

# Supporting Information

## Layer-by-Layer Assembly of Stable Aqueous Quantum Dots for Luminescent Planar Plate

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### **Synthesis of red and green hydrophobic CdSe/ZnS QDs.**

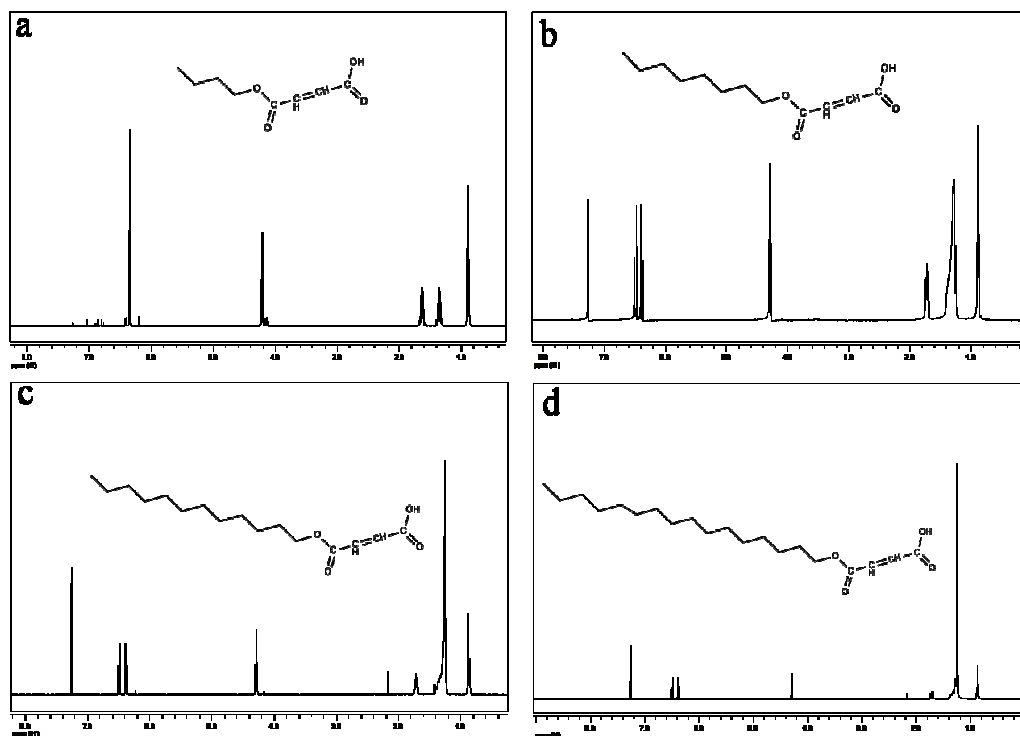
**Stock solution of Se:** Se (0.188 g, 2.4 mmol), OA (2g, 7.2 mmol), and 17.5 mL of ODE were loaded in a 50 mL three-neck flask and degassed, the mixture was heated to 100 °C then maintained for 20 min and subsequently heated to 220 °C then maintained for 3 h.

**Synthesis of CdSe QDs:** A mixture (4 g in total) of CdO (0.0154 g, 0.12 mmol), oleic acid (0.36 mmol), and ODE was loaded in a 25 mL three-neck flask and heated to 240 °C under nitrogen flow to obtain a clear colorless solution. When it was heated to 280 °C, 2 mL (0.24 mmol) Se stock solution was injected into the flask. Aliquots were taken at different time intervals, UV-vis and PL spectra were recorded for each aliquot. When the targeted size of nanocrystals was obtained, the reaction mixture was allowed to cool down to room temperature.

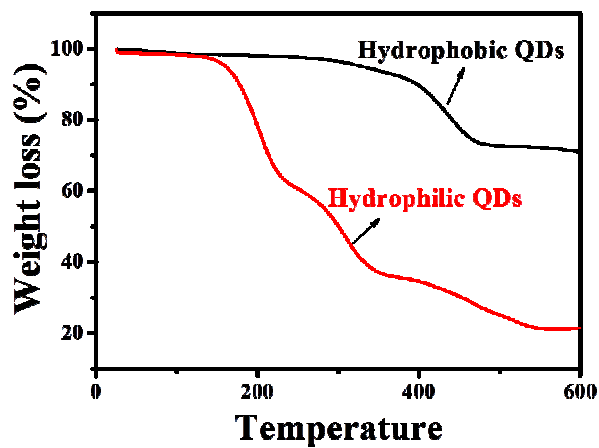
**Synthesis of CdSe/ZnS QDs:** 3 mL of ODE and 1.0 g of OA were loaded into a 25 mL reaction vessel. The CdSe QDs in hexanes ( $2.7 \times 10^{-7}$  mol) were added, and the system was maintained at 100 °C under N<sub>2</sub> flow for 30 min to remove hexanes and other undesired materials. The solution was heated to 160 °C under N<sub>2</sub> flow for the growth of ZnS shell. At 180, 200, 220, 240, and 250 °C, the Zn and S precursors (Zn precursor was prepared by dissolving ZnO in the mixture of OA and ODE at 310 °C while S precursor by dissolving sulfur in ODE at 150 °C) with calculated amounts were added, respectively. After the reaction was completed, the temperature was cooled down to room temperature.

### **Synthesis of blue hydrophobic Zn<sub>x</sub>Cd<sub>1-x</sub>S/ZnS QDs**

*A typical synthesis was performed as follows:* 0.4 mmol of CdO, 0.1 mmol of ZnO, 15 mL of paraffin oil and 1 mL of OA were placed in a 100 mL round flask. The mixture was heated to 150 °C degassed under 0.1 Torr pressure for 20 min, filled with N<sub>2</sub> gas, and further heated to 300 °C to form a clear mixture solution of Cd(OA)<sub>2</sub> and Zn(OA)<sub>2</sub>. At this temperature, 0.5 mmol of S powder dissolved in 2 mL of ODE was quickly injected into the reaction flask. Samples were extracted to monitor their PL spectra. The growth of shell started when the QY of core reached the highest value. For the shell growth reaction, the reaction solution was heated to 310 °C under nitrogen flow and magnetic stirring, and a desired amount of Zn(OA)<sub>2</sub> (10 mmol of ZnO mixed with 15 mL of oleic acid and 5 mL of paraffin was heated to 300 °C to form a clear mixture solution under N<sub>2</sub> flow.) and octanethiol (1.2 equivalent amounts refer to Zn(OA)<sub>2</sub>, diluted in 5 mL ODE) began to be injected dropwise into the reaction solution at a rate of 6 mL h<sup>-1</sup> using a syringe pump. After finishing precursor infusion, the solution was further annealed at 310 °C for 30 min. After the reaction was completed, the temperature was cooled down to room temperature and the QDs were purified using acetone or methanol.



**Figure S1.**  $^1\text{H}$  NMR spectra of monobutyl maleate (a), mono-octyl maleate (b), monododecyl maleate (c), and monohexadecyl maleate (d), respectively.



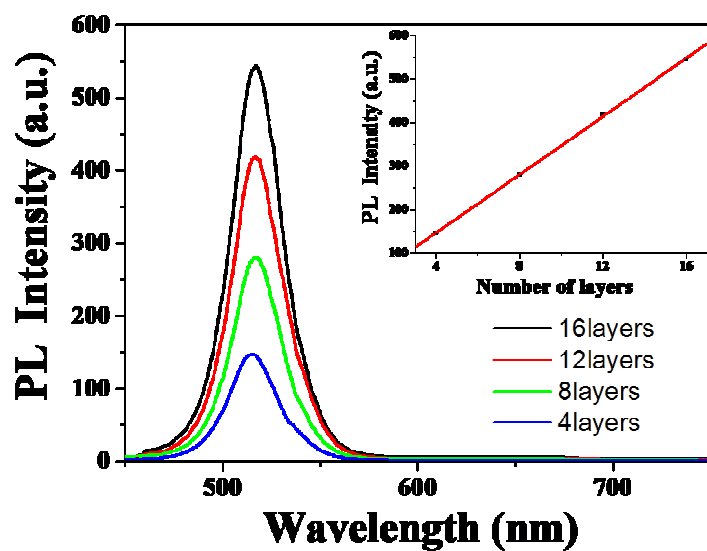
**Figure S2.** TGA data of hydrophobic QD and corresponding aqueous MA-C8-QDs.

As shown in Figure S2, the mass loss of physically adsorbed water in the hydrophobic and mono-octyl maleate modified QDs is 1.4%. In hydrophobic QDs

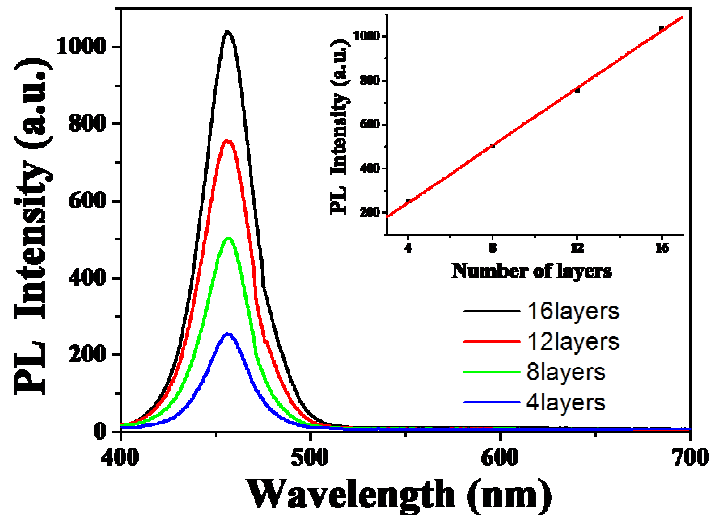
sample, the major weight loss of approximate 25% spans from 300 °C to 450 °C, we speculate that the weight loss is caused by decomposing surface organic ligands (oleic acid) of hydrophobic QDs. After phase transfer, different temperature stages of weight loss can be obviously seen. Great differences may be caused by incomplete decomposition of capping molecules and production of intermediate molecules. The major mass loss of 50% ranging from 150 °C to 300 °C can be attributed to the decomposition of mono-octyl maleate and intermediate molecules, while the major weight loss of approximate 25% spans from 300 °C to 500 °C is attributed to the decomposition of oleic acid. According to the data obtained from the TGA, the proportion of mono-octyl maleate in hydrophilic QDs is estimated as 50%.

**Table S1.** PL QY and full width at half maximum (FWHM) before and after surface modification with mono-octyl maleate.

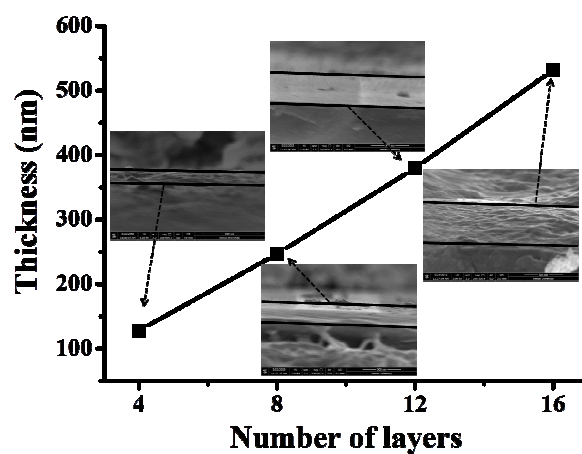
Samples	Hydrophobic QDs			Hydrophilic QDs		
	Red	Green	Blue	Red	Green	Blue
<b>PL QY</b>	<b>70%</b>	<b>58%</b>	<b>67%</b>	<b>66%</b>	<b>49%</b>	<b>55%</b>
<b>FWHM</b>	<b>43nm</b>	<b>43nm</b>	<b>32nm</b>	<b>42nm</b>	<b>56nm</b>	<b>33nm</b>



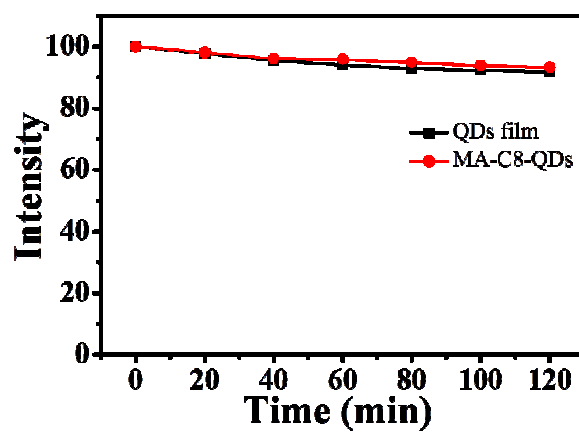
**Figure S3.** PL spectra of green PDDA/QDs (CdSe/ZnS-520nm) luminescent planar plate with different number of layers (inset: PL intensity of green PDDA/QDs (CdSe/ZnS-520nm) luminescent planar plate versus the number of layers).



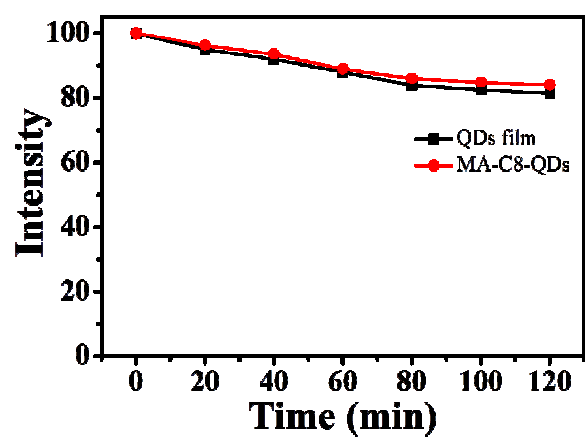
**Figure S4.** PL spectra of blue PDDA/QDs (Cd<sub>1-x</sub>Zn<sub>x</sub>Se-455nm) luminescent planar plate with different number of layers (inset: PL intensity of blue PDDA/QDs (Cd<sub>1-x</sub>Zn<sub>x</sub>Se-455nm) luminescent planar plate versus the number of layers).



**Figure S5.** Side-view SEM images of the red PDDA/QDs luminescent planar plate with different number of layers.



**Figure S6.** Photostability of the red PDDA/QDs film and MA-C8-QDs solution under UV irradiation for 120 min.



**Figure S7.** Thermostability of the red PDDA/QDs film and MA-C8-QDs solution at 60 degrees for 120 min.