Supporting Information

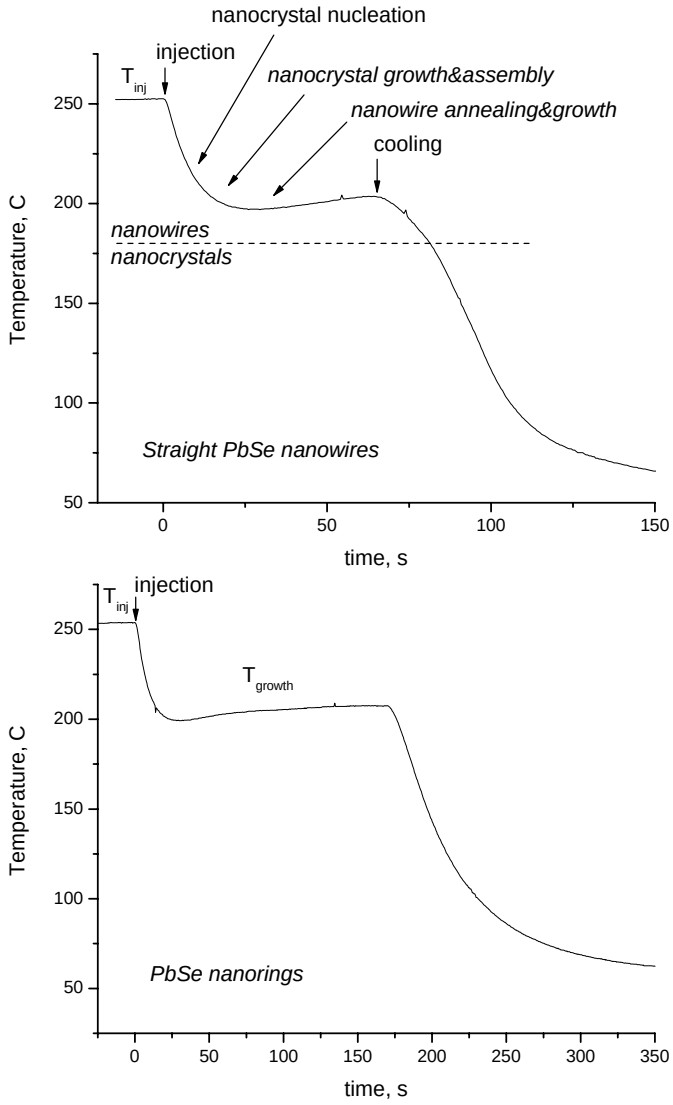

Figure S1. *Temperature profile of the reaction mixture during synthesis of (top) straight 6 nm diameter PbSe nanowires and (bottom) PbSe nanorings.*

Additional experimental details and comments to Table 1

Typical synthetic protocols:

1. For synthesis of quasi-spherical PbSe nanocrystals 2.16g lead acetate trihydrate were dissolved in 40 mL squalane in presence of 7.3 mL oleic acid. After drying under vacuum at 80°C for 1 hour the solution was heated to 180°C and 18 ml of 1 M solution of TOPSe in TOP were injected under vigorous stirring.
2. For synthesis of cubic PbSe nanocrystals 1.517g lead acetate trihydrate and 5 mL oleic acid were added to 20 mL phenyl ether and heated to 150°C for 30 min to form lead oleate. After cooling to 60°C, lead oleate solution was mixed with 12 mL 1M TOPSe in TOP. Approx. 70% of this solution were injected into 30 mL of phenyl ether heated to 110-120°C. After nucleation of PbSe nanocrystals, the rest of Pb:Se stock solution was slowly added to the reaction mixture.
3. Octahedral and star-shape PbSe nanocrystals were synthesized using the same amounts of precursors and oleic acid as in case of cubic nanocrystals. Four grams of hexadecylamine (HDA) were added to 30 ml of phenyl ether as a co-surfactant. The reaction was carried out at high temperature (see Table 1). The shape of nanocrystals was determined by adjusting temperature profile and duration of heating.
4. Synthesis of straight PbSe nanowires described in the Experimental Section. Undulated, zig-zag and star-shape branched PbSe nanowires were prepared using the same amounts of Pb:Se precursors and oleic acid. No co-surfactants were added to the reaction mixture in the case of undulated nanowires. 2-4g HDA was added to 15 mL phenyl ether to synthesize zig-zag and star-shape branched nanowires. The shape was controlled by adjusting temperature profile and by additional injections of lead and selenium precursors.
5. Tapered branched nanowires were synthesized using octyl ether as the reaction medium. The amounts of Pb:Se precursors, oleic acid and HDA were the same as in case of star-shape branched PbSe nanowires.

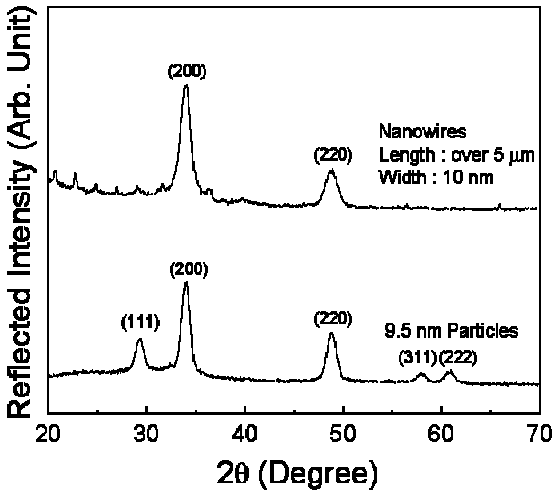

Figure S2. *Comparison of XRD patterns of 10 nm diameter PbSe nanowires and 9.5 nm size PbSe nanocrystals.*

Wide angle powder XRD measurements were performed on Buker D500 diffractometer operating in the Bragg configuration with Co Kα radiation (λ=1.79 Å). Scatter and diffraction slit of 1° and a 0.15-mm collection slit were used for collecting wide-angle X-ray diffraction data. Samples for wide angle XRD measurements were prepared by depositing ~20 mg of nanowires or nanoparticles dispersed in hexane over a 1 cm^2 silicon wafer and allowing the solvent to evaporate.

Figure S2 shows the XRD pattern of an ensemble of wires with the average diameter of 10 nm (standard deviation of 8 %) and the length from 5 to 20 μm. Only (200) and (220) reflexes are observed in the nanowire XRD-pattern while PbSe nanocrystals exhibit all reflections expected for bulk rock-salt structure. Due to the huge aspect ratio, the most of nanowires orient themselves parallel to substrate, what is indeed confirmed by TEM and HRSEM studies. The observed suppression of (111), (311) and (222) reflexes in the powder-XRD patterns of PbSe nanowires means that that only (100) and (110) lattice planes of PbSe nanowires are oriented parallel to substrate and give reflexes in the Bragg configuration. This is possible only if the long axis of PbSe nanowire is the <100> axis.

This is in agreement with the high resolution TEM images shown in Figure 1 and and selected area electron diffraction (SAED) from individual PbSe nanowires.

Table S1. *Volume Fraction of nanowires (nanowire/(nanowire + nanoparticle)) and average length of the nanowires produced at different injection temperature and Pb/Se precursor ratio.*

Injection temperature (°C)	Pb : Se = 1 : 3	Pb : Se = 1 : 1	Pb : Se = 3 : 1
250	~ 20 % (2~3 mm)	over 95 % (10 mm)	over 98 % (over 30 mm)
200	~ 5 % (2~3 mm)	~ 50 % (5~10 mm)	over 95 % (20 mm)
150	No Wires	~ 10 % (5 mm)	~ 50 % (5~10 mm)

* Growth temperature is 170 ^{o}C for all samples.

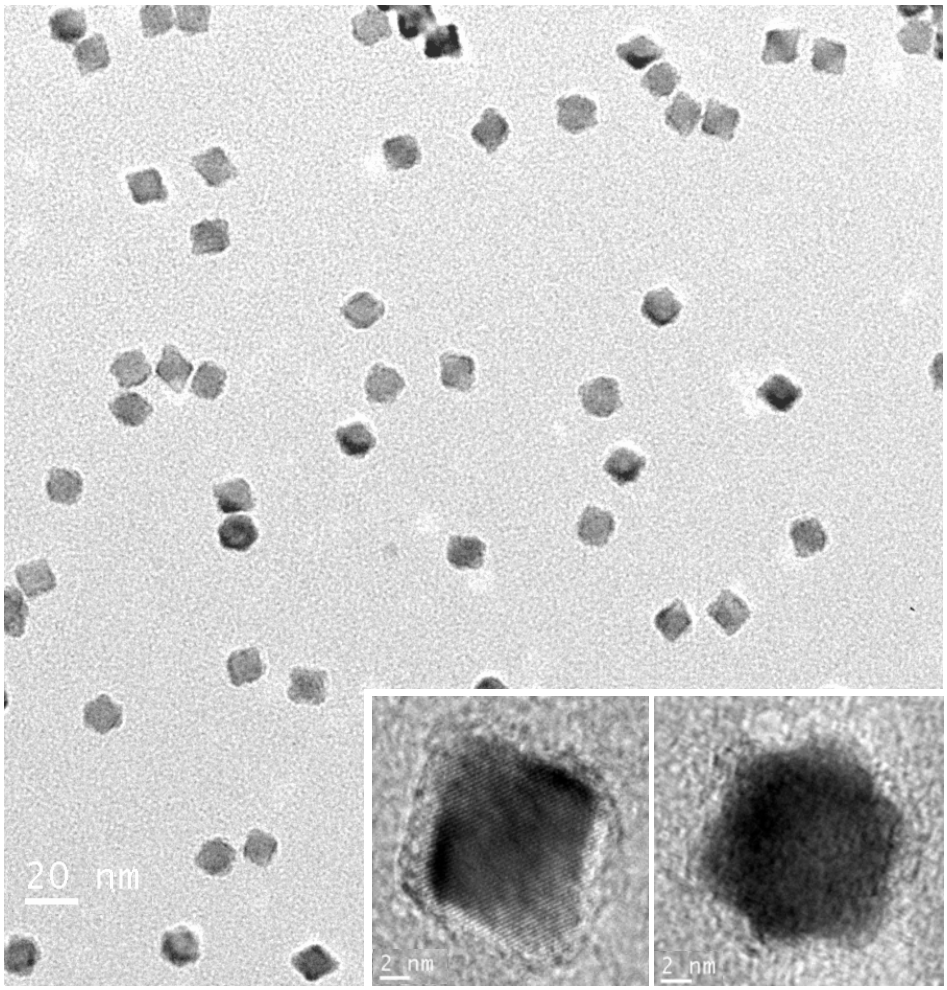

Figure S3. *Octahedral shape PbSe nanocrystals.*

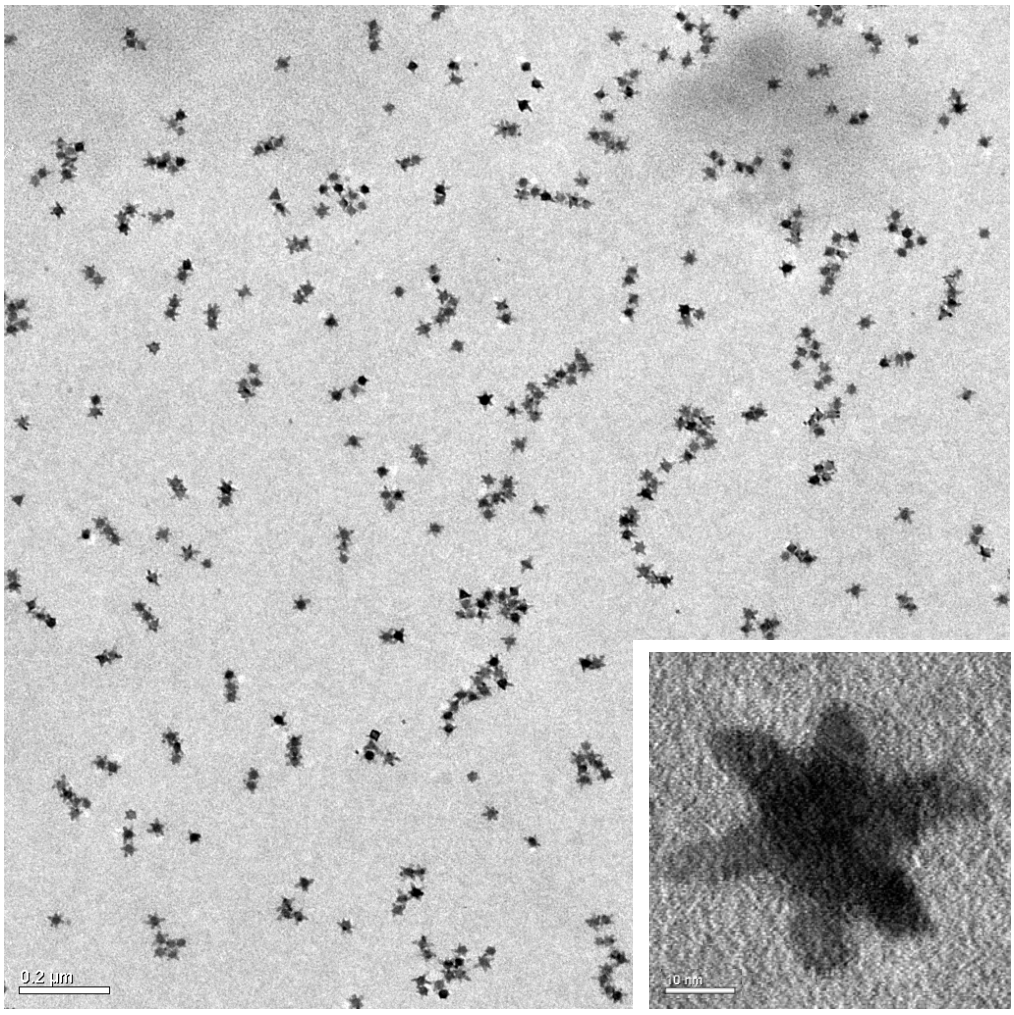

Figure S4. *Star-shape PbSe nanocrystals.*

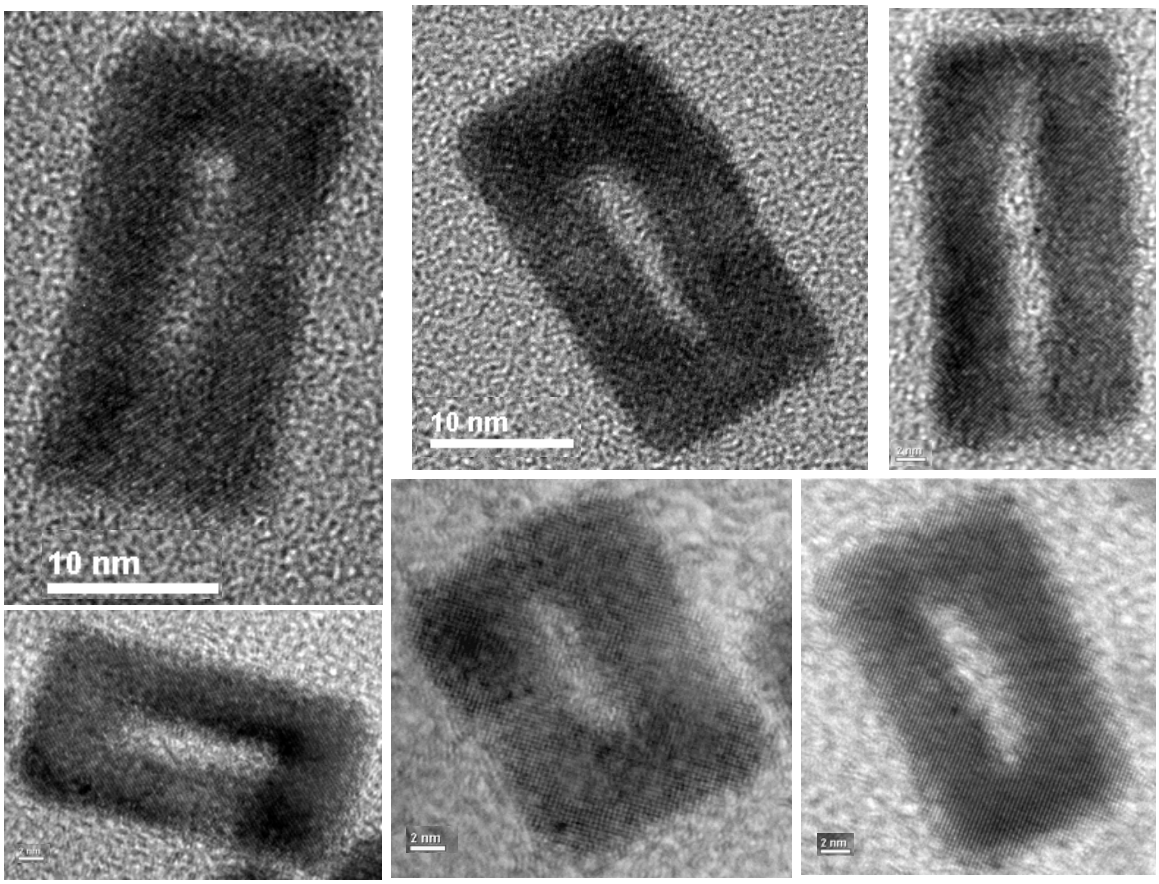

Figure S5. *High-resolution TEM images of PbSe nanorings.*