Electronic Supplementary Material (ESI) for Journal of Materials Chemistry C.

Supporting Information

Gallic acid capped Tb^{3+}-doped CaF_2 nanocrystals: An efficient optical probe for the detection of carbonate and bicarbonate ions

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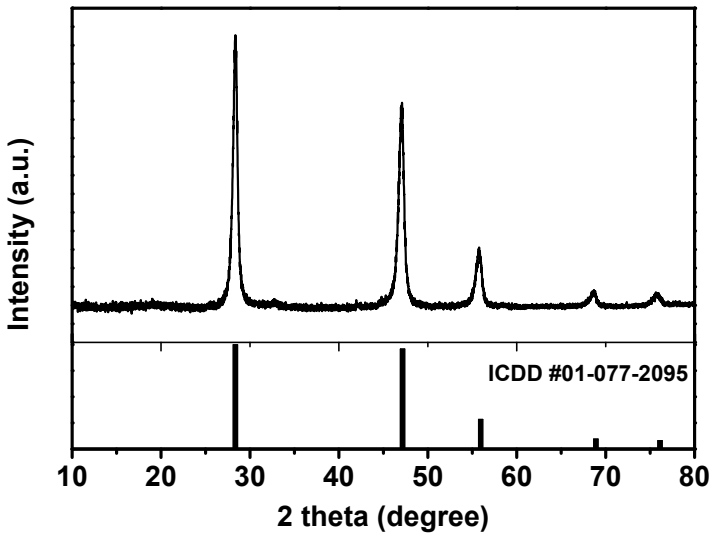

Fig. S1.X-Ray powder diffraction (XRD) pattern of gallic acid (GA)-capped $CaF_2:Tb^{3+}$ (2%) nanocrystals (NCs). The vertical lines at the bottom is the standard pattern of bulk CaF_2.

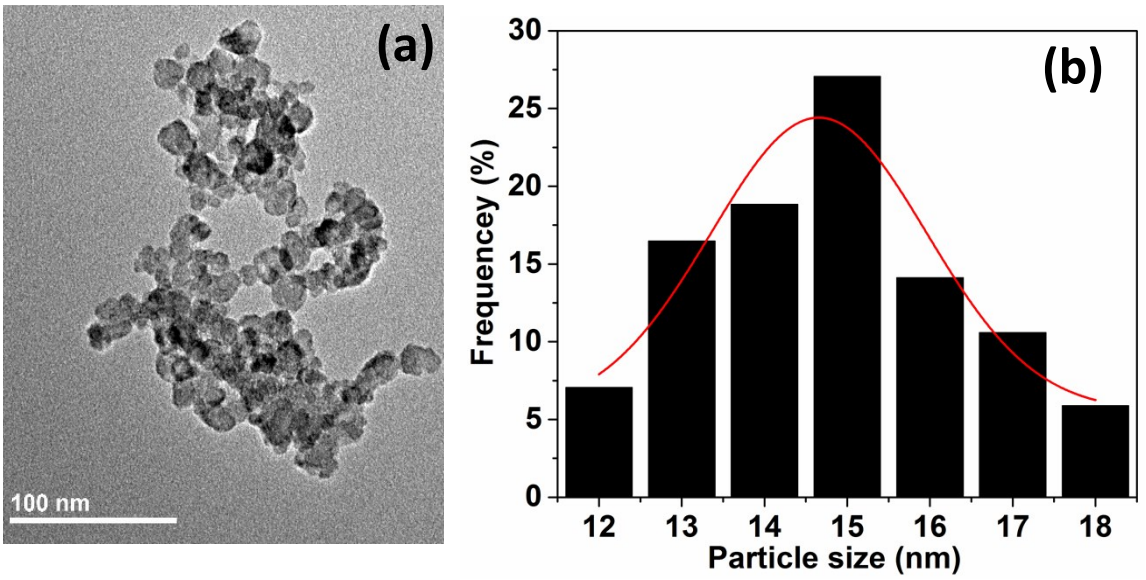

Fig. S2. (a) TEM image of the GA-capped $CaF_2:Tb^{3+}$ (2%) NCs. (b) Histogram shows the particle size distribution.

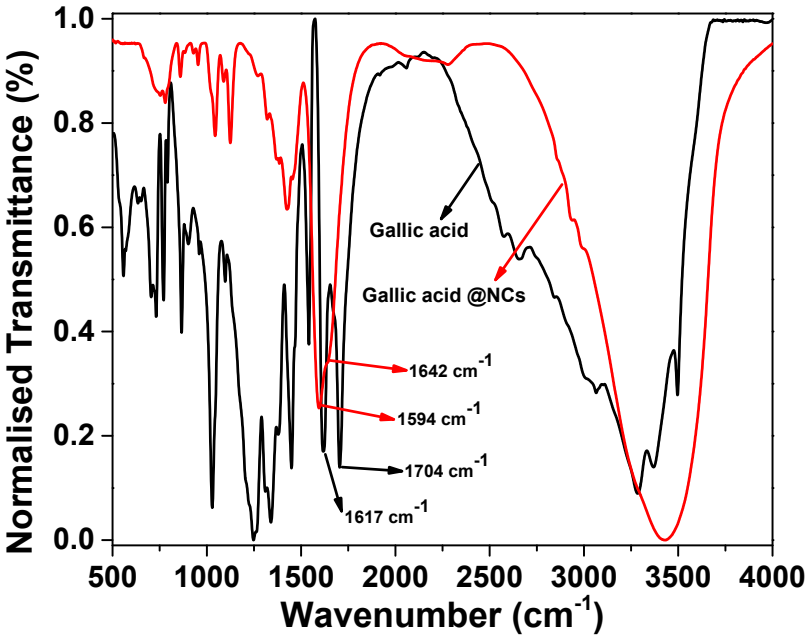

Fig. S3. FTIR spectra of pure gallic acid (GA) and GA-capped CaF_2:Tb^{3+} (2%) NCs.

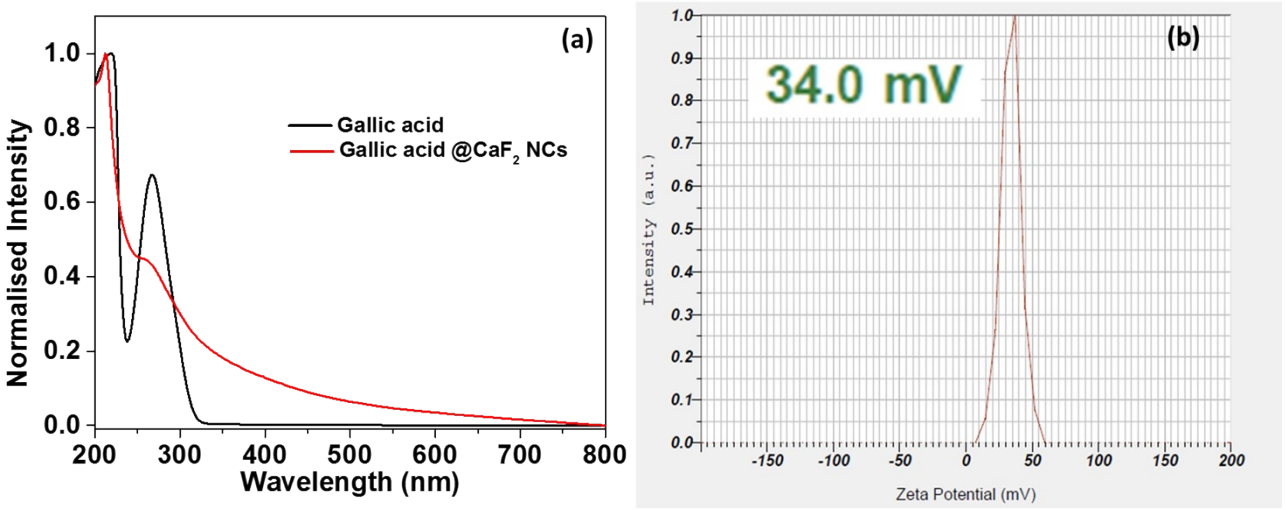

Fig. S4. (a) Absorption spectra of pure gallic acid (GA) and GA-capped CaF_2:Tb^{3+} (2%) nanocrystals. (b) Zeta potential of GA-capped CaF_2:Tb^{3+} (2%) nanocrystals.

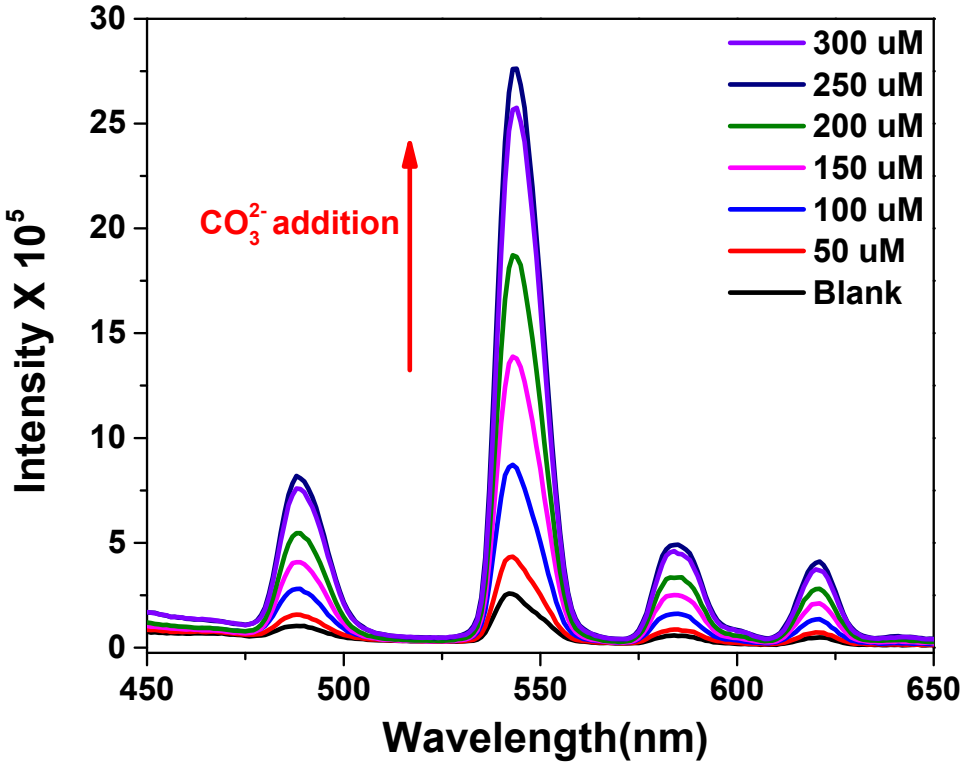

Fig. S5. Photoluminescence spectra of the GA-capped CaF_2:Tb^{3+} NCs in D_2O, a ~ 10-fold enhancement was observed up on addition of Na_2CO_3.

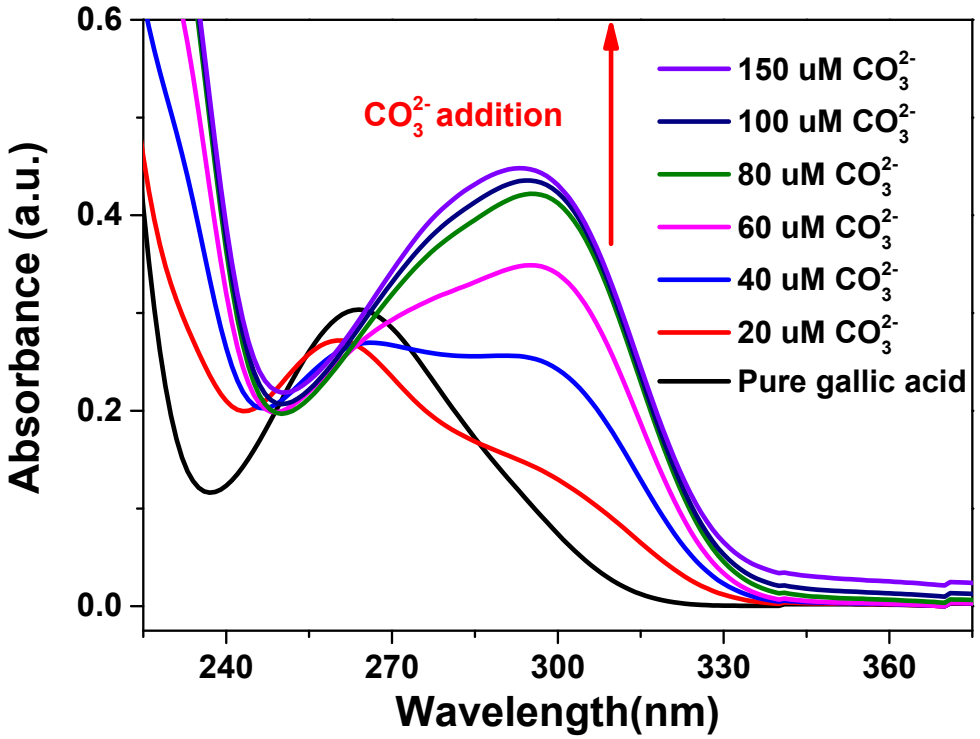

Fig. S6. Absorption spectra of pure gallic acid with the addition of 20 µM, 40 µM, 60 µM, 80 µM, 100 and 150 µM of CO_3^{2-} ion.

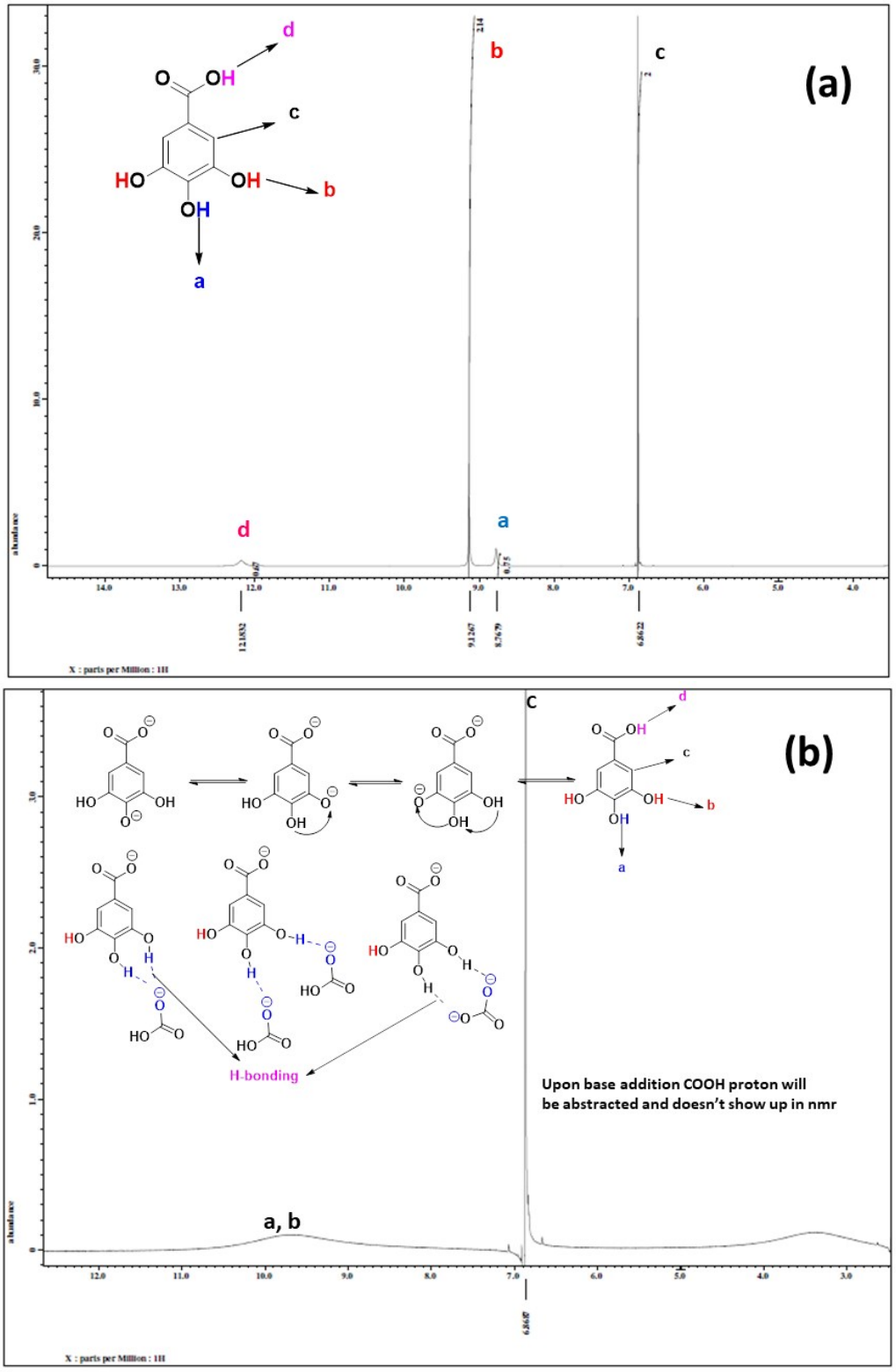

Fig. S7. ^1H NMR spectra of (a) pure gallic acid and (b) gallic acid with CO_3^{2-} ions (D_2O, 400 MHz)**.**

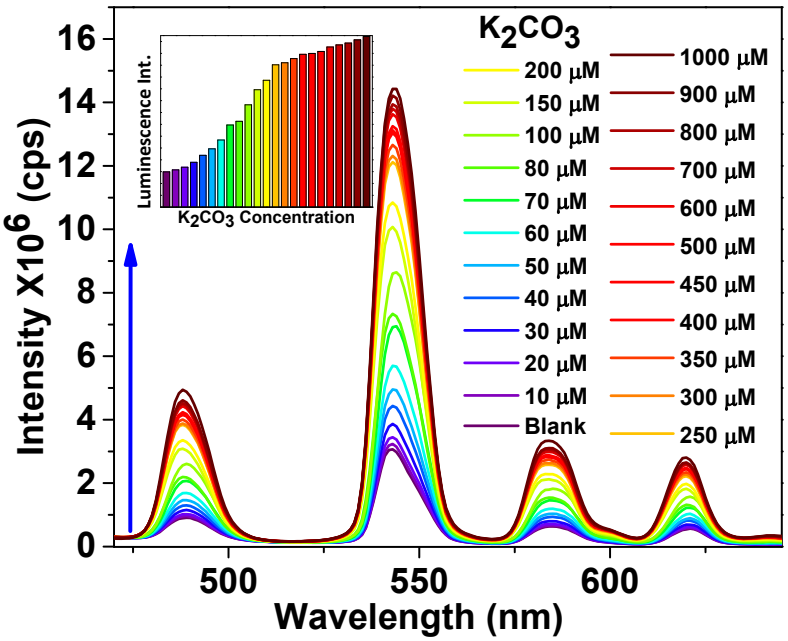

Fig. S8. Photoluminescence spectra of the GA-capped CaF_2:Tb^{3+} NCs collected upon gradual addition of K_2CO_3 ions. Inset shows the bar diagram of Tb^{3+} luminescence enhancement pattern with the addition of K_2CO_3 to the NCs dispersion.

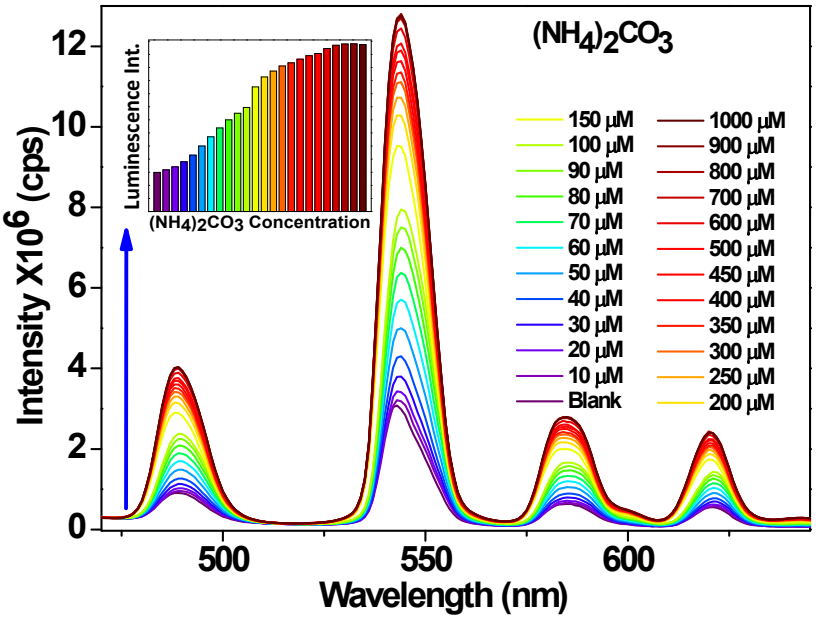

Fig. S9. Photoluminescence spectra of the GA-capped CaF_2:Tb^{3+} NCs, collected upon gradual addition of $(NH_4)_2CO_3$ ions. Inset shows the bar diagram of Tb^{3+} luminescence enhancement pattern with the addition of $(NH_4)_2CO_3$ to the NCs dispersion.

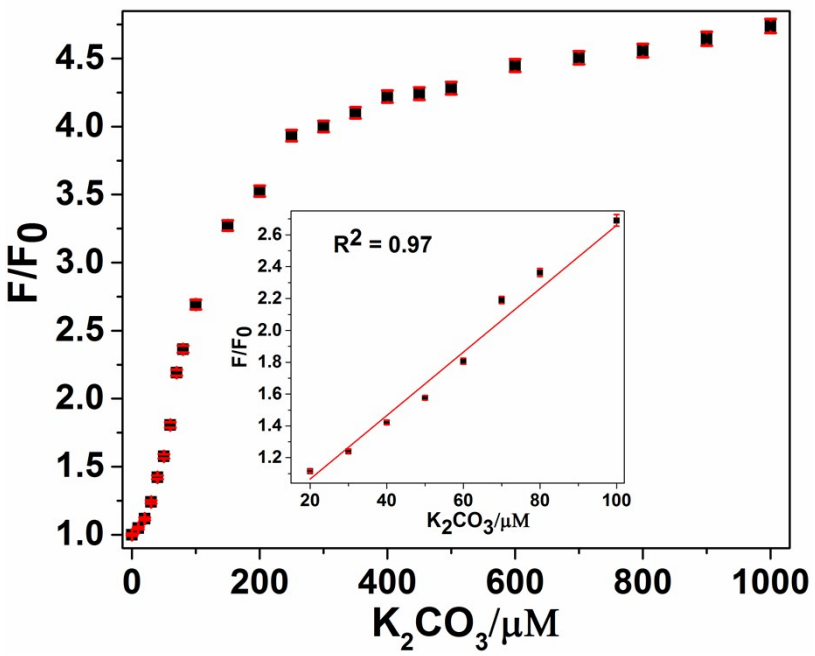

Fig. S10. Stern-Volmer plots of GA-capped CaF_2:Tb^{3+} (2%) NCs with the addition of 1000 μM concentration of K_2CO_3 ions in aqueous medium.

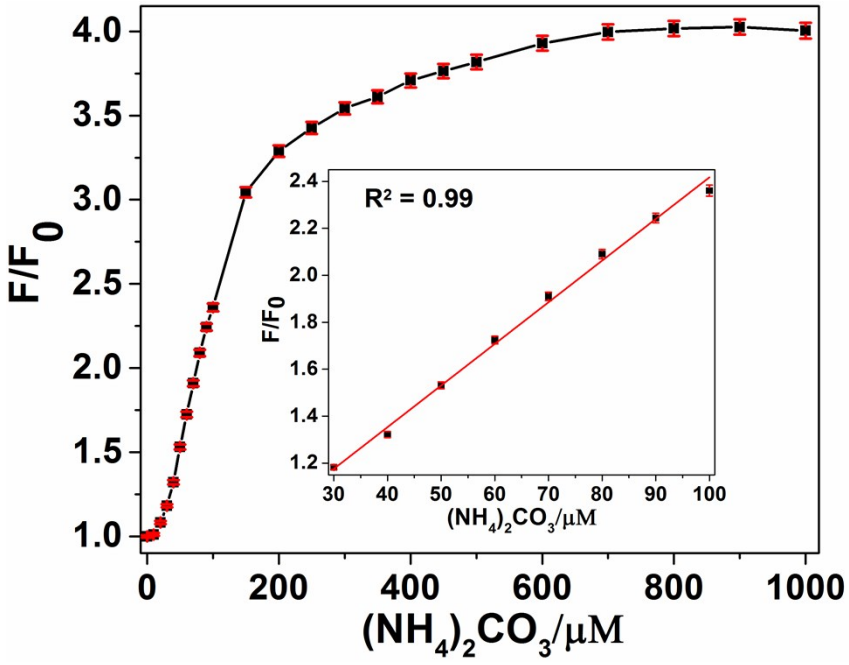

Fig.S11. Stern-Volmer plots of GA-capped CaF_2:Tb^{3+} (2%) NCs with the addition of 1000 μM concentration of $(NH_4)_2CO_3$ ions in aqueous medium.

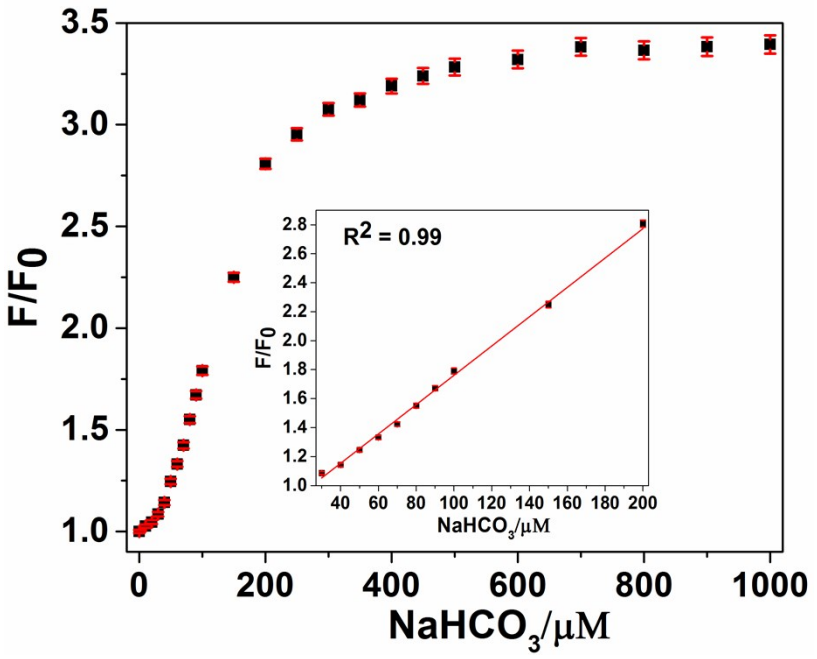

Fig.S12. Stern-Volmer plots of GA-capped CaF_2:Tb^{3+} (2%) NCs with the addition of 1000 μM concentration of $NaHCO_3$ ions in aqueous medium.

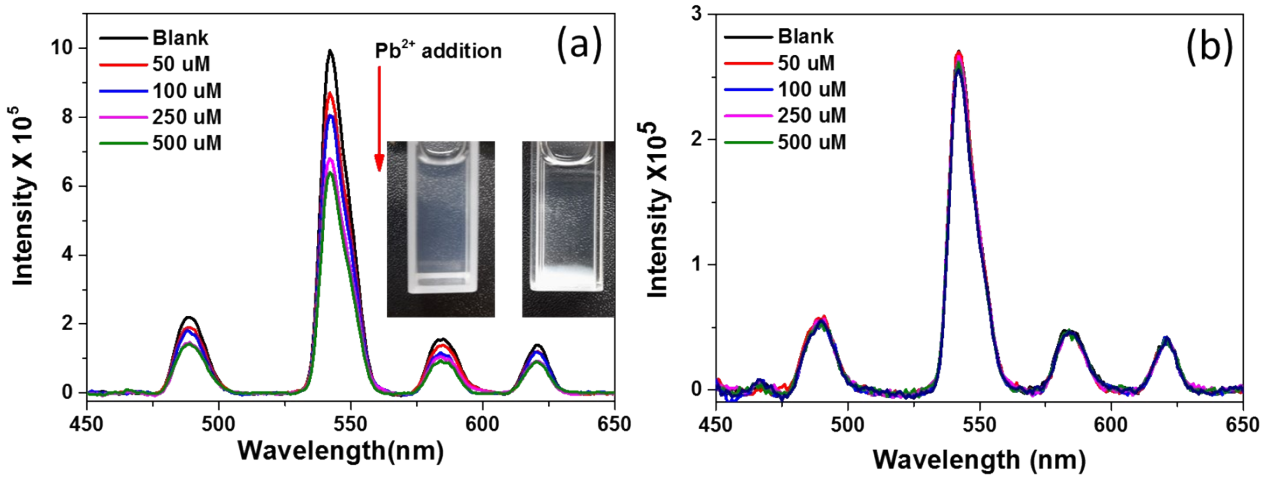

Fig. S13. Photoluminescence spectra of the GA-capped CaF_2:Tb^{3+} NCs (a) through gallic acid excitation (inset shows visible residual upon Pb^{2+} ion addition) and (b) through direct excitation (376 nm).

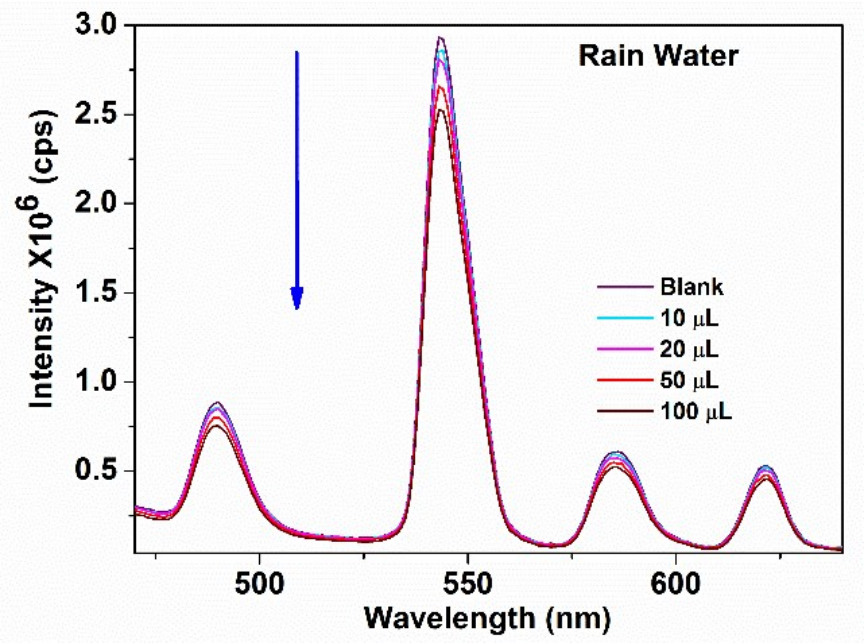

Fig. S14. Photoluminescence spectra of the GA-capped CaF_2:Tb^{3+} NCs collected with the addition of different quantity of rain water.

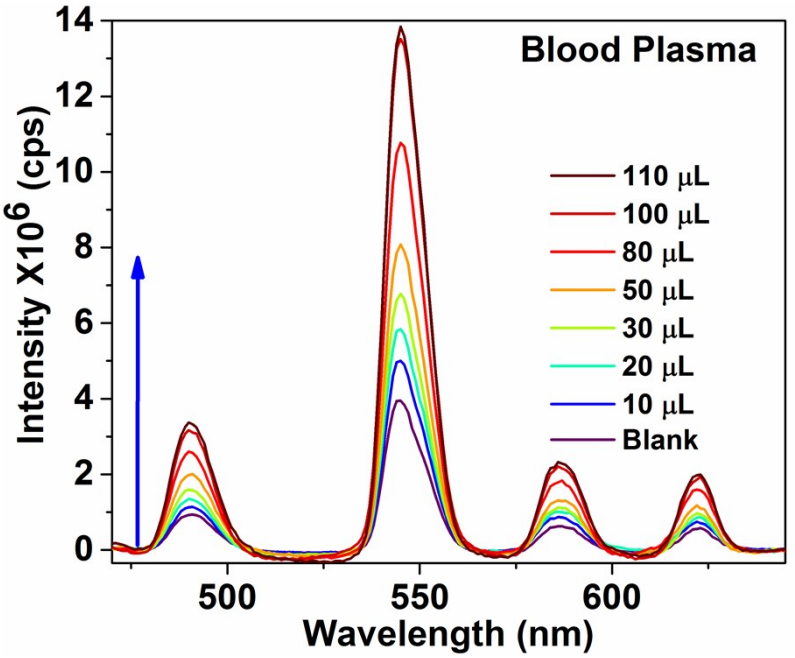

Fig. S15. Photoluminescence spectra of the GA-capped CaF_2:Tb^{3+} NCs collected with addition of different quantity of blood plasma.

Table S1.A Comparison of luminescence constants and limit of detection (LOD) values obtained from present work with that reported for other materials.

No	Sample	Method	KSV/Linear range	LOD	Ref.
1	Azino bis-Schiff base ligand	fluorescent-colorimetric	-NA-	96 nM	6
2	Meso-aryl calix[4]pyrrole derivative	Fluorescence	1.0×10^7 M^{-1}	4 nM	17
3	SERS probe	optophysiyology	1.00 to 35.0 μM	0.16 μM	24
4	TPEMO	Fluorescence	-NA-	71.6 nM	28
5	Eu/Pt-MOFs	Fluorescence	0 to 500 μM	0.021 μM	41
6	2-(arylidenehydrazinyl) pyridines	Optical sensor	0.77×10^4 M^{-2}	0.11 mM	45
7	7,8-dihydroxy-3-(3-chlorophenyl) coumarin (DHMC)	Fluorescence	9.49×10^4 M^{-1}	1.03 μM	46
8	GA- capped CaF_2:Tb^{3+} NCs	Fluorescence	10 to 1000 μM	0.99 μM(Na_2CO_3) 1.3 μM (K_2CO_3) 1.23 μM $(NH_4)_2CO_3$ 2.15 μM ($NaHCO_3$)	This work

Table S2 : geographic locations and other details on the collected tap water, pond water and river water samples.

Sample	**pH**	**Geographic coordinate**	**Sample collected date**
Sample-1 (IISER-Tap water)	8.03	22°57'50.3"N 88°31'34.3"E	14-7-2020
Sample-2 (IISER- Pond water)	8.4	22°57'46.6"N 88°31'33.5"E	14-7-2020
Sample-3 (MN-Saha pond water)	8.72	22°57'15.7"N 88°31'14.6"E	14-7-2020
Sample-4 (Mohanpur pond water)	8.49	22°56'40.6"N 88°31'44.3"E	14-7-2020
Sample-5 (BCKV pond water)	8.93	22°56'53.0"N 88°31'54.8"E	14-7-2020
Sample-6 (Lichi pond water)	8.71	22°56'18.5"N 88°30'46.9"E	14-7-2020
Sample-7 (Kancharapara pond water)	8.87	22°57'00.6"N 88°27'33.3"E	15-7-2020
Sample-8 (Bara-Jaguli pond water)	8.79	22°56'53.1"N 88°32'35.5"E	14-7-2020
Sample-9 (Kolkata municipal water)	7.96	22°31'23.6"N 88°21'05.4"E	17-7-2020
Sample-10 (Nico-park water)	7.88	22°34'15.0"N 88°25'16.4"E	6-8-2020
Sample-11 (Hoogli river water)	8.08	22°51'49.5"N 88°22'29.6"E	20-7-2020

Table S3: Luminescence enhancement of GA-capped CaF_2:Tb^{3+} NCs with addition of specific amount of tap water, pond water and river water samples.

Sample	**Amount of sample water added**	**No. of Folds in Luminescence enhancement to blank emission**
Sample-1 (IISER-Tap water)	200 µL	3.1
Sample-2 (IISER- Pond water)	300 µL	3.25
Sample-3 (MN-Saha pond water)	300 µL	3.05
Sample-4 (Mohanpur pond water)	150 µL	2.74
Sample-5 (BCKV pond water)	200 µL	2.90
Sample-6 (Lichi pond water)	250 µL	2.51
Sample-7 (Kancharapara pond water)	300 µL	3.29
Sample-8 (Bara-Jaguli pond water)	200 µL	2.90
Sample-9 (Kolkata municipal water)	500 µL	2.96
Sample-10 (Nico-park water)	400 µL	2.95
Sample-11 (Hoogli river water)	200 µL	3.02