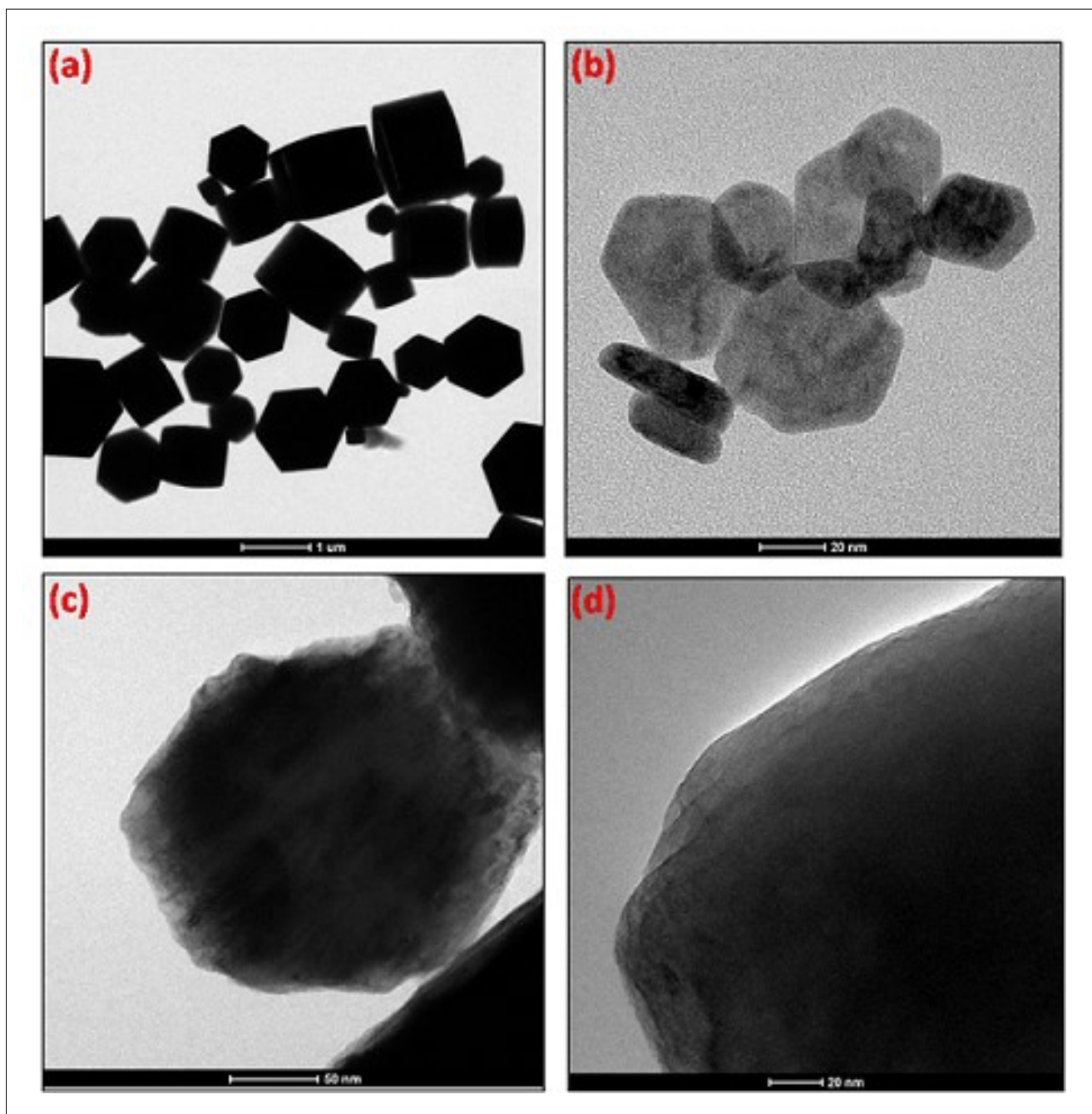


Fig. S5 TEM micrographs of (a) $\text{NaCeF}_4:\text{Tb}^{3+}$ nanophosphors (b) $\text{NaCeF}_4:\text{Tb}^{3+}/\text{Eu}^{3+}$ (Eu-7%) nanophosphors (c)-(d) PEI functionalized $\text{NaCeF}_4:\text{Tb}^{3+}/\text{Eu}^{3+}$ (Eu-7%) nanostructure

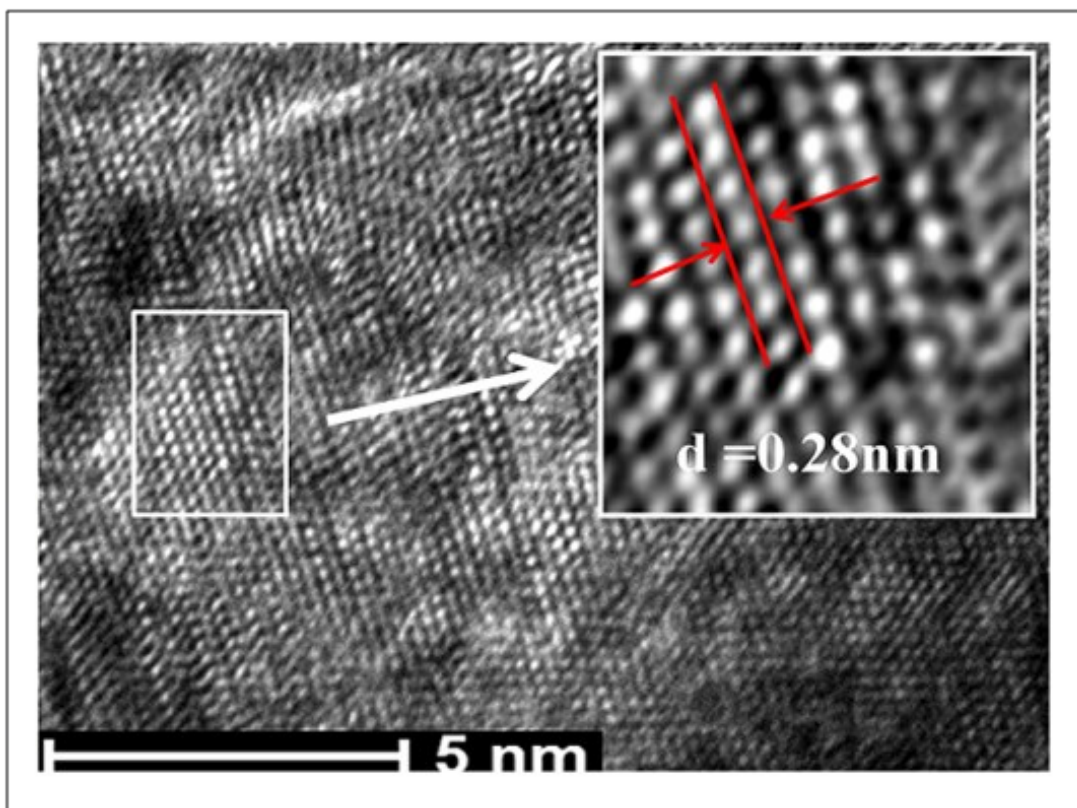


Fig. S6 HR-TEM images of as-synthesized NaCeF₄:Tb³⁺ nanophosphors

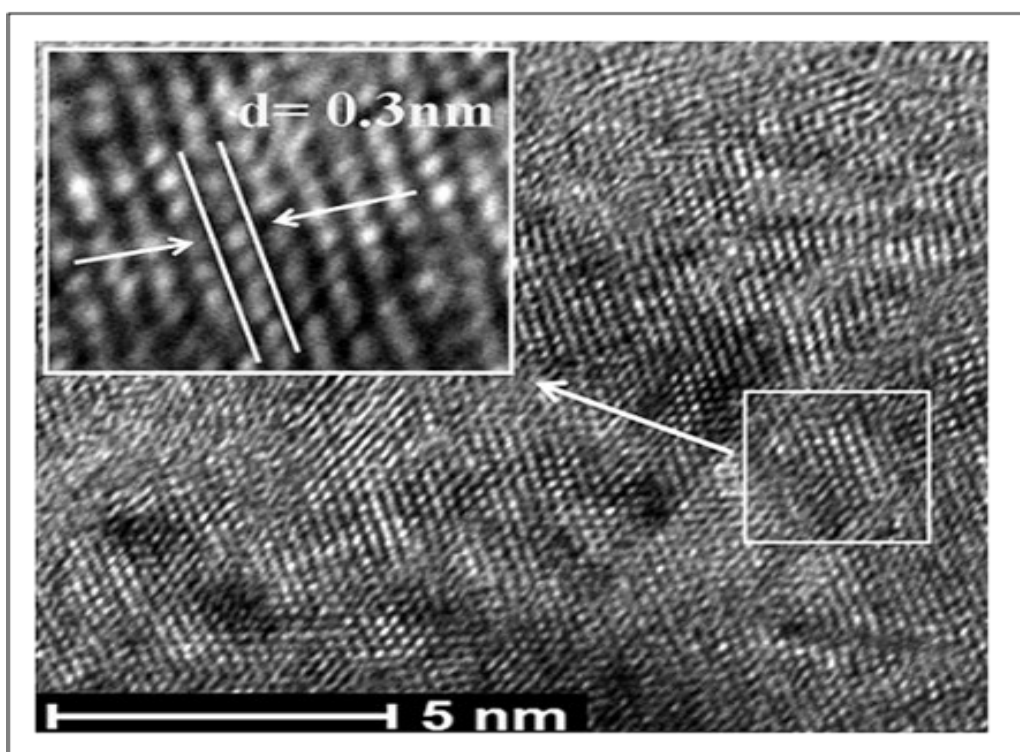


Fig. S7 HR-TEM images of as-synthesized NaCeF₄:Tb³⁺/Eu³⁺ (Eu-7%) nanostructures showing d-spacing.

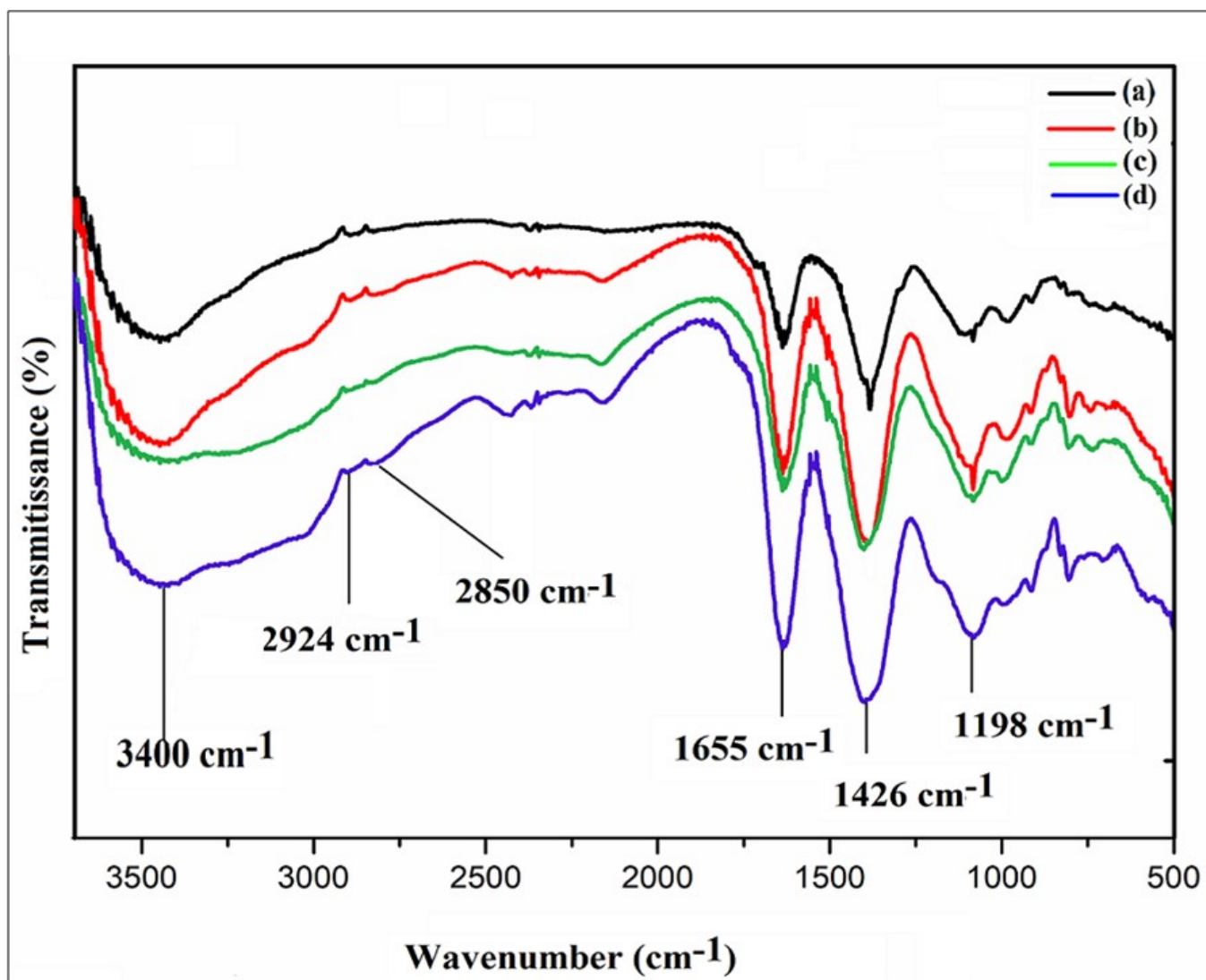


Fig. S8 FTIR spectra of NaCeF₄:Tb³⁺/Eu³⁺ with varying Eu³⁺ contents:(a) 1% (b) 3% (c) 5% (d) 7%

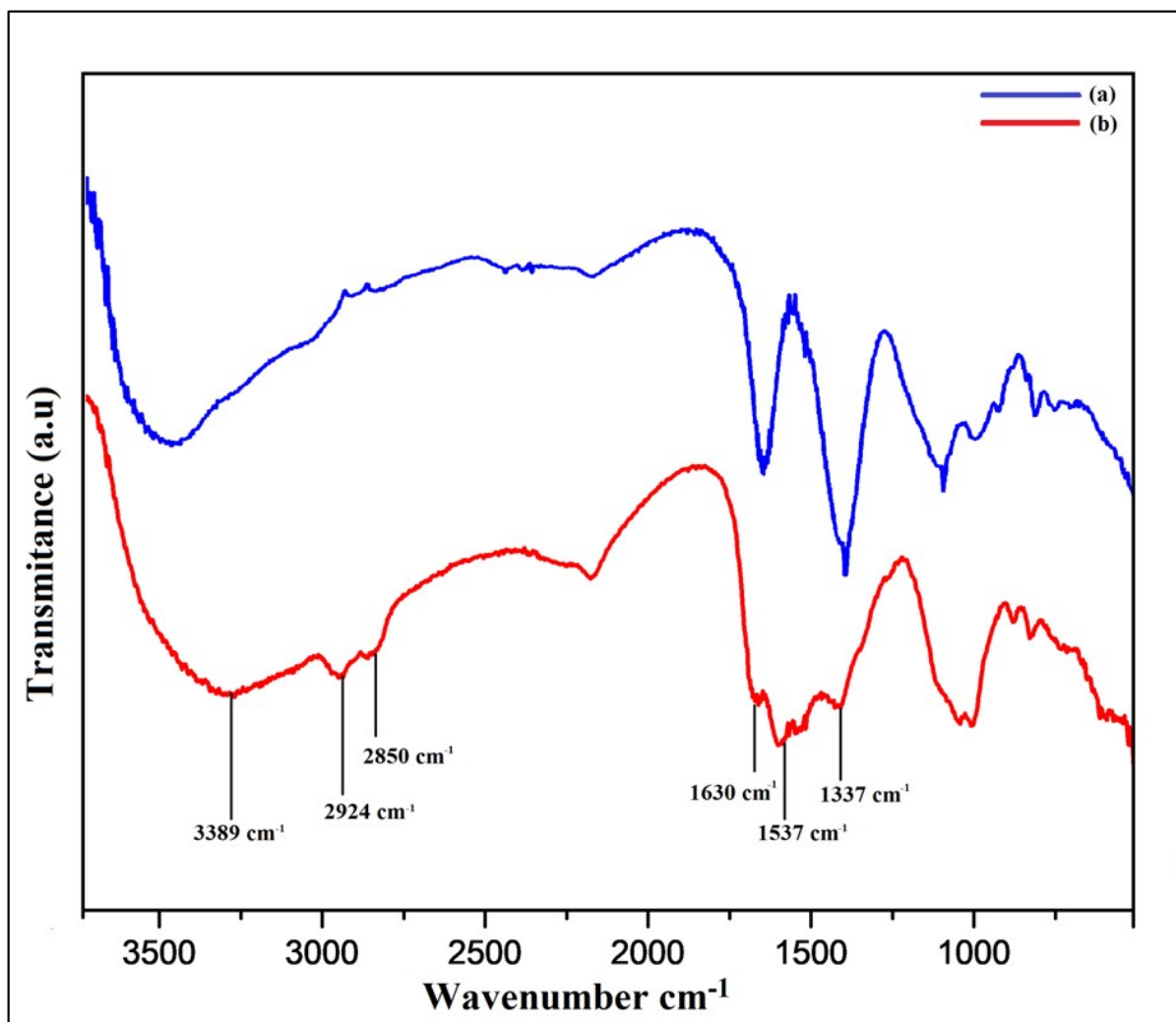


Fig. S9 FT-IR spectra of fabricated nanomaterials **(a)** NaCeF₄:Tb³⁺/Eu³⁺ (Eu-7%)
(b) PEI functionalized NaCeF₄:Tb³⁺/Eu³⁺ (Eu-7%)

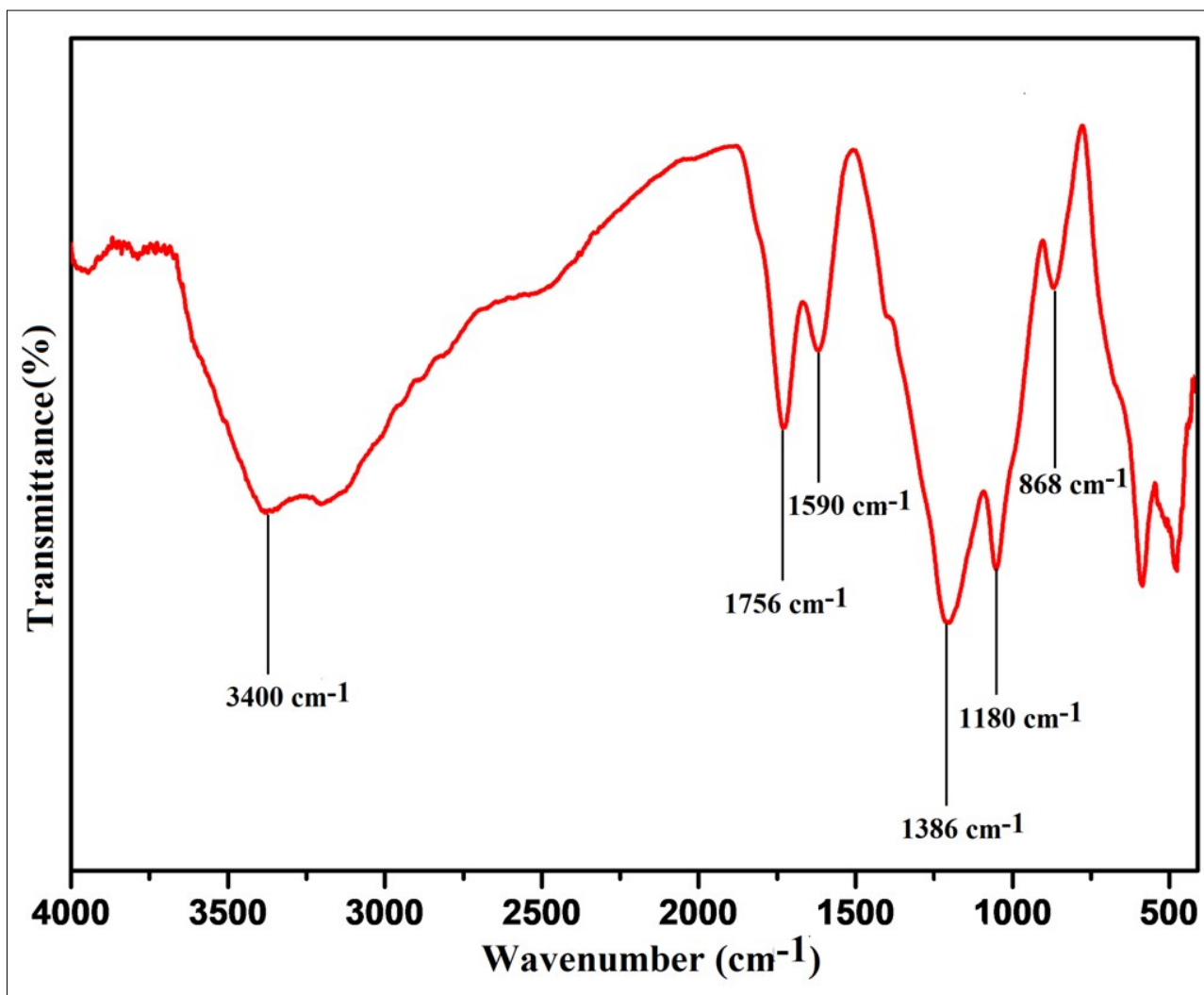


Fig. S10 FT-IR spectrum of fabricated graphene oxide (GO).

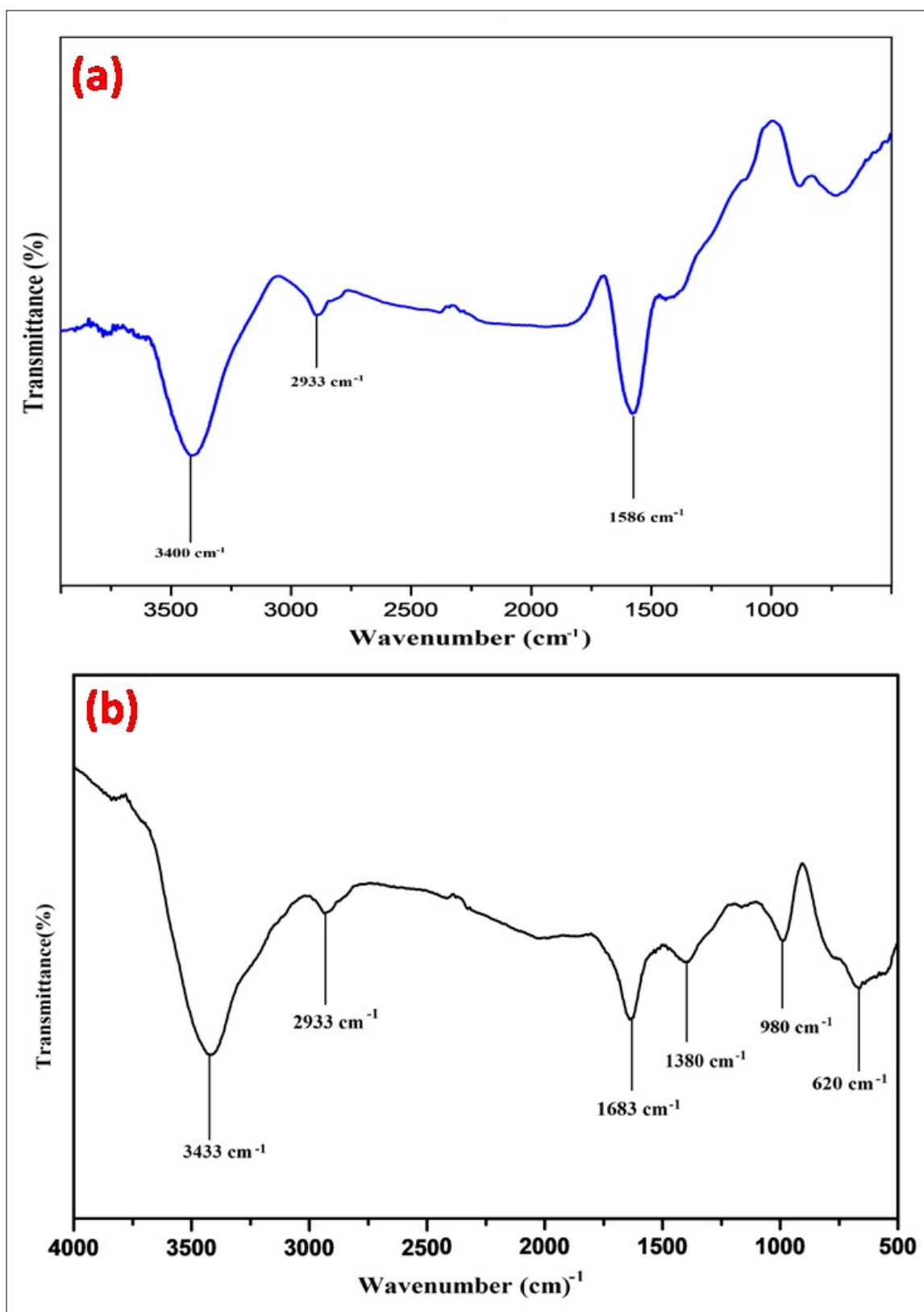


Fig. S11 FT-IR spectra of fabricated nanomaterials **(a)** Reduced graphene oxide (R-GO)
(b) R-GO@PEI@ NaCeF₄:Tb³⁺/Eu³⁺ (Eu-7%)

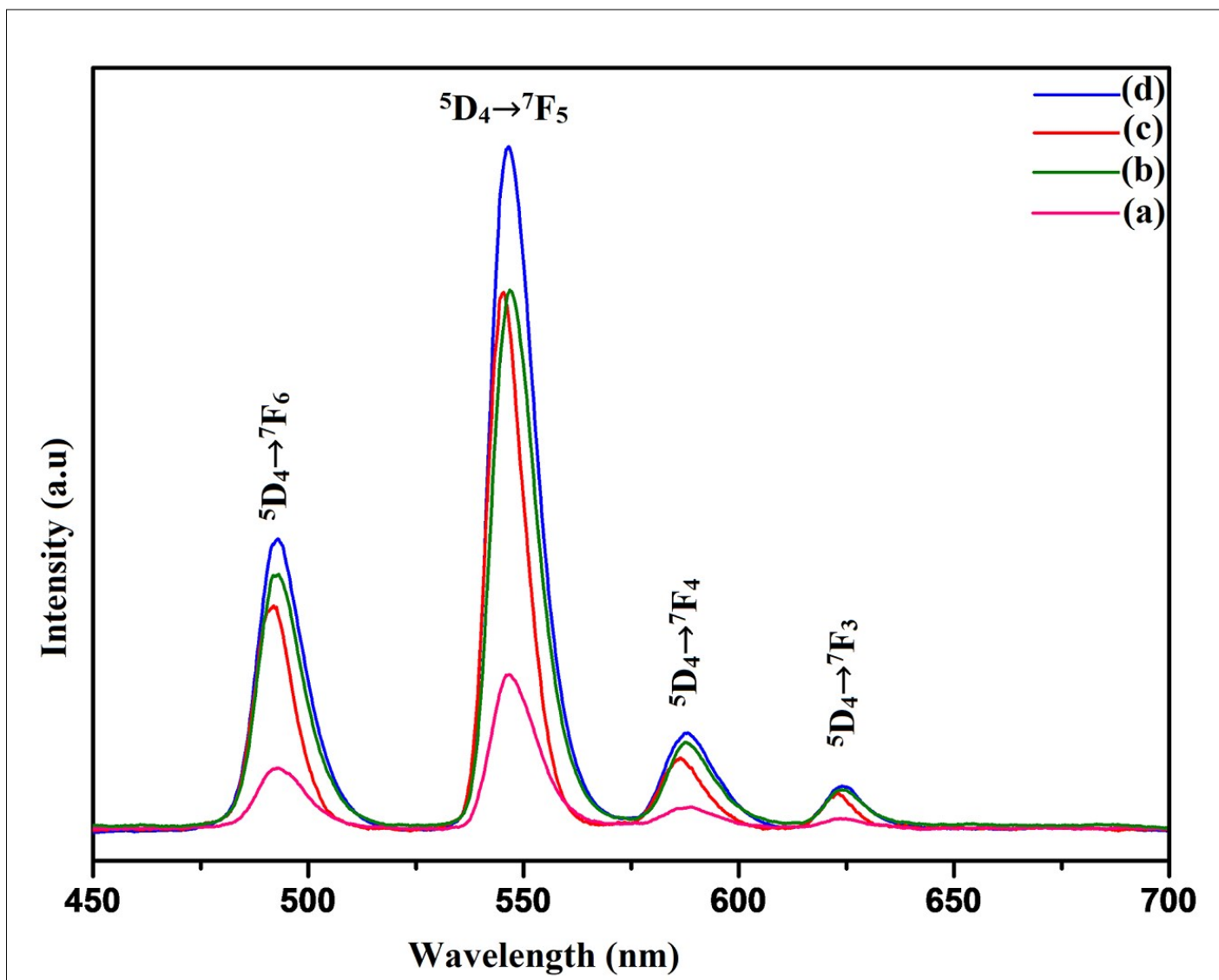


Fig.S12 Photoluminescence emission spectra of NaCeF₄:Tb (Tb-5%) nanophosphors at different heating temperatures (a) 120 °C (b) 140 °C (c) 160 °C (d) 180 °C

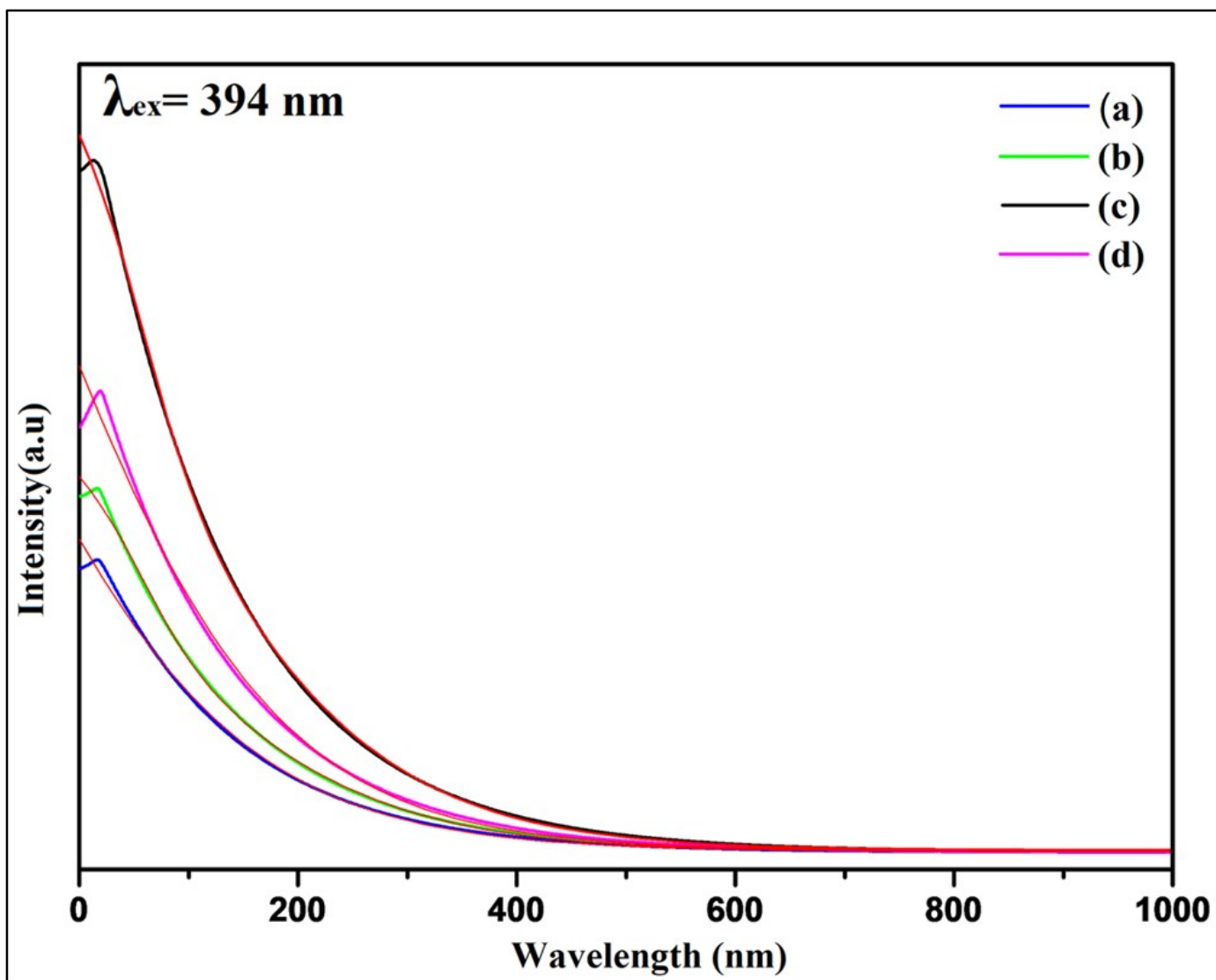


Fig. S13 Photoluminescence decay curves of NaCeF₄:Tb³⁺ (Tb-5%) with different heating temperature (a) 120 °C (b) 140 °C (c) 160 °C (d) 180 °C

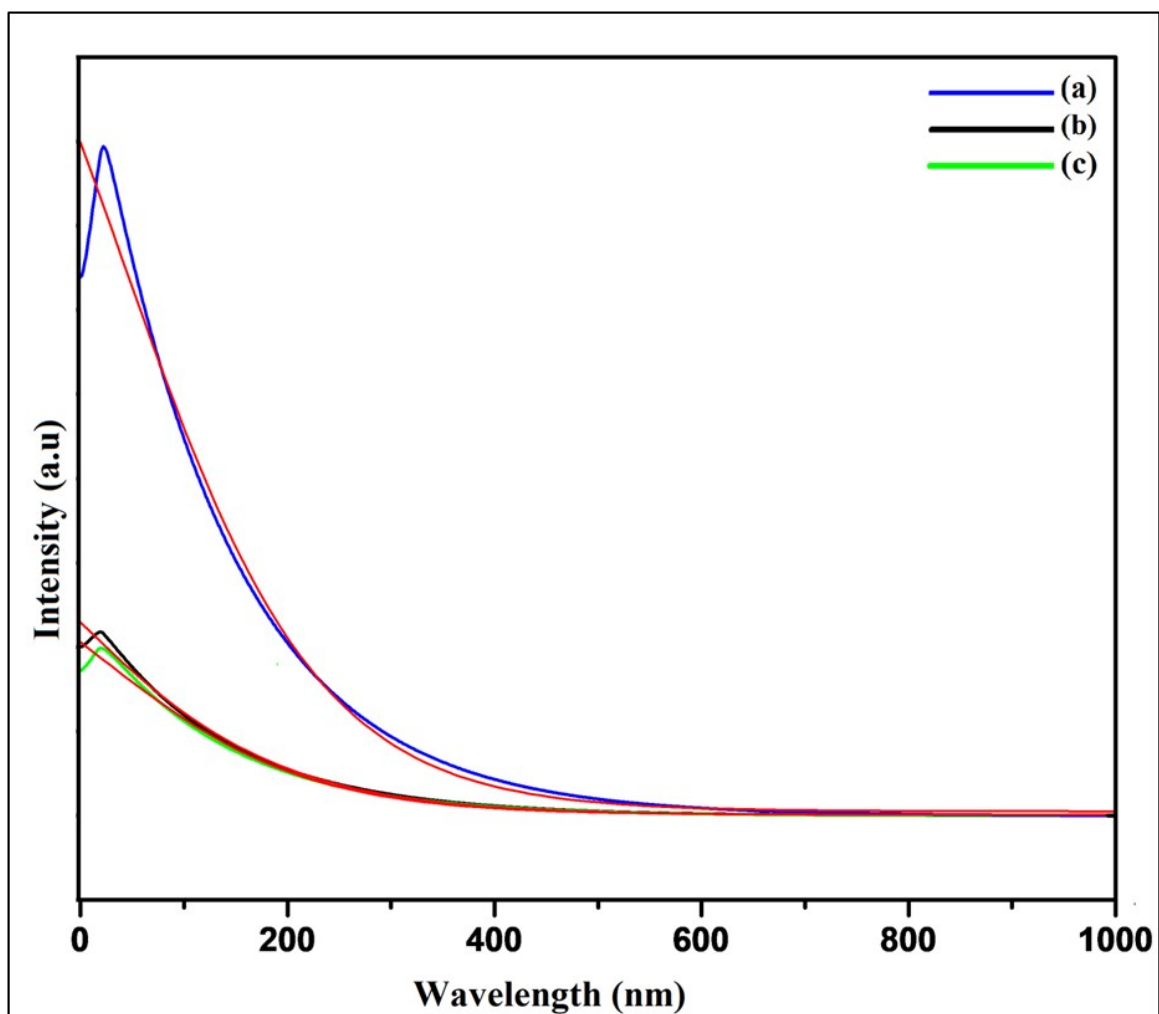


Fig. S14 Photoluminescence lifetime decay curves of **(a)** PEI-NaCeF₄:Tb³⁺/Eu³⁺ (Eu-7%)
(b) NaCeF₄:Tb³⁺/Eu³⁺ (Eu-7%) **(c)** NaCeF₄:Tb³⁺/Eu³⁺ (Eu-3%)

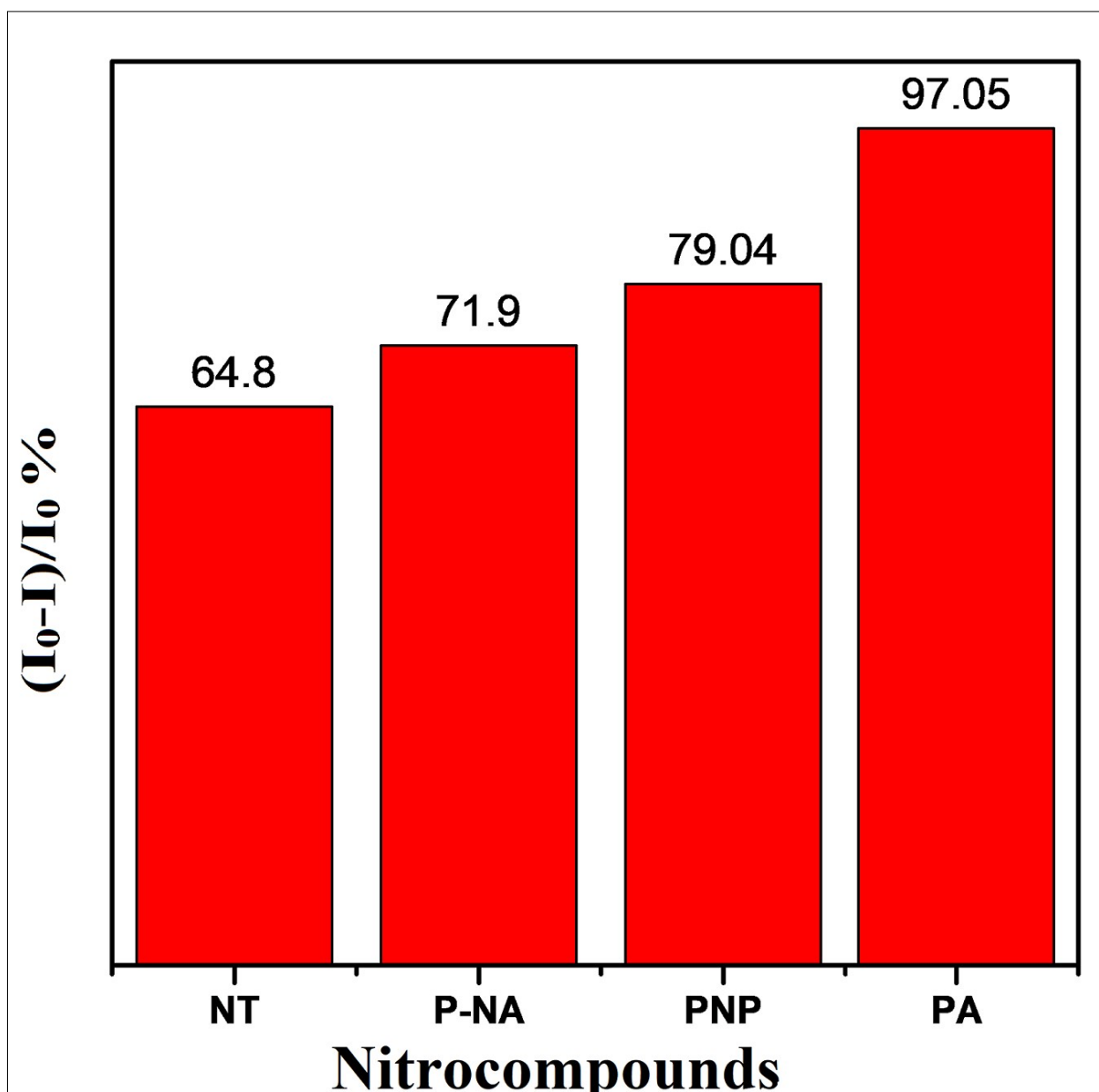


Fig. S15 Quenching efficiency of the prepared samples containing colloidal solution of PEI-functionalized $\text{NaCeF}_4:\text{Tb}^{3+}/\text{Eu}^{3+}$ (Eu-7%) with different nitrocompounds (100 ppm) in aqueous medium.

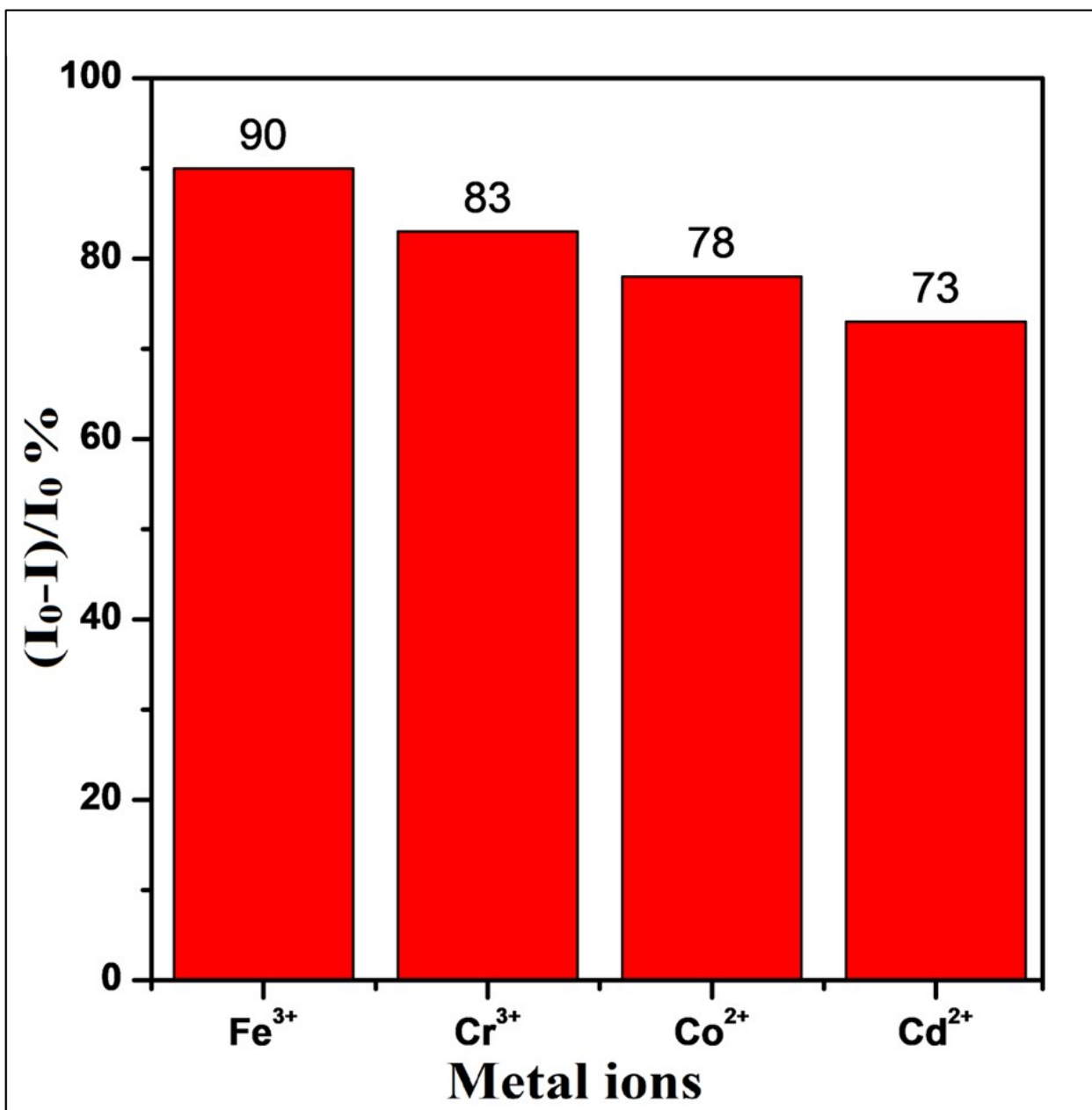


Fig. S16 Quenching efficiency of the prepared samples containing PEI-functionalized NaCeF₄:Tb³⁺/Eu³⁺ (Eu-7%) nanophosphors and different metal ions analytes (100 ppm) in aqueous medium.

Table. S1 Atomic and Weight (%) of elements consisting in $\text{NaCeF}_4:\text{Tb}^{3+}/\text{Eu}^{3+}$ with varying Eu^{3+} molar concentrations.

Elements	Eu^{3+} 1 %		Eu^{3+} 3 %		Eu^{3+} 5 %		Eu^{3+} 7 %	
	Wt%	At%	Wt%	At%	Wt%	At%	Wt%	At%
Cerium	66.22	43.33	78.14	43.30	70.53	29.76	64.11	24.73
Terbium	3.48	0.73	4.59	2.34	3.99	1.48	4.66	1.46
Europium	0.89	0.19	5.29	2.59	4.93	1.92	5.90	2.10
Sodium	3.78	5.46	0.42	4.10	0.54	1.40	1.59	10.14
Fluorine	17.40	30.58	10.18	42.31	18.25	56.78	20.04	57.01
Carbon	5.3	16.74	1.3	4.92	1.73	8.56	3.58	4.10
Nitrogen	2.93	2.97	0.08	0.44	0.03	0.12	0.12	0.46

Table.S2 Atomic and Weight (%) of elements present in PEI-functionalized NaCeF₄:Tb³⁺/Eu³⁺ (Eu-7%) nanostructure and RGO doped PEI-NaCeF₄:Tb³⁺/Eu³⁺ (Eu-7%) nanocomposite.

Elements	PEI- functionalized NaCeF ₄ :Tb ³⁺ /Eu ³⁺		RGO-PEI- NaCeF ₄ :Tb ³⁺ /Eu ³⁺ Nanocomposite	
	Wt%	At%	Wt%	At%
Cerium	58.25	18.30	20.08	2.41
Terbium	3.81	1.06	2.44	0.26
Europium	5.29	1.53	1.13	0.13
Sodium	3.83	7.34	1.87	1.37
Fluorine	24.73	57.34	15.30	13.56
Carbon	2.94	7.80	55.53	77.87
Nitrogen	1.15	6.63	3.65	4.40