Supporting information

Highly Efficient Electrochemiluminescence of Ruthenium Complex-Functionalized CdS Quantum Dots and Its Analytical Application

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Experimental section

Synthesis of Ru-NH_2-functionalized CdS QDs.

CdS-Ru nanoparticles were prepared as following process. First, diazonium $Ru(bpy)_2(N_2^+$-phen)$[PF_6]_2$ (Ru-N_2^+) was synthesized using a reported procedure.[1] Briefly, add 5 mL of 0.14 mg/mL $NaNO_2$ into 5 mL of 0.5 M HCl solution containing 9.0 mg Ru-NH_2 and stay in complete darkness for 10 min in an ice bath. Then, 0.4 mg $NaBH_4$ were added drop-wise into the above mixture and stirred for 1 h at room temperature.[2] Finally, 0.144 mL of 1.0 mg/mL CdS QDs solution was added into the above mixture and the reaction mixture was stirred at room temperature for 2 h. The initial solution was centrifuged at 4000 rpm for 20 min and then the supernatant was continually centrifuged at 10000 rpm for 20 min. Finally, the obtained CdS-Ru nanoparticles on the bottom were homogeneously dispersed in 1 mL of aqueous solution and stored in 4 °C.

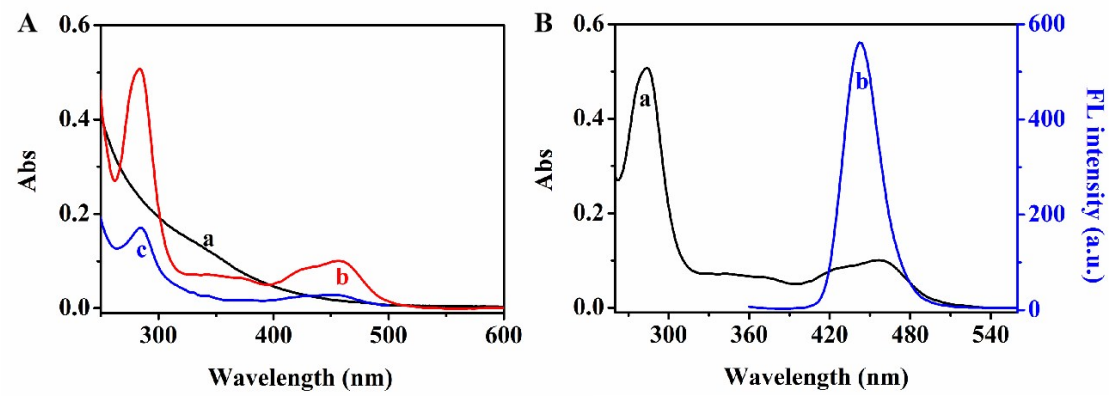

Figure S1. (A) UV-Vis of (a) 0.02 mg/mL CdS QDs; (b) 0.2 mg/mL Ru-NH_2; (c) 0.06 mg/mL Ru-NH_2 nanoparticles. (B) UV-Vis absorption spectrum of (a) 0.2 mg/mL Ru-NH_2 and fluorescence spectrum of (b) 0.02 mg/mL CdS QDs.

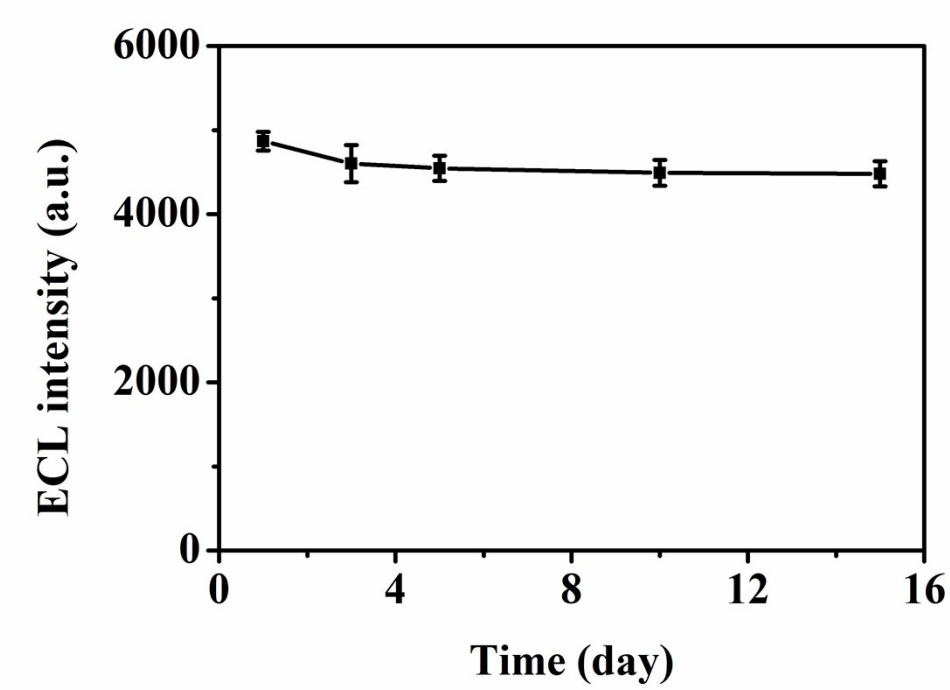

Figure S2. ECL responses of 0.06 mg/mL CdS-Ru nanoparticles after the storage of 1, 3, 5, 10 and 15 days in a refrigerator at 4 °C. ECL measurement conditions: 0.1 M PBS (pH 7.4) containing 45 mM TPA, scan rate, 0.1 V/s. PMT= -500 V.

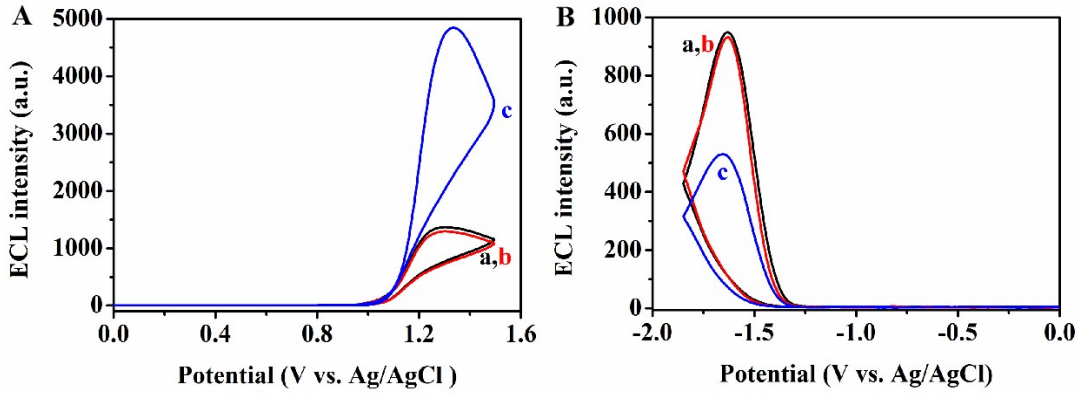

Figure S3. (A) ECL intensity *vs.* potential profiles of (a) 0.06 mg/mL Ru-NH_2, (b) the mixture of 0.02 mg/mL CdS QDs and 0.06 mg/mL Ru-NH_2 and (c) 0.06 mg/mL CdS-Ru nanoparticles in 0.1 M PBS containing 45 mM TPA. (B) ECL intensity vs. potential profiles of (a) 0.02 mg/mL CdS QDs, (b) the mixture of 0.02 mg/mL CdS QDs and 0.06 mg/mL Ru-NH_2 and (c) 0.06 mg/mL CdS-Ru nanoparticles in 0.1 M PBS containing 45 mM $K_2S_2O_8$. PMT= -500 V, scan rate, 0.1 V/s.

Table S1. Results for the determination of thrombin.

Method	Materials used	Linear range	Detection limit	Ref
Colorimetry	Graphene oxide/gold/platinum nanoparticles	0.30-100 nM	0.15 nM	3
Chemiluminescence	Graphene oxide	0.25-1 nM	83 pM	4
Fluorescence	silica nanoparticles	0.6-100 nM	0.20 nM	5
Electrochemistry	Graphene-porphyrin nanocomposite	5-1500 nM	0.2 nM	6
Electrochemistry	Gold-streptavidin nanoparticles and silver reduction enhancement	0.1-100 pM	0.3 pM	7
Electrochemistry	Ag nanoparticles decorated graphene oxide	0.05-5 nM	0.03 nM	8
ECL	Streptavidin modified QDs	27.2-545 nM	2.72 nM	9
ECL	graphene oxide	0.9-226 pM	0.4 pM	10
ECL	CdS-Ru nanoparticles	1-100 pM	0.6 pM	This work
ECL	CdS-Ru nanoparticles	1-500 pM	0.7 pM	This work

Table S2. Analytical results for thrombin in human serum.

Sample number	Added in the serum (pM)	Found results (pM)	Recovery (%)
1	10.0	10.73±0.02	107.3
2	20.0	20.56±0.02	102.8
3	50.0	45.52±0.01	91.04

References

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