Supporting Information

Elucidating the Quenching Mechanism in Carbon Dot-Metal Interactions–Designing Sensitive and Selective Optical Probes

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Table S1: Summary of characterization for FG-CDs showing **(A)** the functional groups observed from FTIR analysis **(B)** the functional groups observed from XPS analysis and **(C)** the elemental composition of the dots.

(A) FTIR Analysis

Wavenumber (cm^{-1})	Type of vibration	Type of bond	Functional group
1307 & 1386	Stretch	C-N	amide/amine
1583	Stretch	C=N	-
1583	Stretch	C=C	Aromatic
1645	Stretch	C=O	Amide
3000-3500	Stretch	N-H	amide/amine
3000-3500	Stretch	O-H	hydroxyl/carboxylic acid

(B) XPS Analysis

Peak	Binding energies (eV)	Type of bond	Functional group
C1s	285.58	C=O/C=N	amide/carboxylic
	286.89	C-O	-
	288.68	C-C/C=C	-
N1s	400.58	C=N/C-N	graphitic nitrogen
	402.71	NH_2	pyrrolic nitrogen
O1s	532.02	C=O	amide/carboxylic
	533.26	C-OH/C-OC	-
S2p	163.38	C_4S-H	thiophene
	164.14	C_4S-H	thiophene
	165.51	C-S-H	thiol

(C) Elemental Analysis

Element	Percent Composition
Carbon	53.10%
Oxygen	26.10%
Nitrogen	17.40%
Sulfur	3.40%

Table S2: Fluorescence lifetimes of FG-CDs at increasing concentrations of lead (II) ions.

$[Pb^{2+}]$	Lifetime 1 (ns)	±	Lifetime 2 (ns)	±	χ^2
0 nM	0.8	2.8E-03	5.7	4.5E-03	1.2
400 nM	0.8	4.1E-03	5.9	8.1E-03	1.1
1000 nM	0.8	3.3E-02	5.7	3.5E-02	1.1

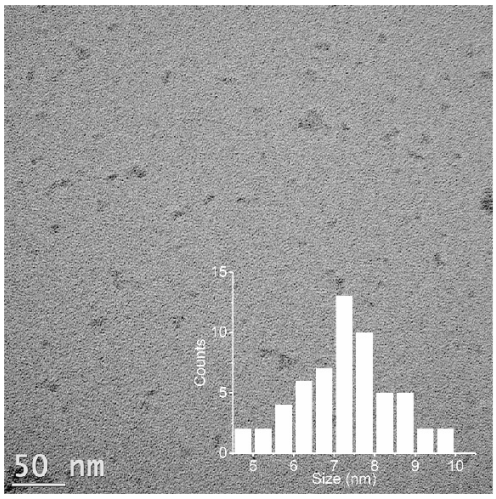

Figure S1: TEM image of FG-CDs with inlaid size distribution plot showing an average size of 7.7 ± 1.5 nm.

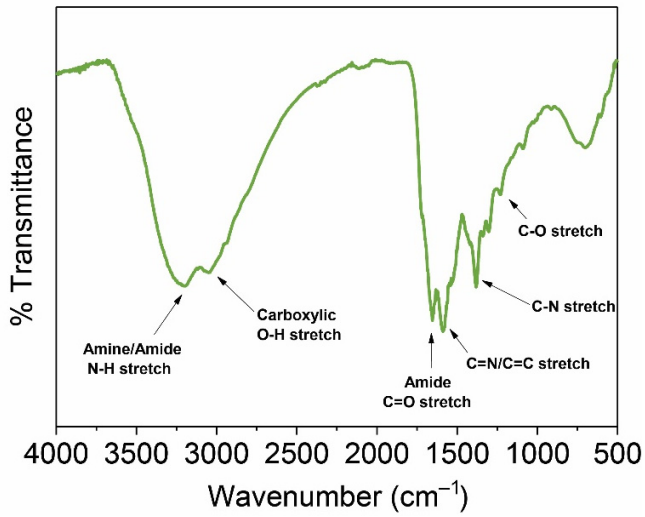

Figure S2: FTIR spectrum of FG-CDs showing the presence of amide and carboxyl stretches as well as N-H and O-H functional groups.

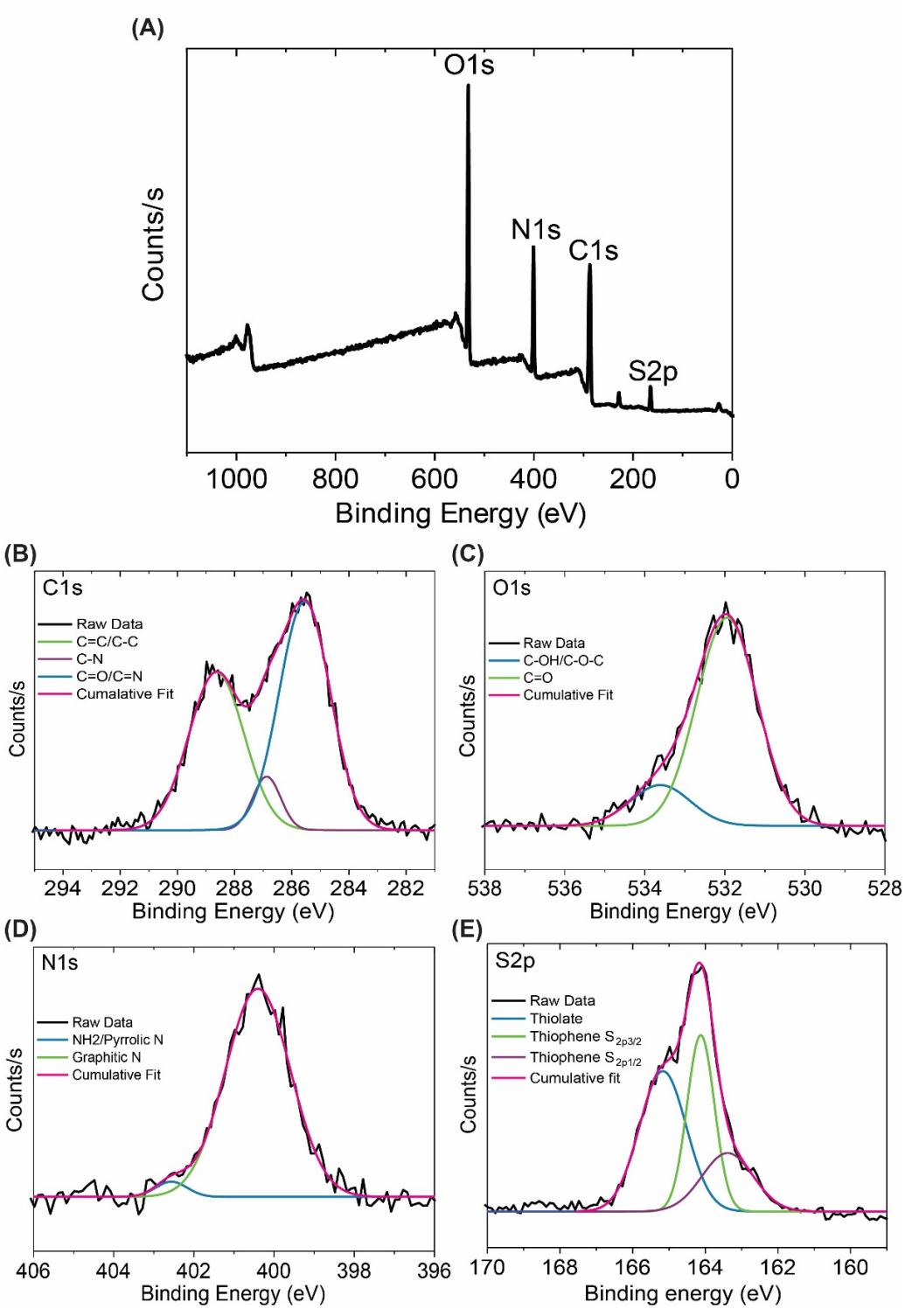

Figure S3: (A) XPS survey spectrum of FG-CDs showing binding energies of C1s, N1s, O1s and S2p. Spectra of deconvoluted binding energies reveal **(B)** a maximum for C1s at 286.08 eV, **(C)** a maximum at 400.08 eV for N1s **(D)** a maximum at 532.08 eV for O1s and **(E)** for S2p a maximum at 165.08 eV.

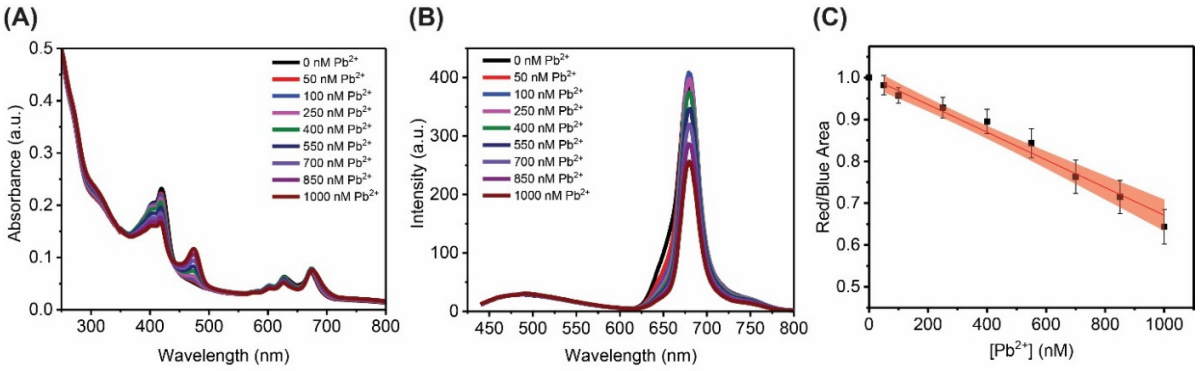

Figure S4: **(A)** Absorbance spectra for FG-CDs showing a new peak at ~475 nm in the presence of Pb^{2+}. **(B)** Fluorescence spectra for FG-CDs in the presence of Pb^{2+}. **(C)** The linear plot of the decreasing overall R/B area ratio showing a ~40% in red fluorescence with an r^2=0.98.

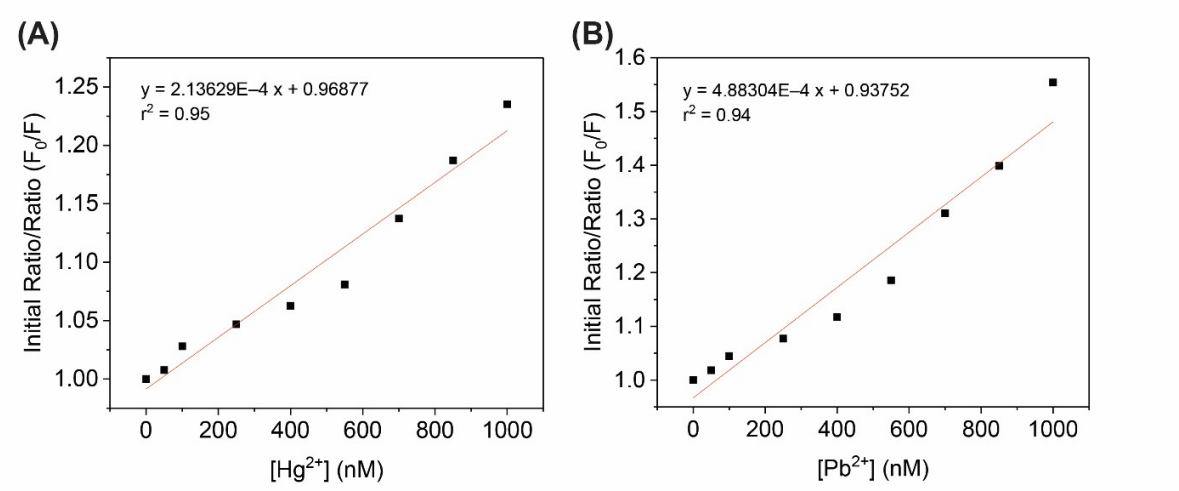

Figure S5: (A) Stern-Volmer plot displaying the linear equation for FG-CDs and Hg^{2+} with k_{sv} = 2.14x10^{-4} and r^2= 0.95 **(B)** Stern-Volmer plot displaying the linear equation for FG-CDs and Pb^{2+} with k_{sv} = 4.88x10^{-4} and r^2 = 0.94.

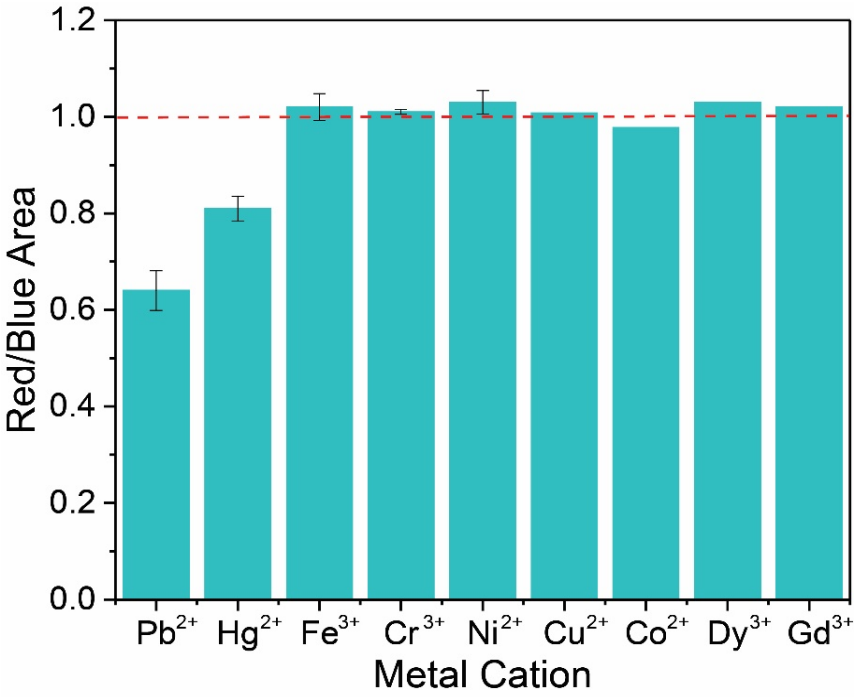

Figure S6: R/B area ratio of FG-CDs with 1000 nM of various metallic cations showing comparison of quenching effectiveness.