

Ultrasensitive Copper (II) Detection Using Plasmon-Enhanced and Photo-Brightened Luminescence of CdSe Quantum Dots

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Supporting Information

Synthesis of CdSe QDs. 250 mg of CdO with 2.85 g hexadecylamine, 1.15 g TOPO and 1.09 g tetradecylphosphic acid were degassed under reduced pressure at 110 °C for one hour. Then, under nitrogen, the solution was heated to 300 °C until it became optically clear. 0.5 g tri-n-butylphosphine (TBP) was injected and the temperature was reduced to 260 °C. 0.8 g of a 10% by weight Se powder in TBP solution was then quickly injected. When the desired size was reached, the flask was cooled down to 60 °C and 10 g of nonanoic acid was added. Methanol was used to clean the solution and the nanocrystals

were subsequently resuspended in toluene. Cleaning with methanol was repeated three times. Exchange of surfactant group from TOPO to water- soluble group was performed as follows.¹ First, 20 mg of 16-mercaptohexadecanoic acid (16-MHA) was dissolved in 15mL of methanol. The pH of the solution was adjusted to 10-11 using tetramethylammonium hydroxide and 20 mg of CdSe nanocrystals were added to this solution. The mixture was refluxed under nitrogen atmosphere for 6 hours. To clean the nanocrystals, a mixture of ethyl acetate and ether was used to precipitate the particles which could then be resuspended in methanol. Subsequent cleanings used only ethyl acetate to precipitate the particles. After the final cleaning, the 16-MHA-passivated CdSe were re-suspended in water. The particle size was determined by TEM to be ~ 5.5 nm in diameter

TEM Image of CdSe QDs

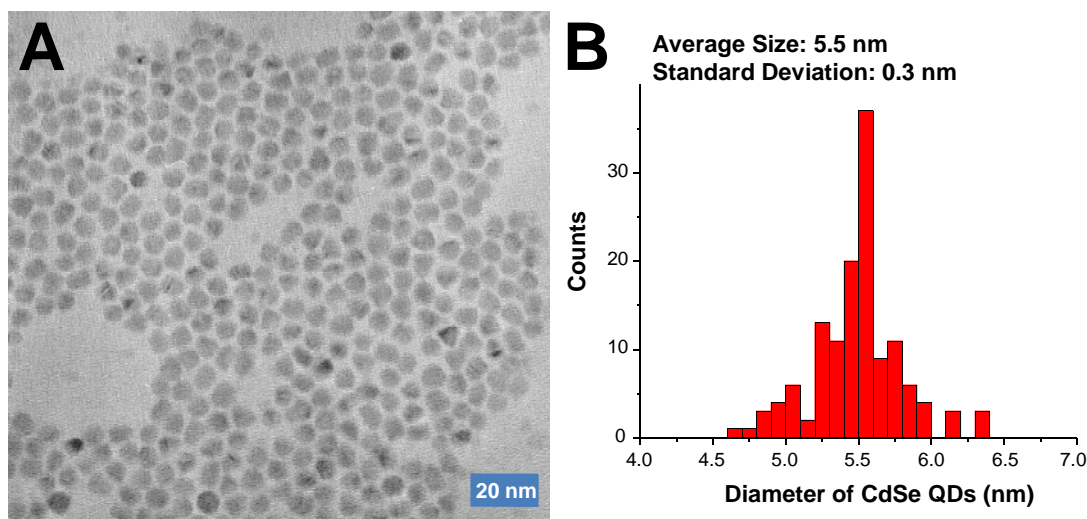


Figure S1. TEM images of (A) 5.5 nm and (B) size distribution of CdSe QDs.

Original Composition of DMEM D5671.²

Component	g/L
Inorganic Salts	
CaCl ₂ • 2H ₂ O	0.2
Fe(NO ₃) ₃ • 9H ₂ O	0.0001
MgSO ₄	0.09767
KCl	0.4
NaHCO ₃	3.7
NaCl	6.4
NaH ₂ PO ₄	0.109
Amino Acids	
L-Arginine • HCl	0.084
L-Cysteine • 2HCl	0.0626
Glycine	0.03
L-Histidine • HCl • H ₂ O	0.042
L-Isoleucine	0.105
L-Leucine	0.105
L-Lysine • HCl	0.146
L-Methionine	0.03
L-Phenylalanine	0.066
L-Serine	0.042
L-Threonine	0.095
L-Tryptophan	0.016
L-Tyrosine • 2Na • 2H ₂ O	0.10379
L-Valine	0.094
Vitamins	
Choline Chloride	0.004
Folic Acid	0.004
<i>myo</i> -Inositol	0.0072
Niacinamide	0.004
D-Pantothenic Acid • 1/2Ca	0.004
Pyridoxine • HCl	0.004
Riboflavin	0.0004
Thiamine • HCl	0.004
Other	
D-Glucose	4.5
Phenol Red • Na	0.0159
ADD	
L-Glutamine	0.584

XPS Results of CdSe OD Samples

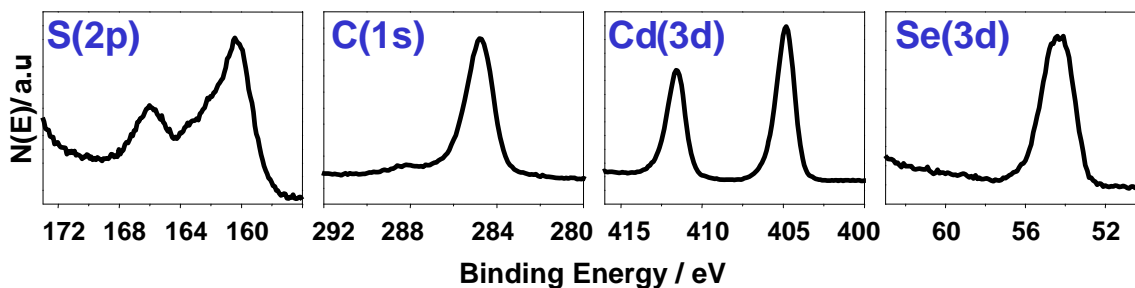


Figure S2. XPS spectra in the S(2p), C(1s), Cd(3d), and Se(3d) regions of CdSe QD film before UV illumination.

Ion Concentration	Element / Atomic Concentration (%)				
	Cd	Se	S	C	Cu
Original	10.70	6.23	16.51	66.56	-- ^b
Control ^a	9.80	6.01	14.99	69.20	-- ^b

Table S1. Summary of atomic concentration of Cd, Se, S, C, and Cu of CdSe QDs samples before and after UV illumination. ^aThe sample was reacted under pure water conditions. ^bThe peak intensity is negligible.

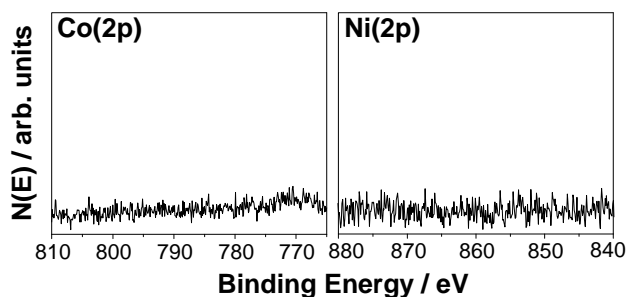


Figure S3. XPS spectra in the Co(2p) and Ni(2p) regions of CdSe QDs after treatment with 100 μM Co^{2+} and Ni^{2+} ions, respectively.

References

- (1) Aldana, J.; Wang, Y. A.; Peng, X. *J. Am. Chem. Soc.* **2001**, *123*, 8844-8850.
- (2) Sigma Aldrich Homepage. Product Information.
<http://www.sigmaaldrich.com/etc/medialib/docs/Sigma/Formulation/d5671for.Par.0001.File.tmp/d5671for.pdf> (accessed December 27, 2009).