Electronic Supplementary Material (ESI) for New Journal of Chemistry.

Supporting Information

Dual functions of metal ion detection and antibacterial activity of sulfur quantum dots

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Experimental

Determination of cytotoxicity by MTT assay

L929 fibroblasts were used to evaluate the biocompatibility of the SQDs. For this, L929 cells were cultured in Dulbecco's modified Eagle medium (DMEM) (Corning, Glendale, AZ, USA) supplemented with 10% fetal bovine serum (Gibco, Franklin Lakes, NJ, USA) and 1% antibiotic/antimycotic solution in a humidified incubator with 5% CO_2 at 37 °C. The medium was refreshed every two days until 80% cell confluence was achieved. The 3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyl-tetrazolium bromide (MTT) assay is an indirect cell viability measurement that uses the reaction of mitochondrial dehydrogenase to reduce tetrazolium salts to insoluble formazan (purple compound) in metabolically active cells. For the MTT test, L929 cells (7×10^3 cells/well) were seeded in 96-well plates and incubated overnight. Then the cells were treated with different concentrations of SQDs (up to a maximum concentration of 2000 μg/mL) for 72 hours. After the treatment, 20 μL of 2 mg/mL MTT solution was added to each well and incubated at 37 °C for three hours. After dissolving formazan crystals with DMSO, the absorbance was monitored at 570 nm using a microplate reader (Molecular Devices, CA, USA). Data were presented as mean ± standard deviation (SD) from at least three independent experiments in triplicate.

Results

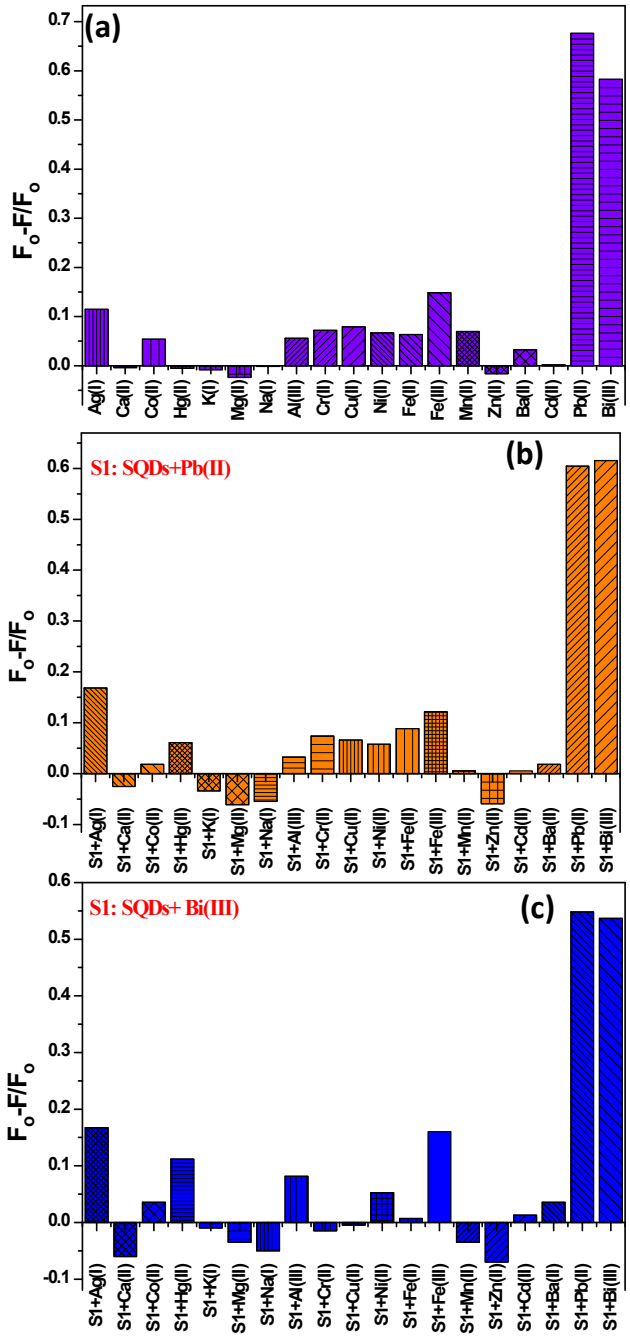

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Figure S1 (a) Selectivity of SQDs in the presence of various metal ions, (b) Interference evaluation of SQDs+Pb(II) in the presence of interferents (1:3) (c) Interference evaluation of SQDs+Bi(III) in the presence of interferents.

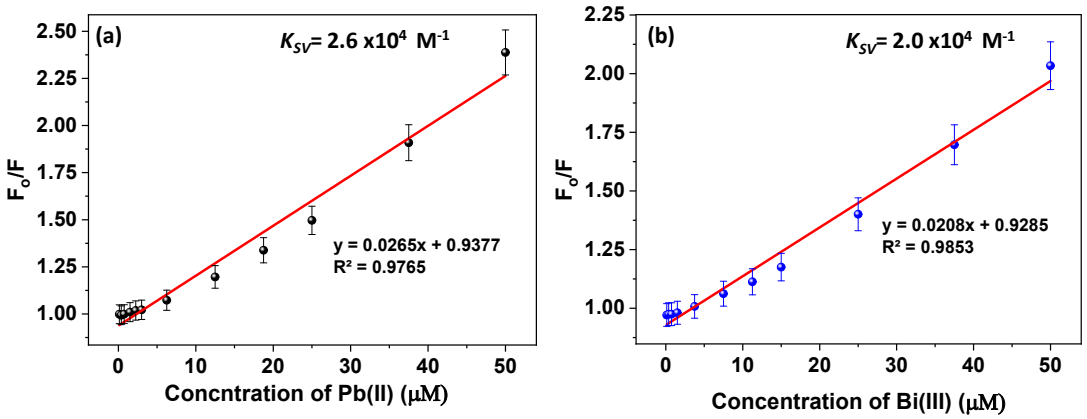

Figure S2. Stern-Volmer plots of SQDs in the presence of (a) Pb(II) and (b) Bi(III).

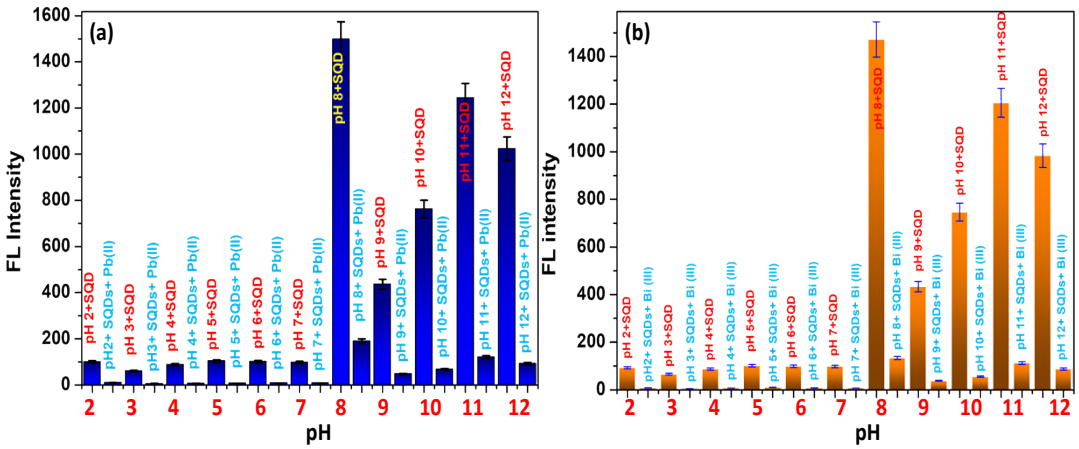

Figure S3. pH effect on SQDs emission and sensing to (a) Pb(II) and (b) Bi(III) ions. The test was performed in triplicate (n=3).

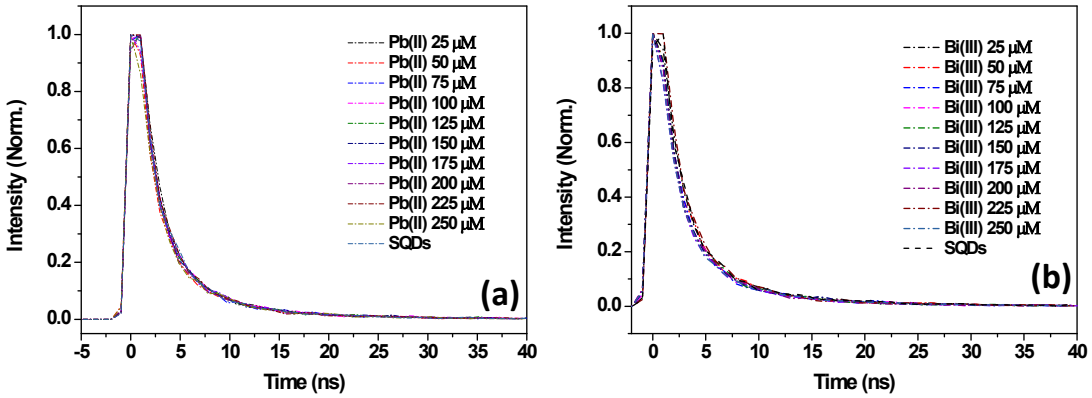

Figure S4. Conentration-dependent and normalized TRPL spectral titrations for (a) SQDs and SQDs+Pb(II) and (b) SQDs and SQDs+Bi(III).

Sample	τ_1	τ_2	τ_3	T_{avg}
SQDs	0.395	1.782	7.702	4.012
SQDs+Pb (II) 25 µM	0.360	1.909	8.068	4.431
SQDs+Pb (II) 50 µM	0.443	1.467	7.278	3.992
SQDs+Pb (II) 75 µM	0.464	1.845	8.449	4.489
SQDs+Pb (II) 100 µM	0.446	1.854	8.411	4.621
SQDs+Pb (II) 125 µM	0.428	1.978	8.659	4.590
SQDs+Pb (II) 150 µM	0.388	1.990	8.932	4.527
SQDs+Pb (II) 175 µM	0.369	1.962	8.311	4.500
SQDs+Pb (II) 200 µM	0.519	1.689	7.999	4.499
SQDs+Pb (II) 225 µM	0.380	2.163	9.164	4.457
SQDs+Pb (II) 250 µM	0.311	1.788	7.38	4.247
SQDs+Bi (III) 25 µM	0.173	2.053	8.021	4.226
SQDs+Bi (III) 50 µM	0.452	1.756	7.764	4.427
SQDs+Bi (III) 75 µM	0.286	1.888	7.736	4.164
SQDs+Bi (III) 100 µM	0.258	1.917	7.775	4.149
SQDs+Bi (III) 125 µM	0.611	1.050	5.792	3.742
SQDs+Bi (III) 150 µM	0.326	1.808	8.144	4.352
SQDs+Bi (III) 175 µM	0.288	1.472	6.289	3.645
SQDs+Bi (III) 200 µM	0.453	1.196	5.507	3.625
SQDs+Bi (III) 225 µM	0.304	2.001	9.213	4.297
SQDs+Bi (III) 250 µM	0.365	1.384	6.439	3.779

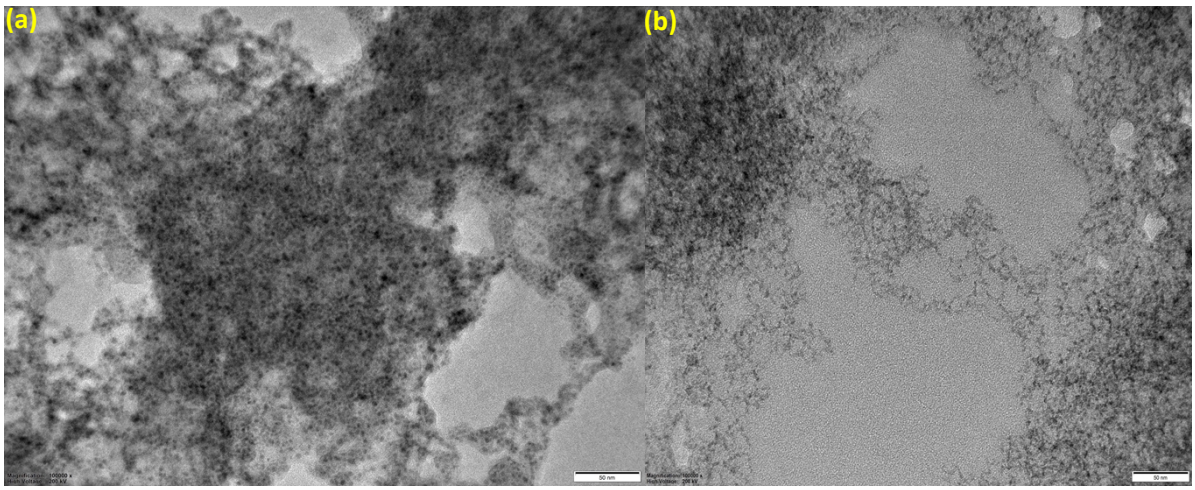

Figure S5. HR-TEM images of SQDs in the presence of Pb(II) and Bi(III) ions.

Table S1. Fitted decay constants of SQDs with Pb(II) and Bi(III) ions from TRPL data.

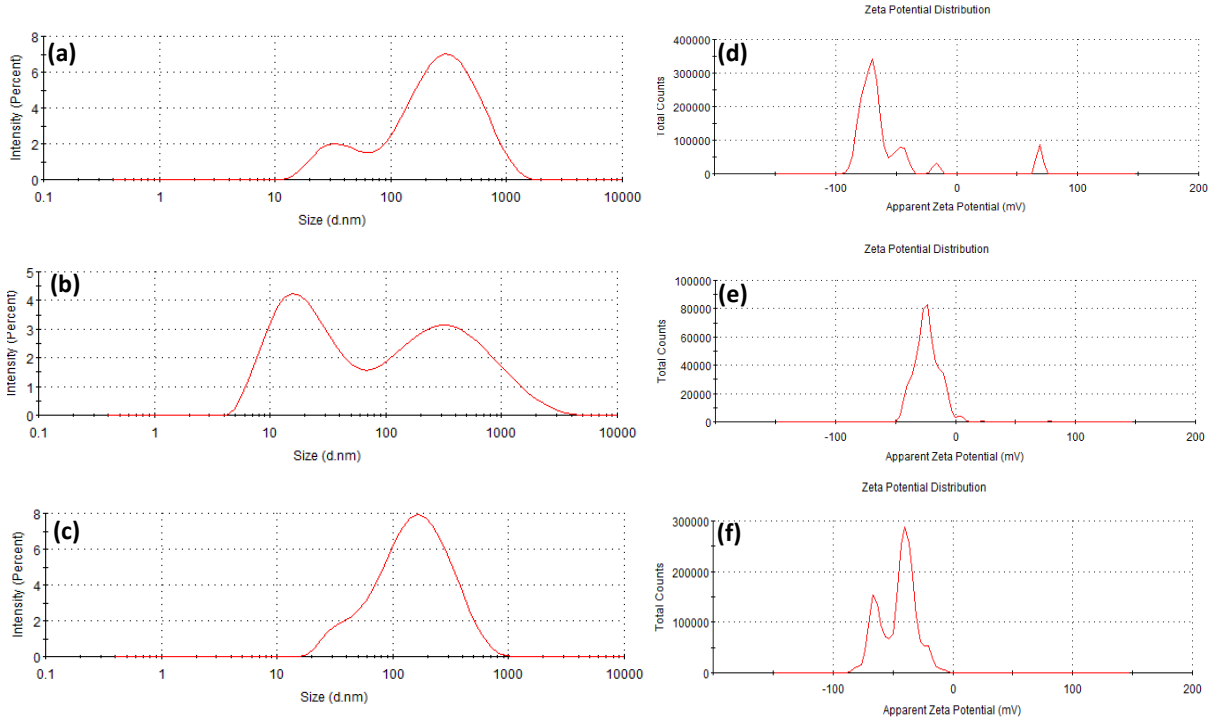

Figure S6. Influence of metal ions on the size of SQDs via DLS (a) SQDs (b) SQDs+Pb(II) (125 µM) (c) SQDs+Bi(III) (125 µM) and zeta potential of SQDs (d) SQDs+Pb(II) (125 µM) (e) and SQDs+Bi(III) (125 µM) (f).

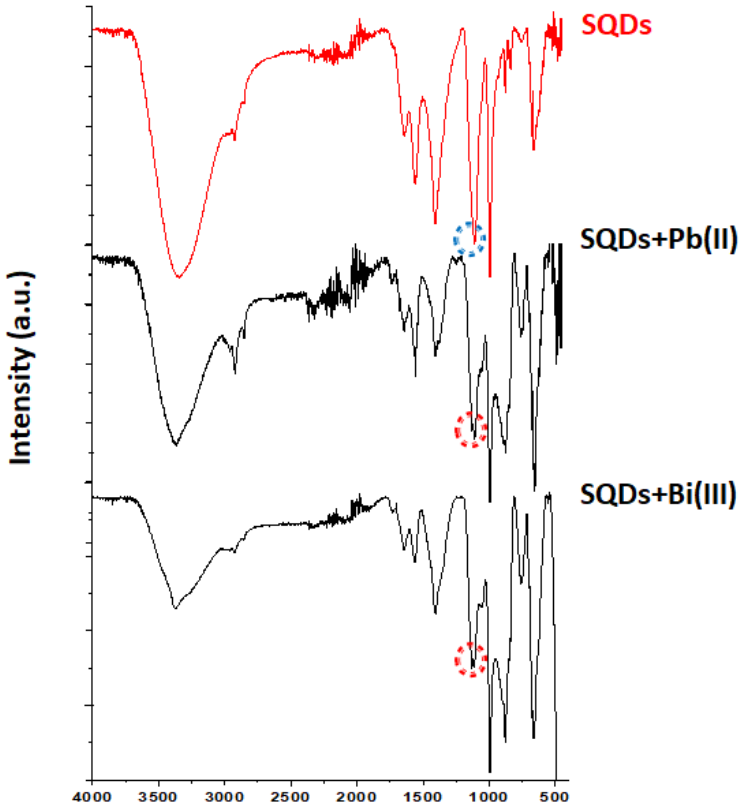

Figure S7. FTIR spectra of SQDs in the presence and absence of metal ions.

Table S2. Influence of Pb(II) and BI(III) ions on PLQY of SQDs.

Sample	PLQY	Sample	PLQY
SQDs	11.42	SQDs	11.42
SQDs+Pb(II)(25 μM)	6.26	SQDs+Bi(III)(25 μM)	4.84
SQDs+Pb(II)(50 μM)	5.78	SQDs+Bi(III)(50 μM)	4.01
SQDs+Pb(II)(75 μM)	3.77	SQDs+Bi(III)(75 μM)	3.27
SQDs+Pb(II)(100 μM)	2.05	SQDs+Bi(III)(100 μM)	2.40
SQDs+Pb(II)(125 μM)	1.39	SQDs+Bi(III)(125 μM)	1.86

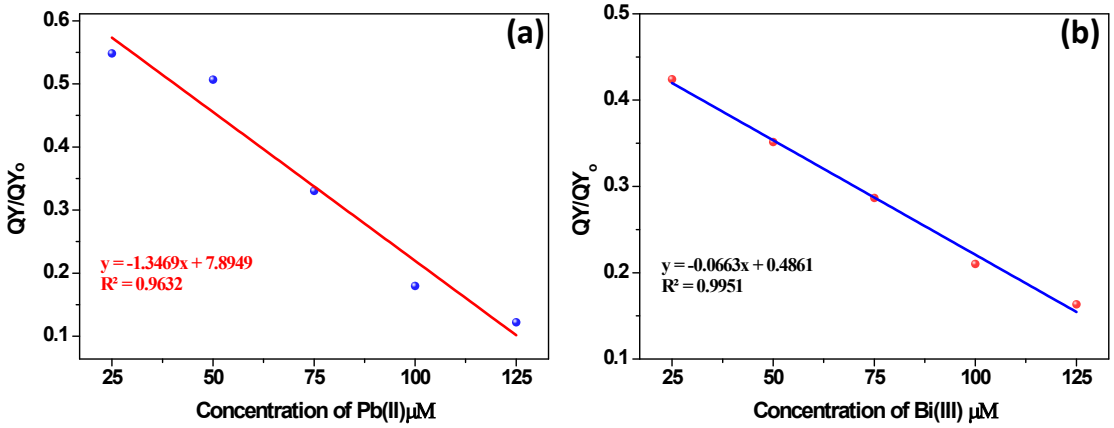

Figure S8. Effect of metal ions on QY of SQDs: (a) SQDs+Pb(II) (b)SQDs+Bi(III).

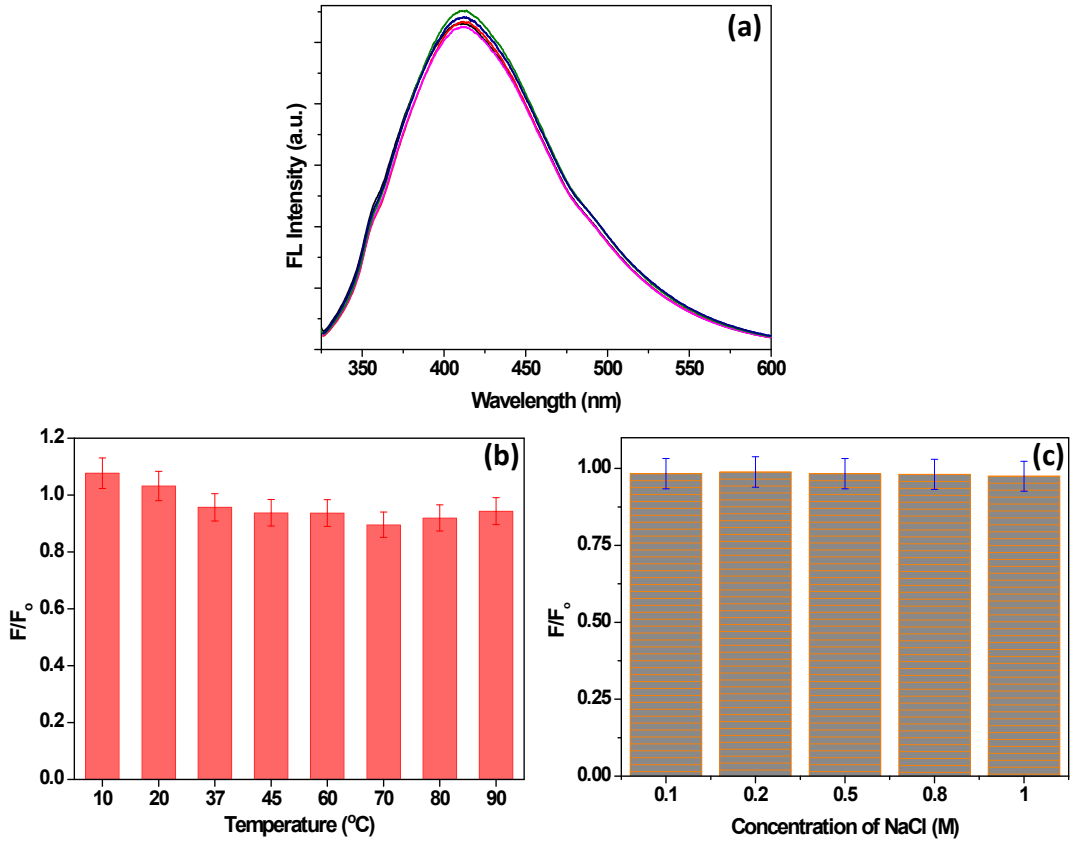

Figure S9. (a) Luminescence response of SQDs for 90 days, the effect of (b) temperature, and (c) NaCl on SQDs emission property. The test was performed in triplicate (n=3).