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Electronic Supplementary Information

Direct Synthesis of Size-Tunable PbS Nanocubes and Octahedra and the pH Effect on Crystal Shape Control

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Experimental Section

Reagents

Lead acetate ($Pb(CH_3COO)_2$ or $Pb(Ac)_2$, 99%, Alfa Aesar), thioacetamide (TAA, 99%, Sigma–Aldrich), cetyltrimethylammonium bromide (CTAB, 98%, Alfa Aesar), and nitric acid (HNO_3, 65%, Fluka) were used without further purification. Ultrapure distilled and deionized water was used for all solution preparations.

One-pot synthesis of small PbS nanocrystals

To make PbS nanocubes, 0.01 M lead acetate solution, 0.1 M TAA solution, and 0.1 M HNO_3 solution were first prepared. Next, 0.01 g of CTAB and 0.3 mL of deionized water were added to a 25-mL vial. The solution was sonicated until dissolution of surfactant. Then 9 mL of the prepared TAA solution, 0.2 mL of lead acetate solution, and 0.5 mL of HNO_3 solution were added in the order listed. The total solution volume is 10 mL. After shaking the vial slightly, it was placed in an oven and heated at 90 ºC for 3 h. The product was cooled to room temperature using water bath, followed by centrifugation twice at 8500 rpm for 7 min. For the growth of PbS octahedra, a solution of 0.01 g of CTAB and 8.3 mL of deionized water was prepared first, followed by the sequential introduction of 1 mL of 0.1 M TAA solution, 0.2 mL of 0.1 M lead acetate solution, and 0.5 mL of 0.1 M HNO_3 solution. The other steps are the same as those performed for the synthesis of PbS nanocubes.

Characterization

SEM images were acquired using a JEOL JSM-7000F electron microscope. TEM characterization was performed on a JEOL JEM-2100 microscope with an operating voltage of 200 kV. XRD patterns were recorded on a Shimadzu XRD-6000 diffractometer with Cu Kα radiation. UV–vis absorption spectra were collected using a JASCO V-670 spectrophotometer.

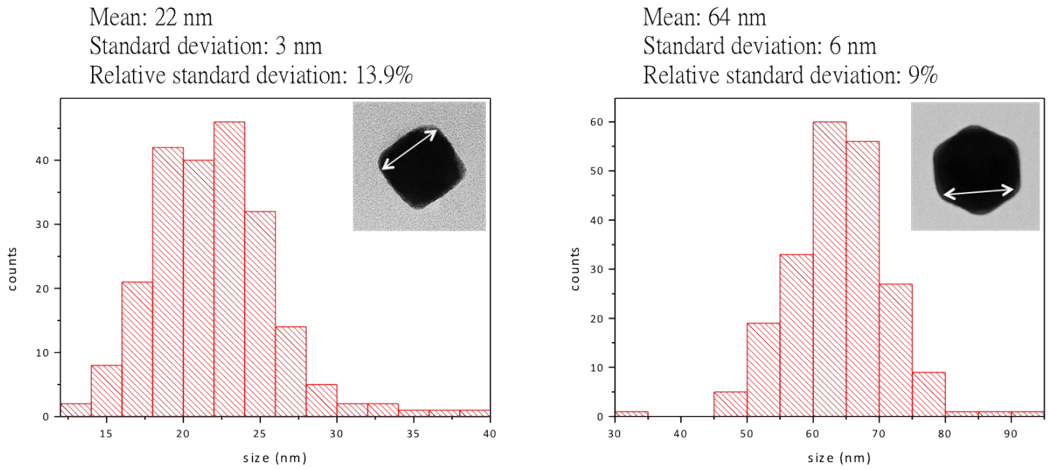


Fig. S1 Size distribution histograms of the synthesized PbS nanocubes and octahedra. The arrows indicate the measured particle sizes.

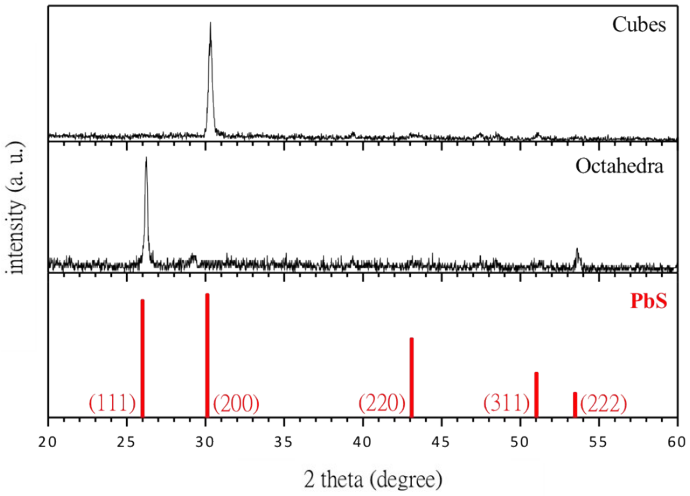


Fig. S2 XRD patterns of the synthesized PbS nanocubes and octahedra. A standard XRD pattern of PbS is provided.

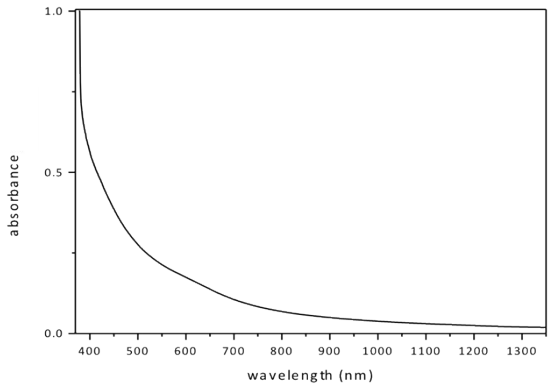
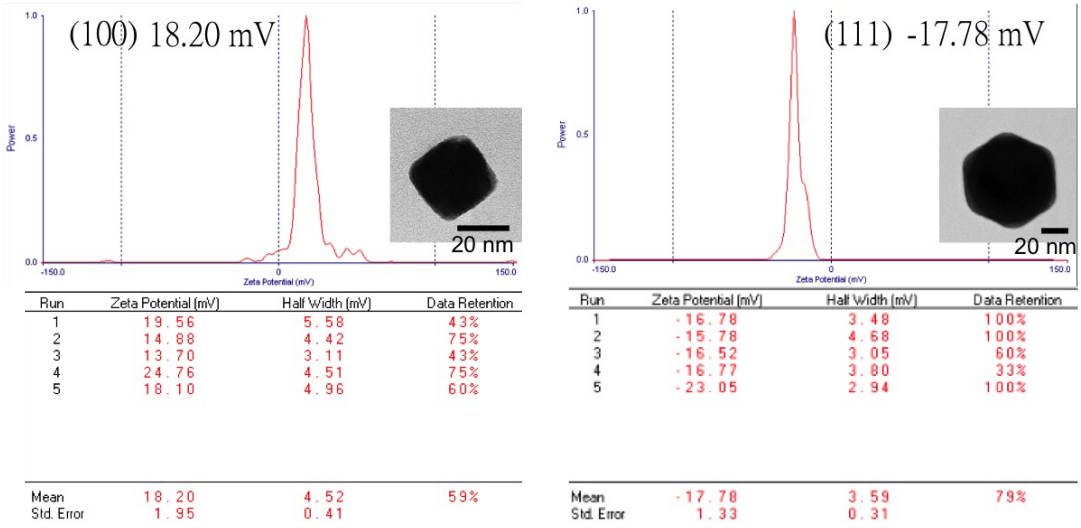


Fig. S3 UV–vis spectra of PbS nanocubes. The absorption covering the entire visible light range due to its small band gap gives a concentrated PbS solution a dark appearance.



Run	Zeta Potential (mV)	Half Width (mV)	Data Retention
1	19.56	5.58	43%
2	14.88	4.42	75%
3	13.70	3.11	43%
4	24.76	4.51	75%
5	18.10	4.96	60%
Mean	18.20	4.52	59%
Std. Error	1.95	0.41	

Run	Zeta Potential (mV)	Half Width (mV)	Data Retention
1	-16.78	3.48	100%
2	-15.78	4.68	100%
3	-16.52	3.05	60%
4	-16.77	3.80	33%
5	-23.05	2.94	100%
Mean	-17.78	3.59	79%
Std. Error	1.33	0.31	

Fig. S4 Zeta potential measurements of the synthesized PbS cubes (left) and octahdra (right).

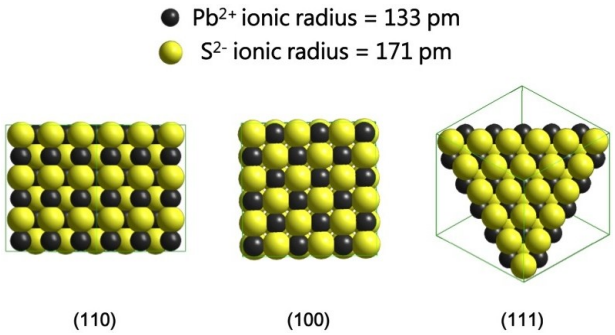


Fig. S5 Crystal plane models of PbS.

0.01 M $Pb(CH_3COO)_2$	0.1 M TAA	CTAB	0.1 M HNO_3	DI water
200 μL	1.0 mL	0.01 g	500 μL	8.3 mL

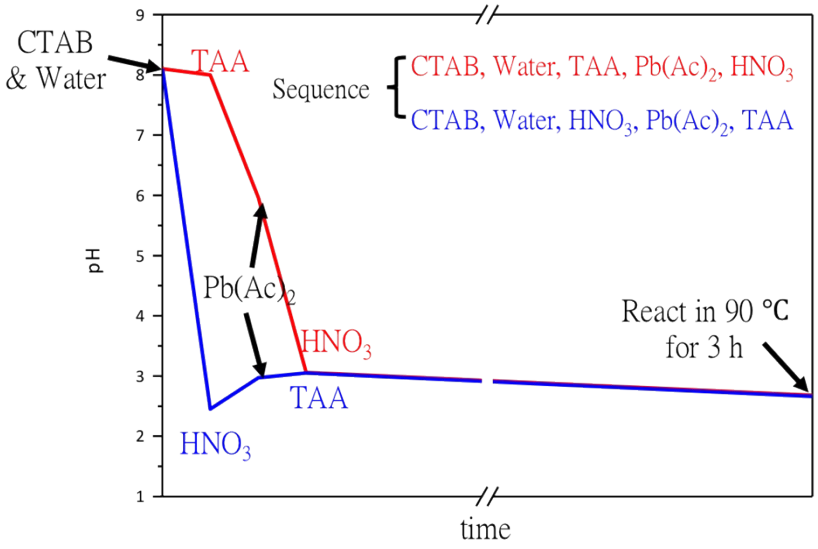


Fig. S6 Changes in the solution pH using different sequences of reagent addition.