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Supporting Information

Parameters Affecting Synthesis of Carbon Dots for Quantitation of Copper Ions

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Table S1. Elemental compositions (%) of four types of C dots before and after reaction with Cu^{2+} ions.

Elements	C dots	Cl-C dots	Br-C dots	I-C dots	I-C dots + Cu^{2+}
C	68.79	66.40	57.00	59.70	44.84
N	14.52	15.35	17.73	15.30	6.50
O	16.33	17.61	23.96	23.33	47.15
I	-[a]	-	-	1.46	0.55
Br	-	-	0.95	-	-
Cl	0.37	0.64	0.23	0.21	0.22

[a] not detected

Table S2. Quantitation of Cu^{2+} ions using different nanomaterial probes.

Probe	Linear range (μM)	LOD (μM)	Ref.
[a]CdSe@C-TPEA	1-100	1	1
[b]ZnS QDs	26-260	7.1	2
[c]Probe L	4-12	1.8	3
[d]B, N-C dots	1-25	0.3	4
Cys-CdS QDs	2-10	1.5	5
C dots	5.16-20	1.72	6
Petroleum coke C dots	0.25-10	0.029	7
N-C dots	0.6-30	0.19	8
I-C dots	0.3-3	0.22	This study

[a]TPEA: N-(2-aminoethyl)-N,N,N'tris(pyridin-2-ylmethyl)ethane-1,2-diamine.
[b]QDs: quantum dots.
[c]Probe L prepared from 4-bromo-1,8 naphthalene anhydride and 2-thiophene formaldehyde.
[d]B, N-C dots prepared from aminophenylboronic acid
eCQD: carbon quant

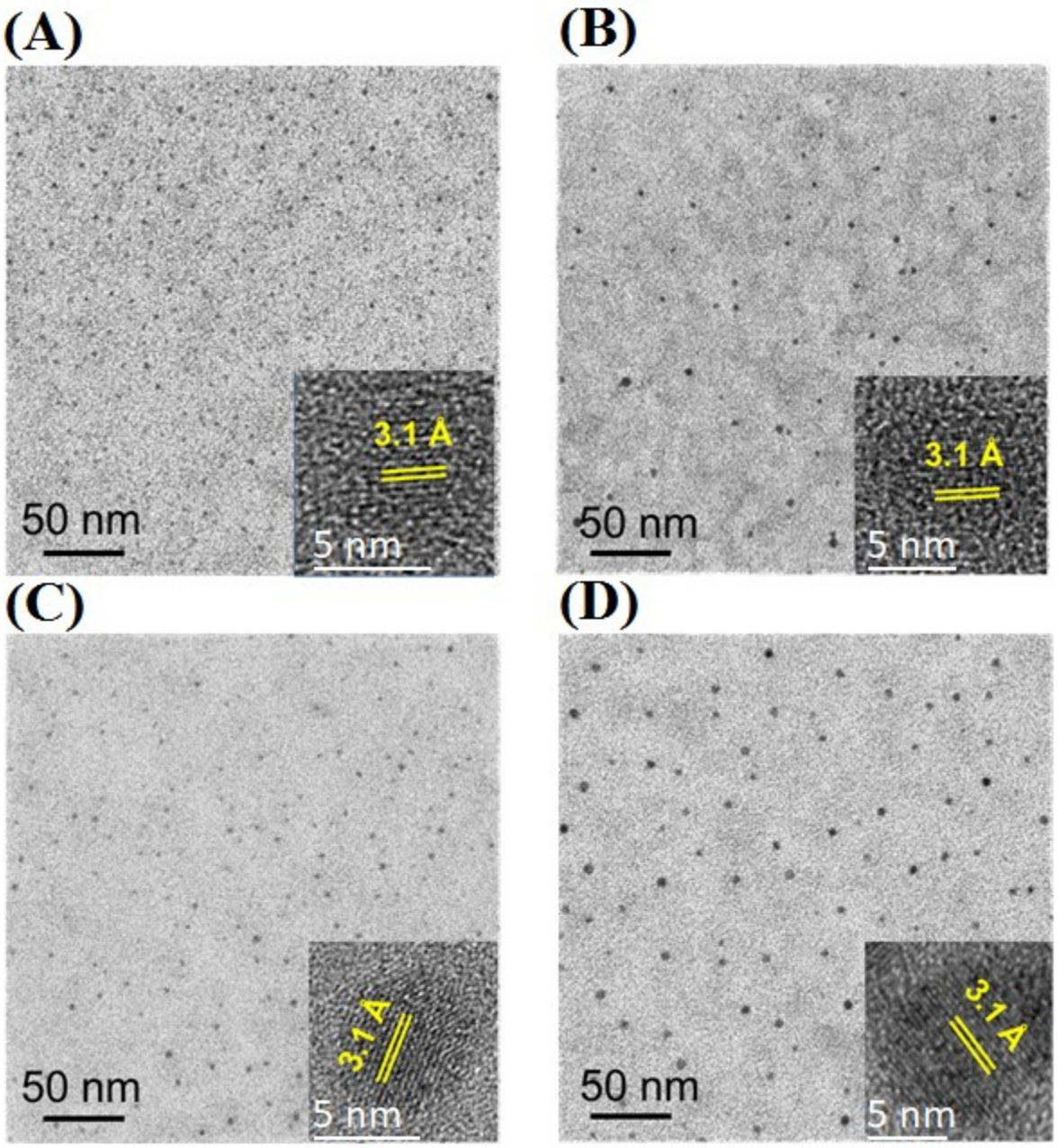

Fig. S1. TEM images of (A) C dots, (B) Cl-C dots, (C) Br-C dots, and (D) I-C dots. Insets: HRTEM images of the corresponding C dots.

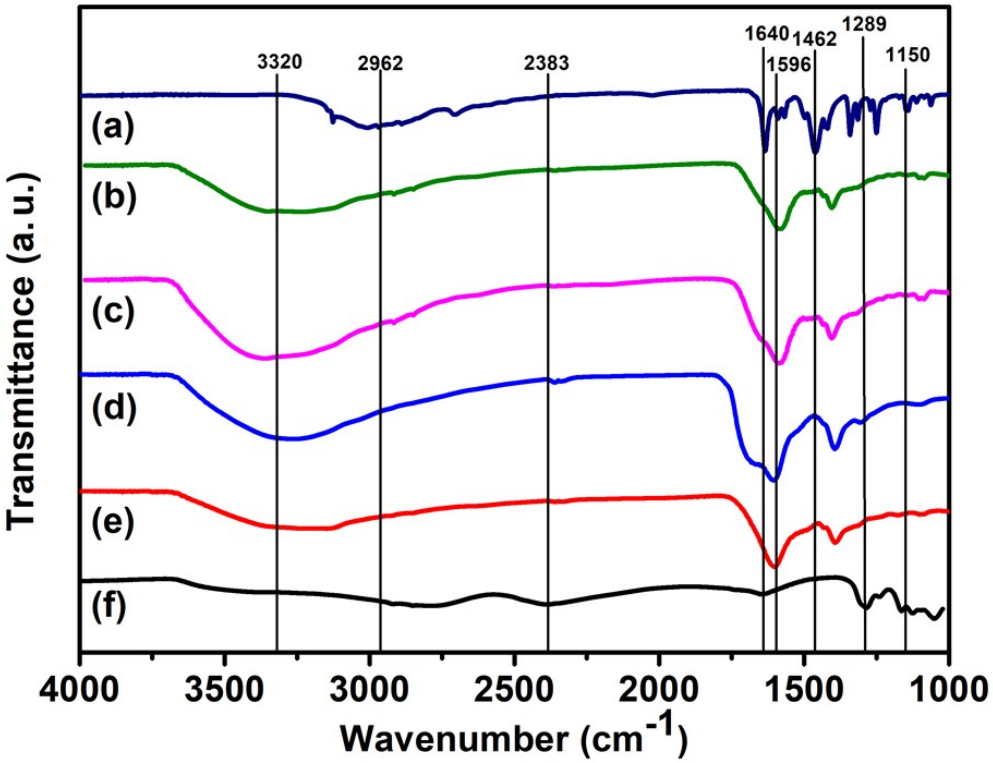

Fig. S2. FTIR spectra of (a) histidine, (b) C dots, (c) Cl-C dots, (d) Br-C dots, (e) I-C dots, and (f) I-C dots after reaction with 100 μM Cu^{2+} ions.

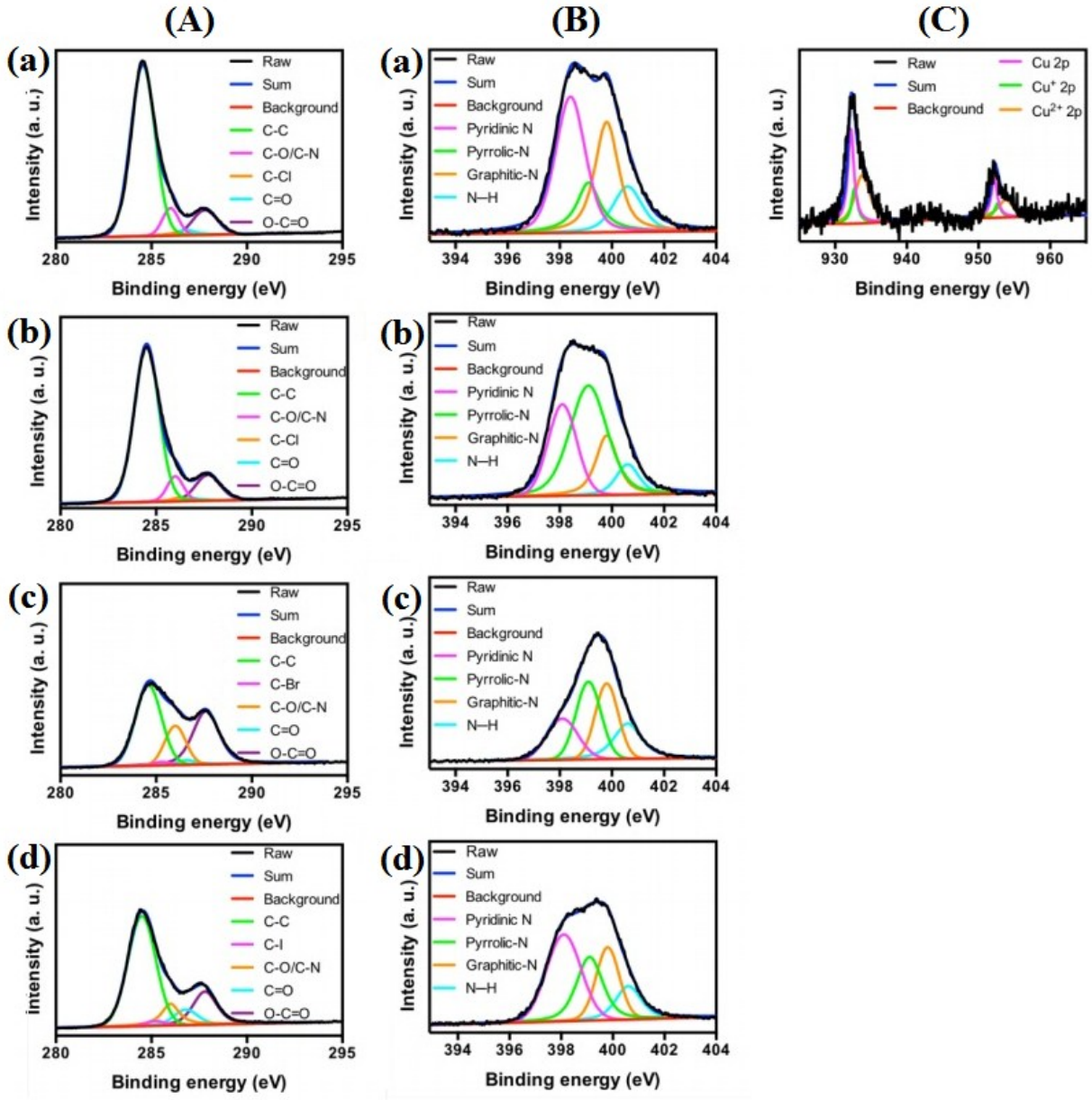

Fig. S3. Deconvoluted (A) C1s and (B) N1s core level XPS spectra of (a) C dots, (b) Cl-C dots, (c) Br-C dots, and (d) I-C dots. (C) Deconvoluted $Cu_{2p3/2}$ core level spectra of I-C dots after reaction with 100 μM Cu^{2+} ions.

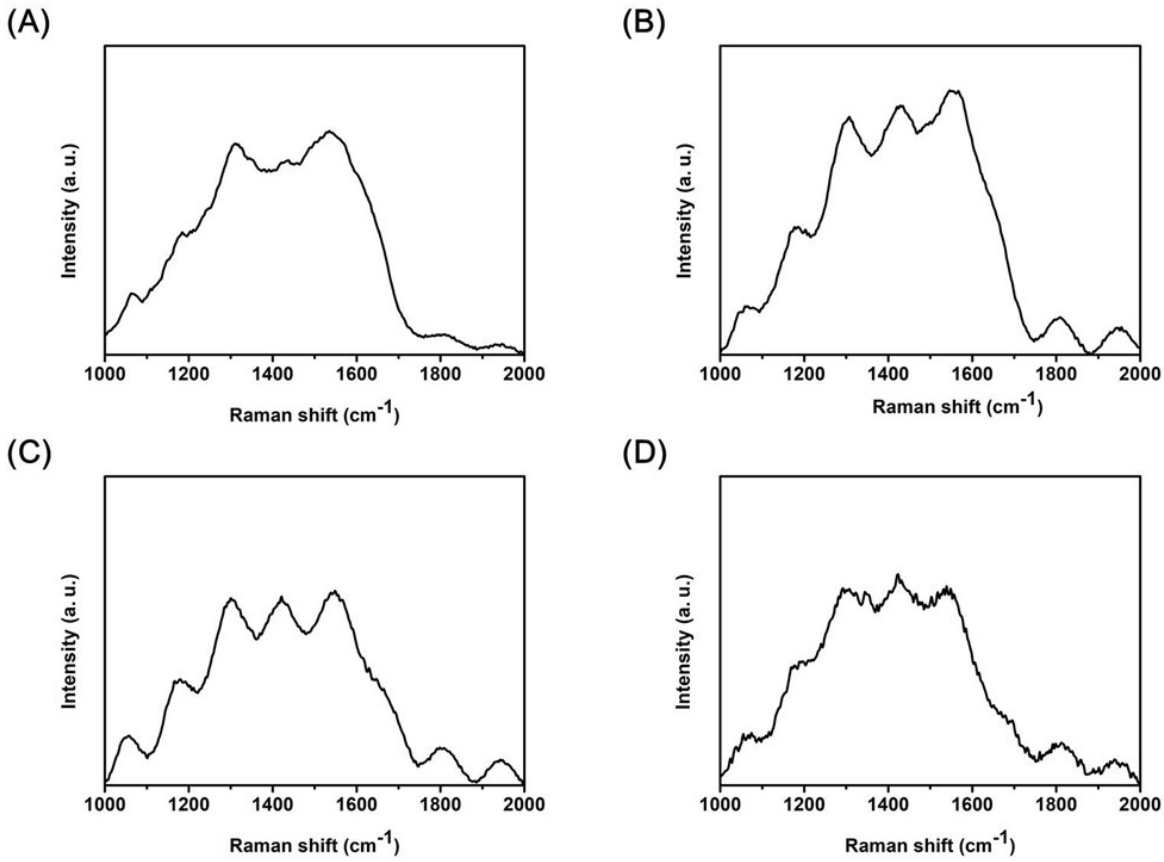

Fig. S4. Raman spectra of (A) C dots, (B) Cl-C dots, (C) Br-C dots, and (D) I-C dots.

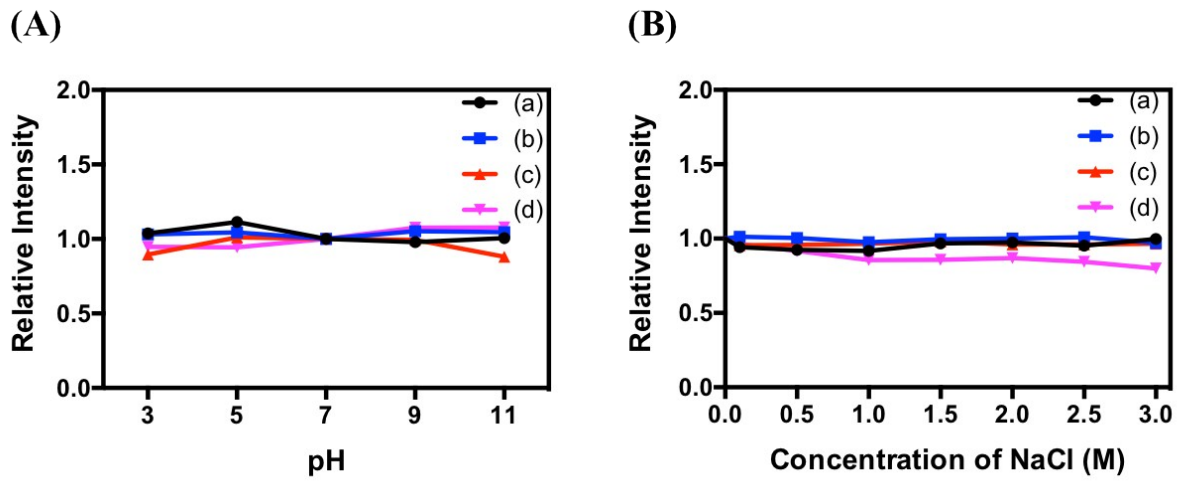

Fig. S5. Effects of (A) pH (3.0–11.0) and (B) NaCl concentration (0–3.0 M) on the stability of (a) C dots, (b) Cl-C dots, (c) Br-C dots, and(d) I-C dots. C dots: 0.01X; phosphate solutions: 20 mM; excitation and emission wavelengths: 420 and 505 nm, respectively.

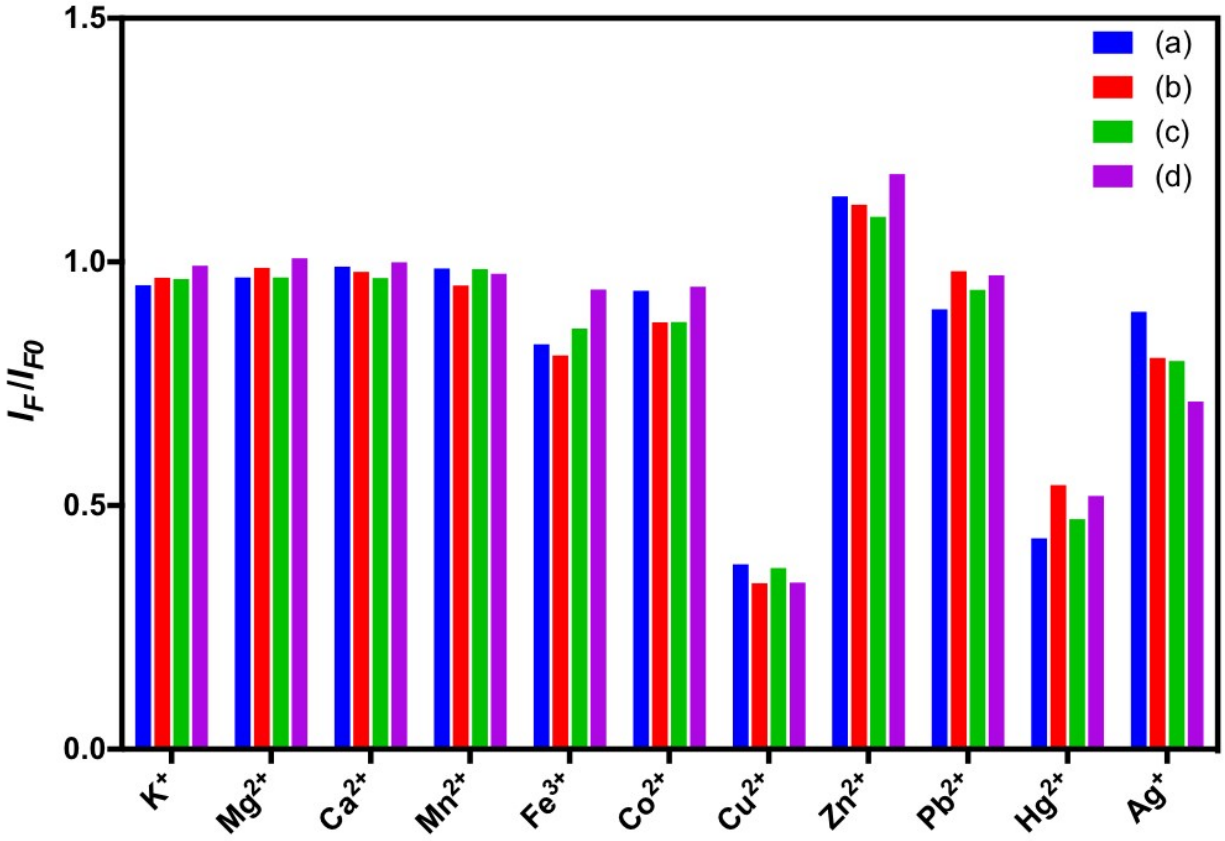

Fig. S6. Selectivity of (a) C dots, (b) Cl-C dots, (c) Br-C dots, and (d) I-C dots toward the detection of Cu^{2+} ions (100 μM) over the other metal ions (100 μM) in phosphate buffer (20 mM, pH 3.0). The concentrations of the four C dots used are all 0.01X. Other conditions are the same as in Fig. 2.

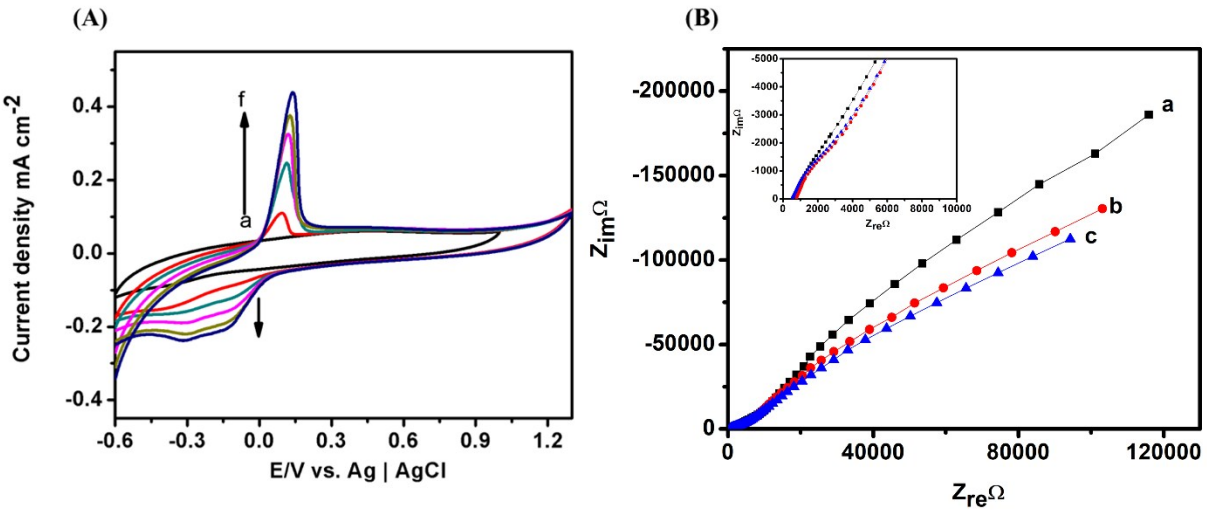

Fig. S7. (A) CV curves and (B) EIS spectra of bare GCE recorded in phosphate buffer (20 mM, pH 3.0) under different conditions. (A) I-C dots were dispersed in phosphate buffer (20 mM, pH 3.0) solution (a) without and (b-f) with containing Cu^{2+} and Fe^{3+} (200 µM). Cu^{2+} ion concentrations (µM) used are (b) 100, (c) 200, (d) 300, (e) 400, and (f) 500. Fe^{3+} was added as a control. Scan rate for CV curves is 50 mV s^{-1}. (B) EIS spectra were recorded over the frequency range from 0.01 to 10000 Hz at an amplitude of 5 mV in N_2 saturated phosphate buffer (a) without I-C dots, (b) with I-C dots, and (c) with I-C dots and 100 µM Cu^{2+} ions. Inset in (B): Magnified view of high frequency region of EIS spectra.

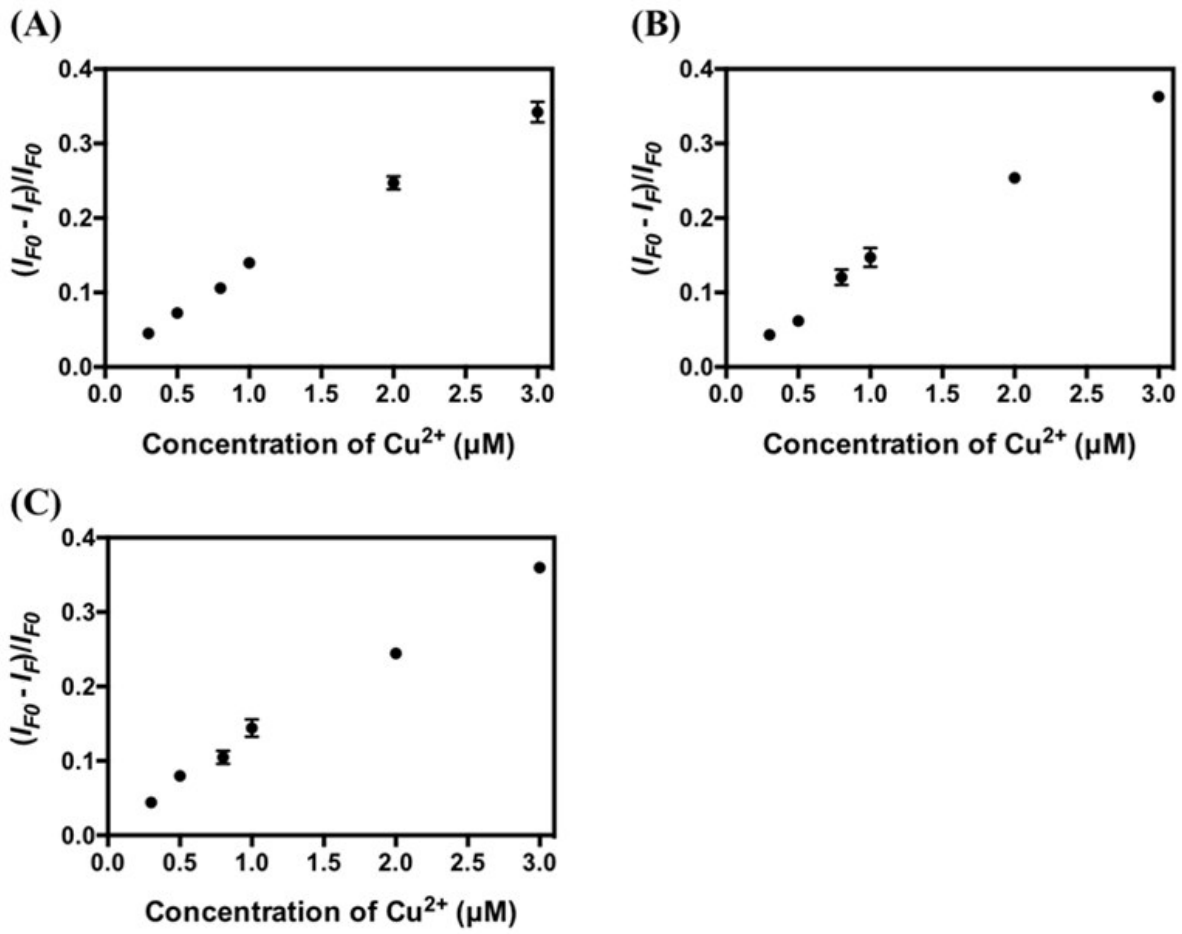

Fig. S8. Linearity of relative PL intensity at 505 nm of I-C dots (0.001X) toward the quantitation of Cu^{2+} ions in (A) tap water, (B) lake water, and (C) seawater. Samples were mixed with phosphate buffer (20 mM, pH 3.0), and standard Cu^{2+} solutions. Other conditions are the same as in Fig. 2.

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