Supporting Information

Photoinduced Electron Transfer in Carbon Dots with Long Wavelength Photoluminescence

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Carbon dots preparation method optimization

To examine the optimum reaction temperature for the formation of carbon dots (CDs) from Evans blue and bovine serum albumin (BSA), several different temperatures were used (140, 160, 180, 200^{0}C) were used to prepare CDs. The reaction conditions were exactly the same for each trial with a 1:15 molar ratio of BSA to Evans blue and a reaction time of 4 hours. The absorption spectrum of each product is shown in figure S1. 140^{0}C showed the presence of Evans blue from the peaks near 320 and 600 nm. 180 and 200^{0}C showed decreased long wavelength absorption. The reaction at 160^{0}C did not show evidence of residual Evans blue, but still possessed long wavelength absorption. This temperature (160^{0}C) was used for all further reactions.

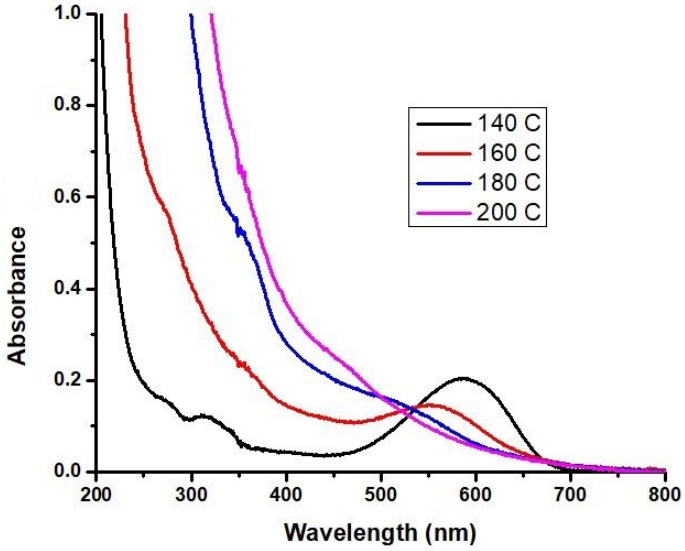

Figure S1: Absorption spectra for different reaction temperature trials. Optical pathlength is 1 cm.

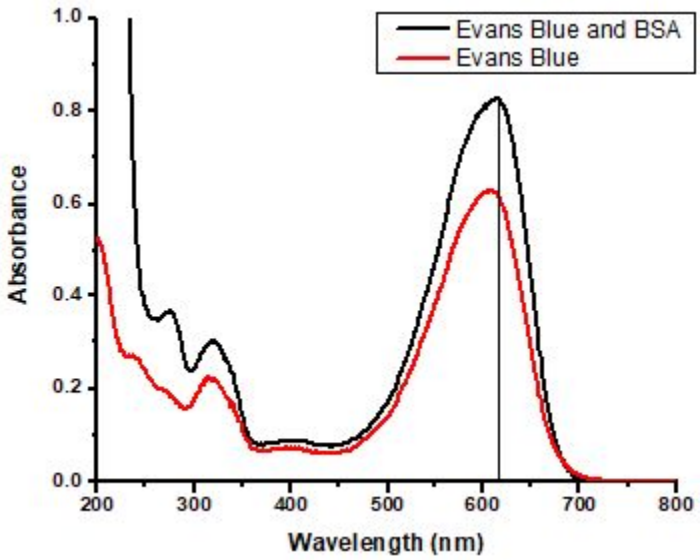

Figure S2: Absorption spectra of an Evans blue (17.5 μM) and BSA (2.5 μM) mixture (black) and of Evans blue (13 μM) alone (red). Optical pathlength is 1 cm.

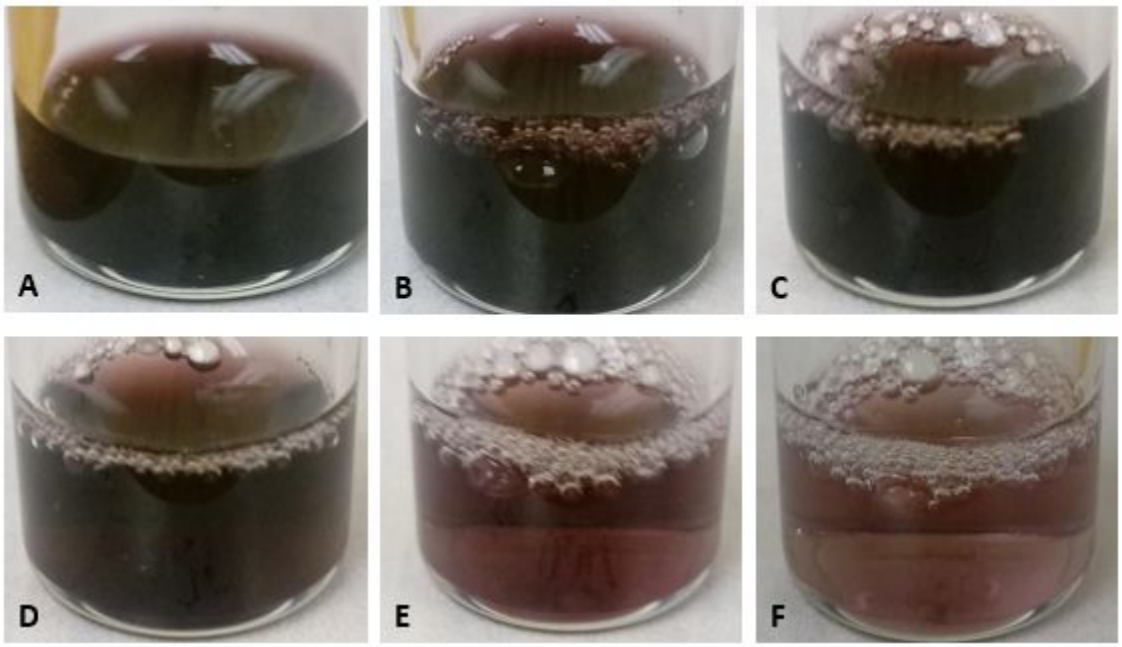

Figure S3: (A) 10, (B) 5, (C) 2.5, (D) 1.25, (E) 0.63, and (F) 0.32 mg/mL BSA-CDs in solution.

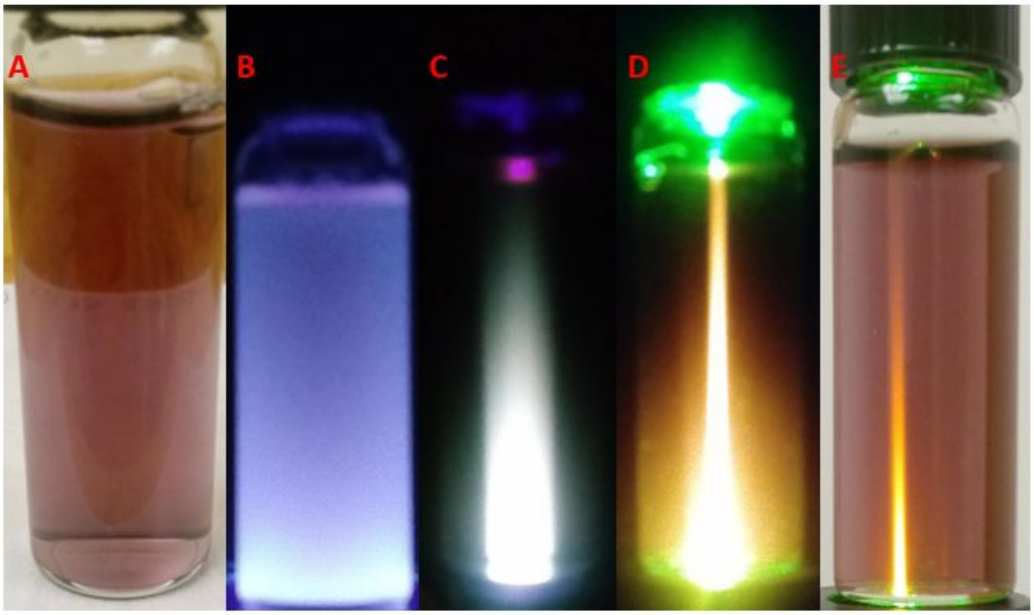

Figure S4: BSA-CDs under (A) white light, (B) 365 nm lamp, (C) 405 nm laser, (D) 532 nm laser, and (E) 532 nm laser and white light. Concentration of BSA-CDs is 0.5 mg/mL.

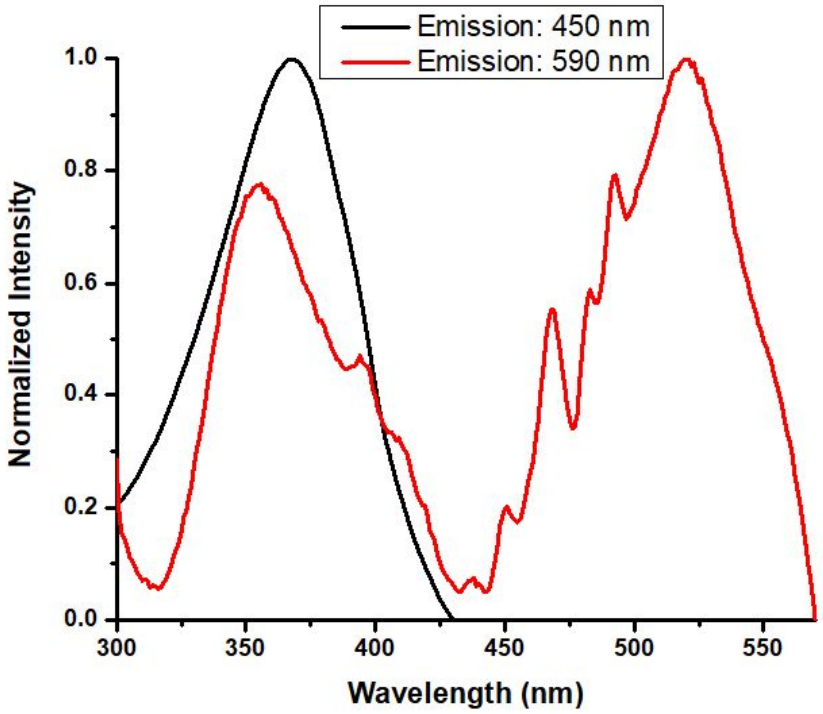

Figure S5: Normalized excitation spectrum of BSA-CDs for emission wavelengths 450 and 590 nm. Irregular peaks in red plot are due to the variations in lamp intensity from different wavelengths.

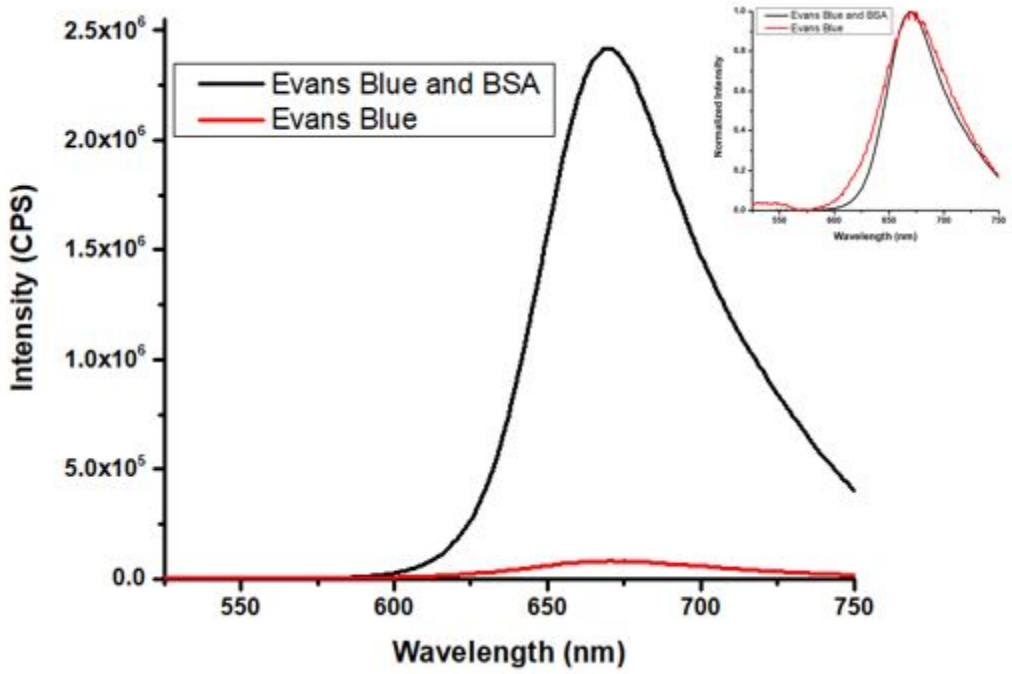

Figure S6: Fluorescence spectra of an Evans blue (17.5 μM) and BSA (2.5 μM) mixture (black) and of Evans blue (17.5 μM) alone (red). Inset, normalized fluorescence spectra.

The quantum yield of BSA-CDs was calculated using equation S1 and Rhodamine B (in water) as a standard with an excitation wavelength of 532 nm (Φ=95%)[1]. The term for viscosity was neglected as the solvent for the standard and BSA-CDs was the same.

$$\varphi_{sample} = \varphi_{reference}\left(\frac{Abs_{reference}}{Area_{reference}}\right)\left(\frac{Area_{sample}}{Abs_{sample}}\right) \qquad \text{Equation S1}$$

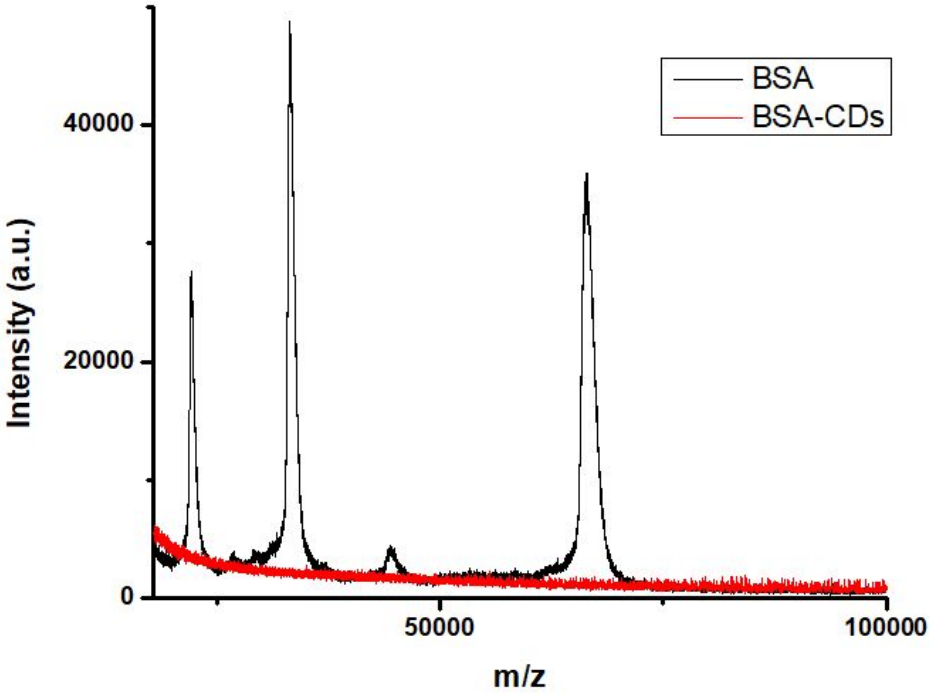

Figure S7: MALDI mass spectra of bovine serum albumin (BSA) and BSA-CDs

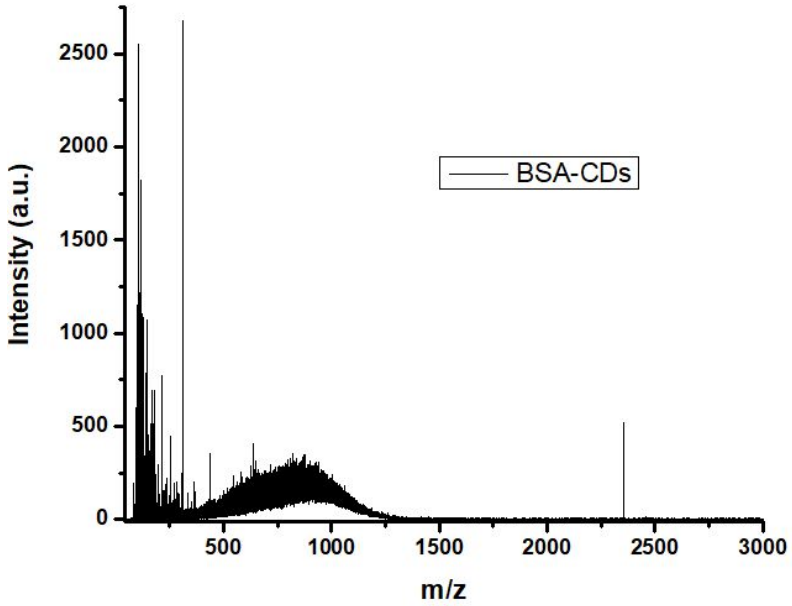

Figure S8: ESI-TOF mass spectrum for BSA-CDs

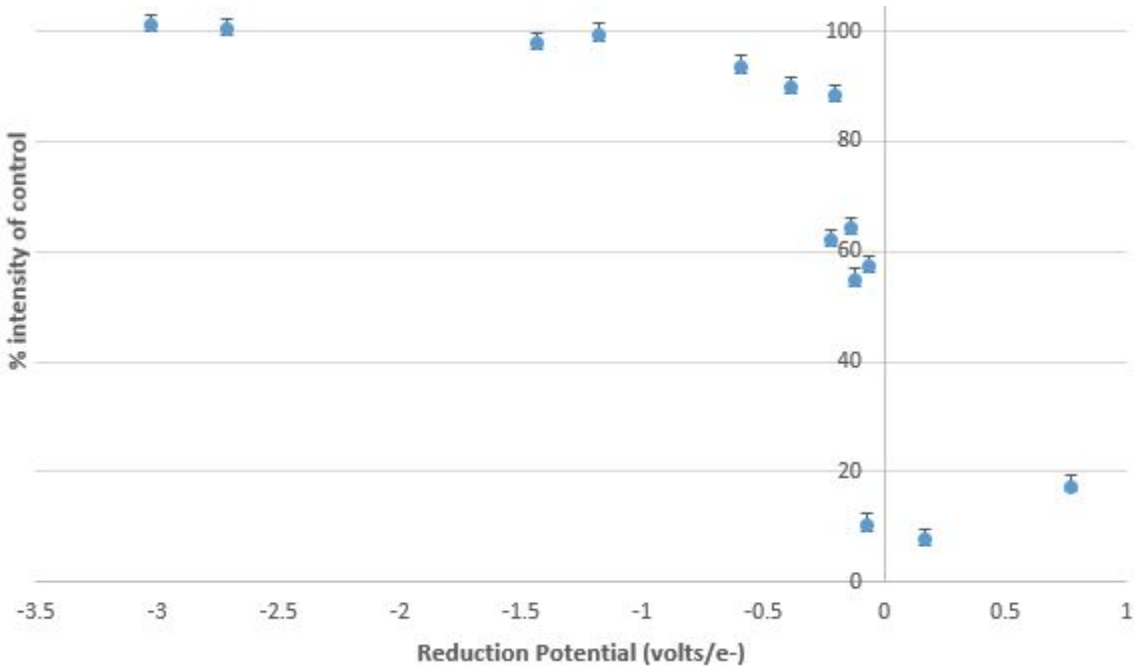

Figure S9: Plot of all ions' quenching ability (excitation at 520 nm) versus their reduction potential.

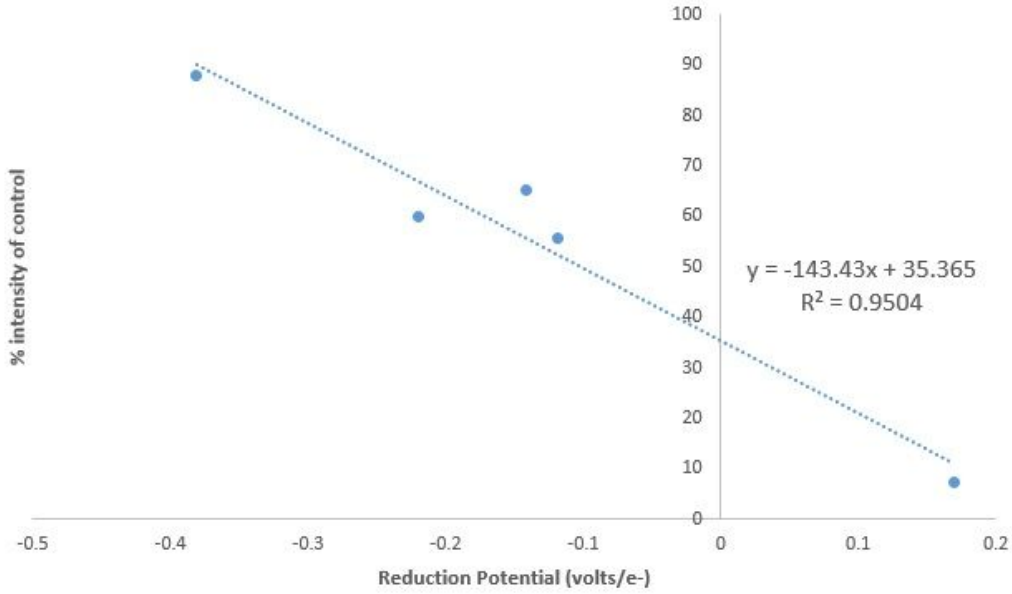

Figure S10: Plot of first row d-block (Fe to Zn) ions quenching ability (excitation 520 nm) versus their reduction potential.

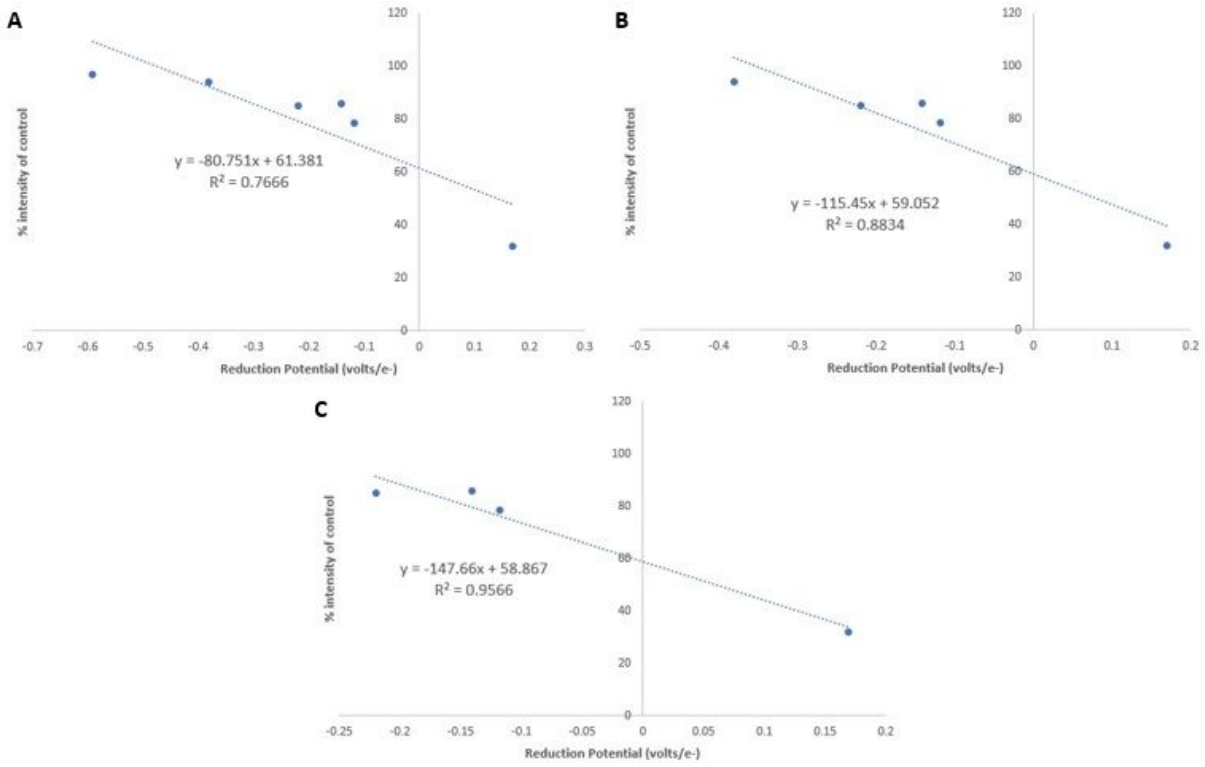

Figure S11: Plots of first row d-block metal ions quenching versus reduction potential at 1 mM ion and 0.1 mg/mL BSA-CDs. (A) Plot of Mn to Zn. (B) Plot of Fe to Zn. (C) Plot of Fe to Cu.

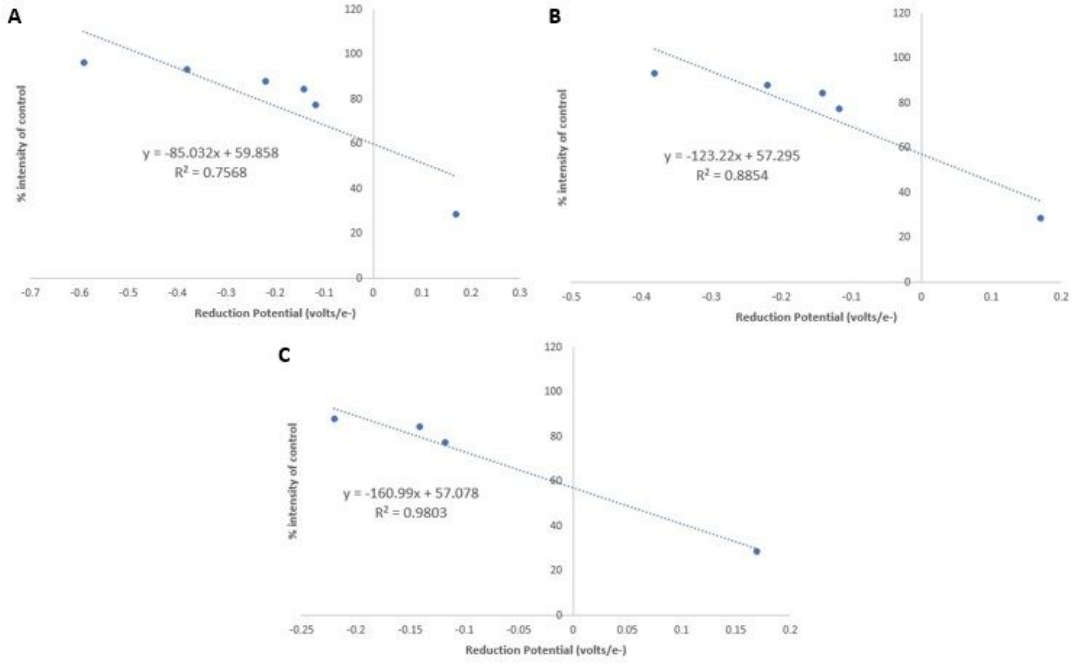

Figure S12: Plots of first row d-block metal ions quenching versus reduction potential at 1 mM ion and 0.05 mg/mL BSA-CDs. (A) Plot of Mn to Zn. (B) Plot of Fe to Zn. (C) Plot of Fe to Cu.

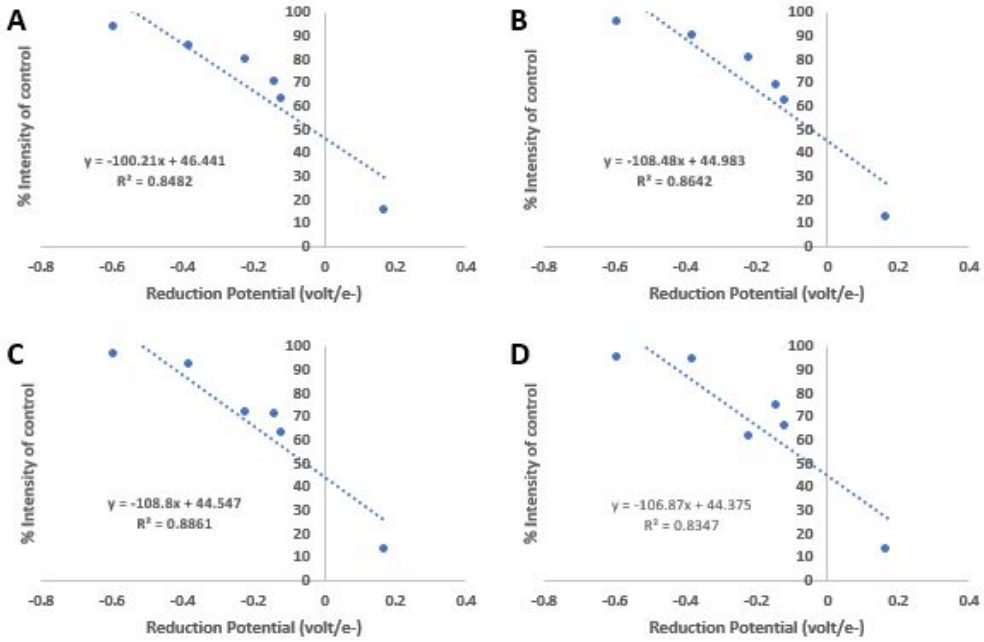

Figure S13: Plot of the quenching of various concentrations of BSA-CDs with 5 mM metal ions versus the reduction potential of metal ions. (A) 0.5, (B) 0.1, (C) 0.05, and (D) 0.01 mg/mL BSA-CDs.

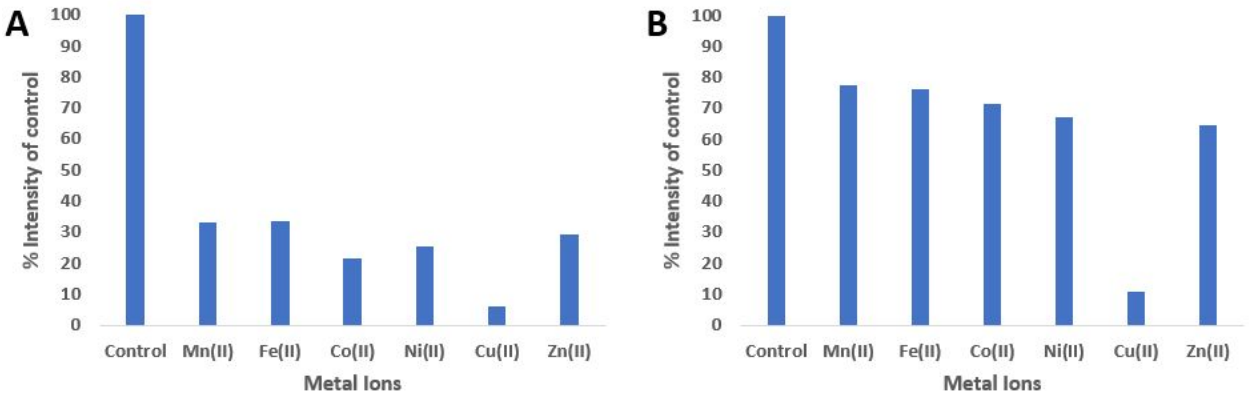

Figure S14: Quenching of (A) Evans blue and (B) Evans blue with BSA by 5 mM metal ions. An excitation wavelength of 510 nm was used and the intensity of emission was measured at 670 nm.

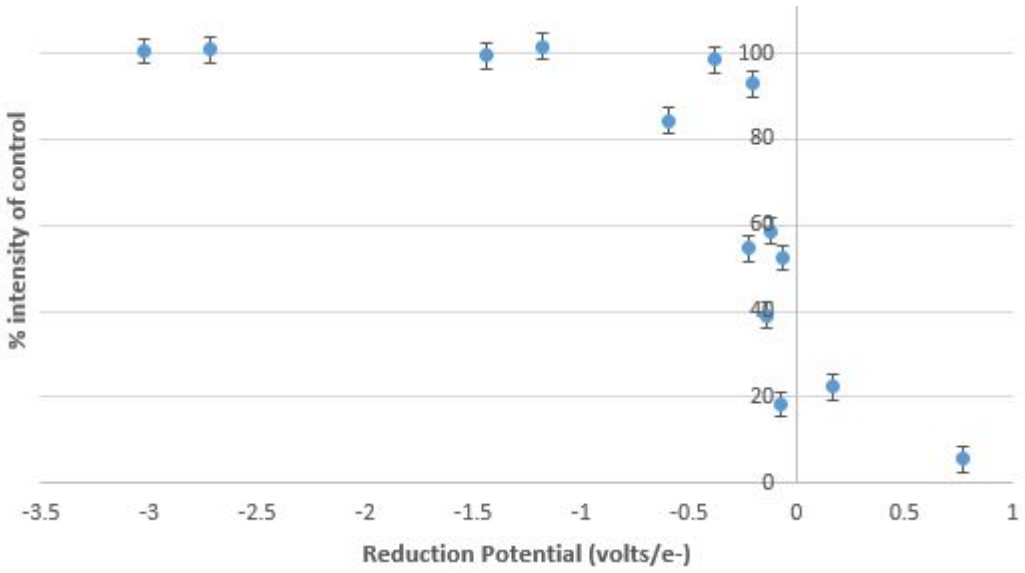

Figure S15: Plot of all ions' quenching ability (excitation at 400 nm) versus their reduction potential.

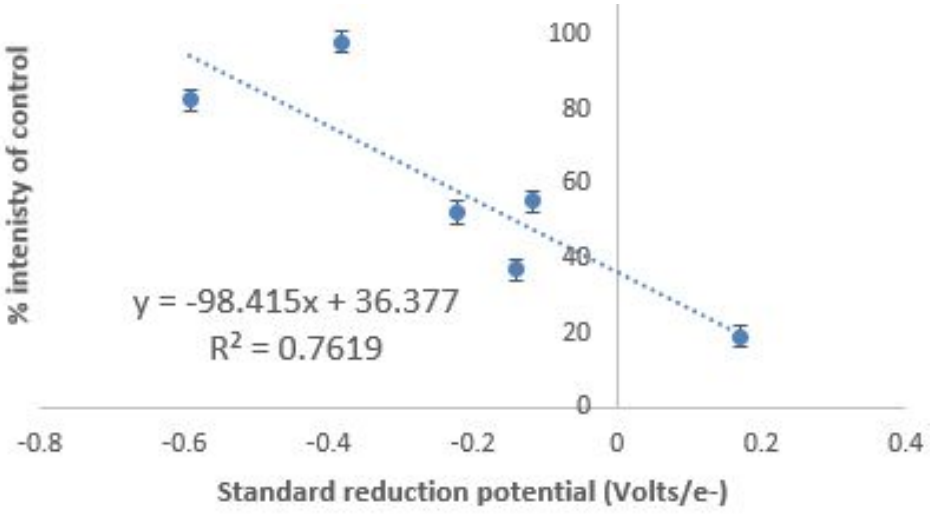

Figure S16: Plot of ions quenching ability (excitation 400 nm) versus their reduction potential.

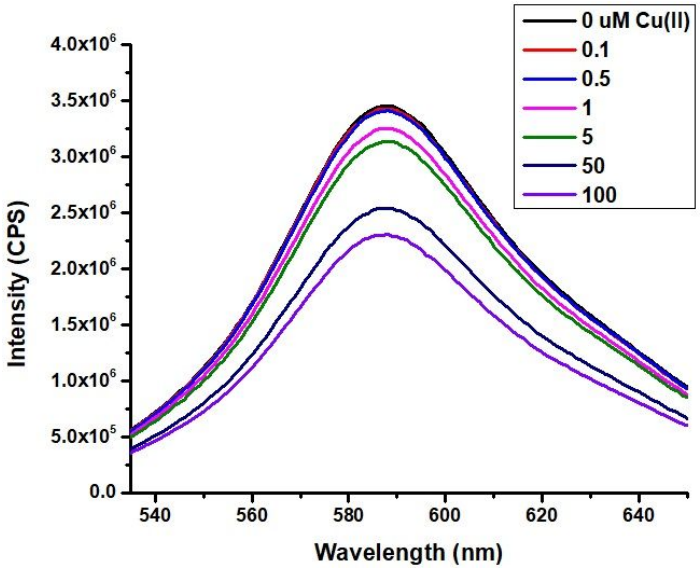

Figure S17: Fluorescence spectra for BSA-CDs mixed with various concentrations of Cu^{2+} in water/glycerol (1:1).

Analyte	**Solvent**	**K_{SV} (M^{-1})**	**Correlation Coefficient**
Cu (II)	Water	$1.09x10^4$	0.9905
Cu (II)	Water:Glycerol (1:1)	$5.12x10^3$	0.9561
Ni (II)	Water	$5.43x10^3$	0.9933
Ni (II)	Water:Glycerol (1:1)	$3.12x10^3$	0.9712
Co (II)	Water	$5.24x10^3$	0.9445
Co (II)	Water:Glycerol (1:1)	$5.87x10^3$	0.9843

Table S1: Summary of K_{SV} values for quenching of BSA-CDs with select metal ions

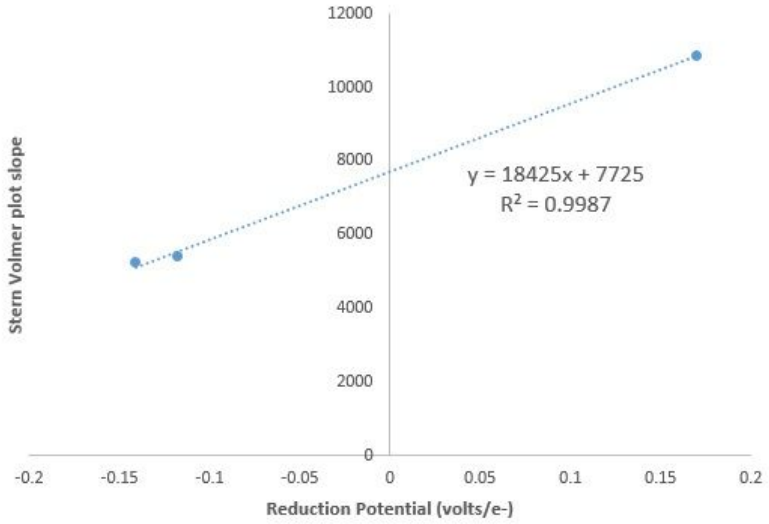

Figure S18: Plot of Stern-Volmer slopes (K_D) for Co^{2+}, Ni^{2+}, and Cu^{2+} versus their reduction potentials

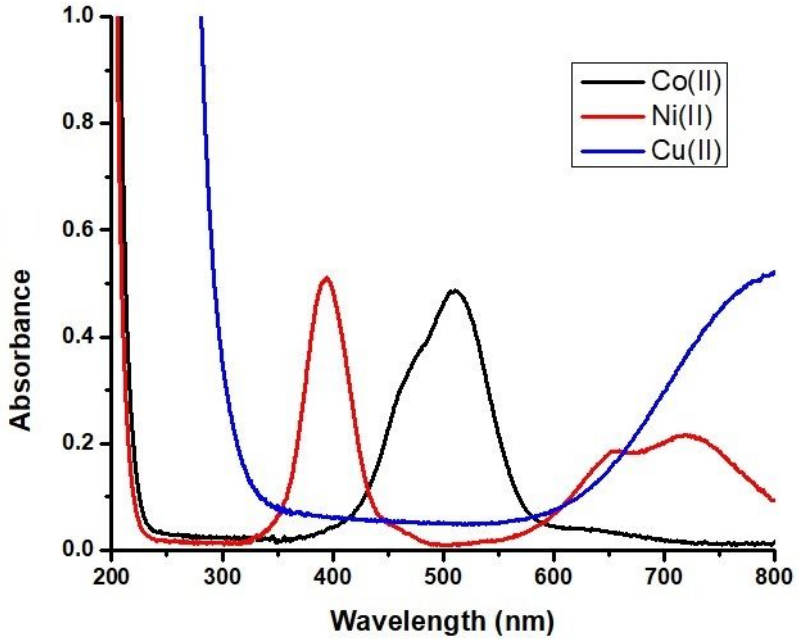

Figure S19: Absorption spectra for Co^{2+}, Ni^{2+}, and Cu^{2+}. Concentration of ions is 0.1M. Optical pathlength is 1 cm.

References

1. Bindhu, C.; Harilal, S., Effect of the excitation source on the quantum-yield measurements of rhodamine B laser dye studied using thermal-lens technique. *Analytical Sciences* **2001,** *17*, 141-144.