SUPPORTING INFORMATION

ZnO-Templated Synthesis of Wurtzite-Type ZnS and ZnSe Nanoparticles

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Materials

$ZnCl_2$ (anhydrous 98%) was purchased from EM Science, tetramethylammonium hydroxide [TMAH, $(CH_3)_4N(OH)\cdot 5H_2O$, 97%] was purchased from Sigma Aldrich, and ethylene glycol (EG, 99.0%) was purchased from JT Baker. Thiourea (99%), ethylenediamine (en, 99%), and poly(vinyl pyrrolidone) (PVP, MW = 40,000) were purchased from Alfa Aesar. All chemical were used as received, without further purification.

Characterization

Powder X-ray diffraction (XRD) data were collected on a Bruker Advance D8 X-ray diffractometer using Cu Kα radiation. Transmission electron microscopy (TEM) images and selected area electron diffraction (SAED) patterns were collected using a JEOL JEM 1200 EXII microscope operating at 80 kV. Samples for TEM analysis were prepared by sonication of the nanoparticles in ethanol and drop coating onto the surface of a carbon coated copper grid. Photoluminescence emission spectra were collected using a Photon Technology Instrument (PTI) using a 814 photomultiplier detection system with quartz cuvettes.

Synthesis of ZnO nanorods

0.065 g of $ZnCl_2$ and 0.330 g of PVP were dissolved in 15 mL of ethanol via sonication. 0.390 g of NaOH was added to the solution and sonicated further. The solution was loaded into a 23 mL TEFLON lined autoclave and sealed and maintained at 80 °C for 24 hours. The autoclave was heated to 80 °C from room temperature and cooled back down at ~20 °C/hr. The white precipitate that was formed was collected through centrifugation and washed with ethanol.

Additional details

In one of the control experiments, substituting ethylenediamine (en) for TMAH results in the elimination of the ZnO intermediate. It is hypothesized that ZnO does not form when en is used because the Zn^{2+} is chelated by en, forming a stronger complex that prevents its precipitation as ZnO. If pre-formed ZnO nanoparticles are reacted with thiourea in the presence of en instead of TMAH, ZB-ZnS forms, because the en produces a basic solution that can dissolve the ZnO and form a Zn^{2+}-en complex.

Supplementary Figures

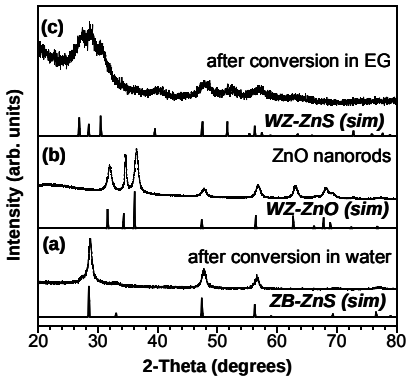

Figure S1. Experimental and simulated powder XRD patterns for (a) ZB-ZnS formed in water, (b) ZnO nanorods formed under solvothermal conditions, and (c) WZ-ZnS formed in EG.

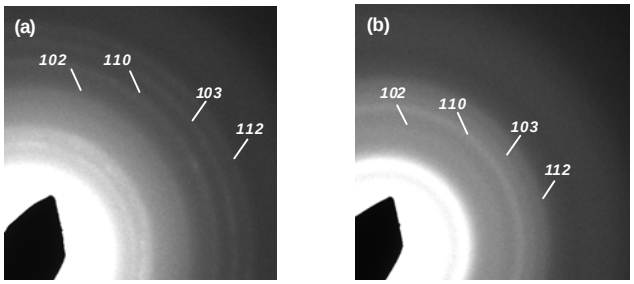

Figure S2. SAED patterns for (a) ZnO nanoparticles shown in Figure 2a and (b) WZ-ZnS nanoparticles shown in Figure 2b.