Supporting Information for

Interfacial Fabrication of Single-Crystalline ZnTe Nanorods with High Blue Fluorescence

Linrui Hou, Qiang Zhang, Luting Ling, Chen-Xiong Li, Li Chen, Su Chen*

State Key Laboratory of Materials-Oriented Chemical Engineering, and College of Chemistry and Chemical Engineering, Nanjing University of Technology, Nanjing 210009 (P. R. China)

Email: chensu@njut.edu.cn

Phone : +86-25-83172258

Supplementary Materials

Experimental

Materials: Zinc acrylate ($Zn(CH_2{=}CHCOO)_2$), undecylenic acid (UA), oleic acid (OA), stearic acid (SA), tellurium and sodium borohydride ($NaBH_4$) were of analytical grade and used as received. Toluene and deionized water were used as solvents.

Synthesis of fresh oxygen-free NaHTe:

In a typical procedure, 40 mg $NaBH_4$ (1.1 mmol) was transferred to a small flask, then 1 mL of ultrapure water was added. After 63.8 mg (0.5 mmol) of tellurium powder was added, the reaction flask was cooled by ice. During the reaction, a small outlet connected to the flask was kept open to discharge the pressure from the resulting hydrogen. After several hours, the black tellurium powder disappeared and white sodium tetraborate precipitate appeared on the bottom of the flask instead.

In situ synthesis of ZnTe nanocrystals: Typically, $Zn(AA)_2$ (0.207 g, 1 mmol) dispersed in toluene (50 mL) was added into deionized water (50 mL) under magnetic stirring, and such mixed solution was degassed with N_2 for 30 min. After that, the fresh oxygen-free NaHTe was injected dropwise into the above N_2-saturated solution under stirring. After injection, the mixture was under magnetic stirring for additional 2 h at room temperature. Finally, the mixture was heated at 90 ^{o}C for 4 h to obtain ZnTe nanocrystals.

Synthesis of ZnTe nanorods: For the preparation of OA-capped ZnTe, $Zn(AA)_2$ (0.207 g, 1 mmol) was dispersed in toluene (30 mL) in a round-bottomed flask under

magnetic stirring, and 2 mL OA (1.787 g, 6 mmol) dissolved in toluene (20 mL) was added under vigorously stirring for 1 h, and then the deionized water (50 mL) was added into the above mixed solution under magnetic stirring, and such mixed solution was degassed with N_2 for 30 min. After that, the fresh oxygen-free NaHTe was injected dropwise into the above N_2-saturated solution under stirring. After injection, the mixture was under magnetic stirring for additional 2 h at room temperature. Finally, the flask was immersed in a hot oil bath and the reaction temperature was increased to 90 ^{o}C from room temperature. The mixture was maintained at 90 ^{o}C for several hours to obtain OA-capped ZnTe nanorods. The synthetic procedure of UA-capped or SA-capped ZnTe was similar to that of OA-capped ZnTe, and the ligand of OA was replaced by 1.2 g UA or 1.8 g SA. Aliquots were taken at different time intervals, and UV-vis absorbance and PL spectra were recorded for each aliquot. The samples were precipitated with ethanol and further isolated by centrifugation. The purified NCs were dispersed in toluene for UV, PL, TEM, and XRD measurements.

Preparation of LEDs: The ultraviolet InGaN LED chips with the peak wavelength centered on 380 nm were used and attached on the bottom of the LED bases. The two threads on LED were prepared to connect to the power supply. Afterwards, the silicone was mixed with the CDs phosphor and put in a vacuum chamber to remove the bubbles. About 30 μL of the phosphor mixture was dispensed into the conventional cup-shaped void on the LED chip and thermally cured at 150 ^{o}C for 1 h. Finally, the optical lenses were placed on the bottom of the LED chip and the voids were filled with the silicone. The ultimate LEDs were then further cured at 150 ^{o}C for 1 h. All the optical

performances were carried out using ZWL-600 instrument with integral sphere.

Characterizations: Photoluminescence (PL) spectra were measured on a Varian Cary Eclipse spectrophotometer equipped with a Xe lamp at room temperature. The excitation wavelength was set at 380 nm. Transmission electron microscope (TEM) images were collected on a JEOL JEM-2100 electron microscope. High-resolution transmission electron microscopic (HRTEM) observation and electron diffraction pattern were performed with a JEOL JEM-2010 transmission electron microscope. The microstructures of the NCs were observed by scanning electron microscopy with a QUANTA 200 (Philips-FEI, Holland) instrument at 30.0 kV. Fourier transform infrared (FT-IR) were recorded on a Nicolet 6700 FT-IR spectrometer and the samples were ground with KBr crystals, and the mixture was pressed into a pellet for IR measurement with 32 scans from 4000 to 500 cm^{-1} at a resolution of 4 cm^{-1}.

PL QYs measurement: The PL QYs were evaluated according to a previous method (Lakowicz, J. R. Principles of Fluorescence Spectroscopy, 2nd Ed., 1999, Kluwer Academic/Plenum Publishers, New York). Quinine in 0.5 mol/L H_2SO_4 aqueous solution with the PL QYs of 54.6% was used as the PL reference. For comparison, ZnTe samples were diluted to the same concentration with quinine before measurement. Then the QYs of ZnTe nanorods were calculated by following equation:

$$\phi_x = \phi_s \times \left(\frac{A_s}{S_s}\right) \times \left(\frac{S_x}{A_x}\right) \times \left(\frac{N_x}{N_s}\right)^2$$

Where ø, A, S and N respectively represent the PL QYs, optical density at excitation wavelength, integrated PL intensity, and the refractive index of solution. The

subscripts s and x denoted the standard (quinine) and measured samples (ZnTe). The split values in PL measurements were kept the same in the course of testing ZnTe and quinine.

Results

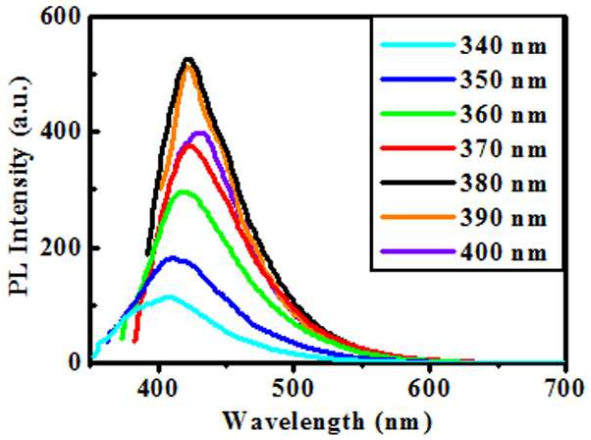

Figure S1. PL spectra of ZnTe-OA nanorods at different excitation wavelengths. The heating temperature and duration were 90 ^{o}C and 4 h, respectively.

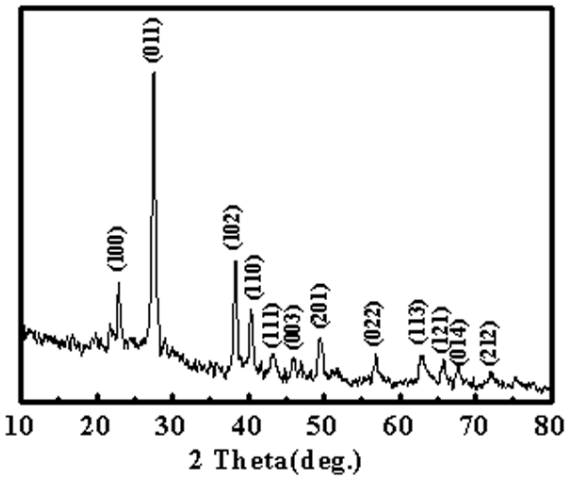

Figure S2. Typical XRD pattern of the product synthesized in the absence of the stabilizing ligands. The heating temperature and duration were 90 ^{o}C and 4 h, respectively.

The structure of the product (black precipitate) obtained was determined by XRD (Figure S2), in which the well-defined peak positions and intensities match closely with the calculated pattern of Te (JCPDS card no. 86-2268, space group P3121[152], a = b = 4.457 Å, c = 5.929 Å) rather than the ZnTe species.

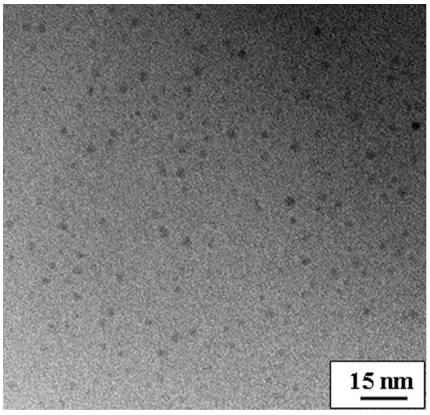

Figure S3. HRTEM images of the product synthesized in the absence of the stabilizing ligands. The heating temperature and duration were 90 ^{o}C and 4 h, respectively.

The microstructure of the sample in toluene after centrifugation was examined by HRTEM (Figure S3), and the product displays spherical structure with a diameter of about 4 nm.

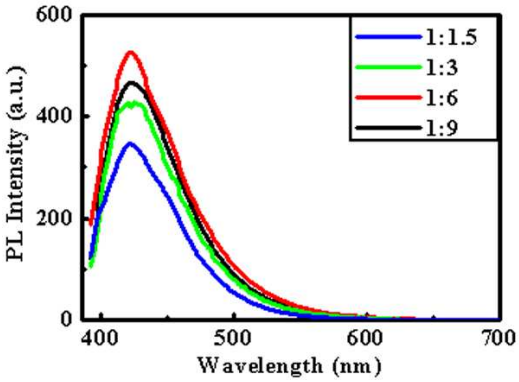

Figure S4. PL spectra of ZnTe-OA nanorods synthesized at different molar ratios of $Zn(AA)_2$ to OA. The heating temperature and duration were 90 ^{o}C and 4 h, respectively.

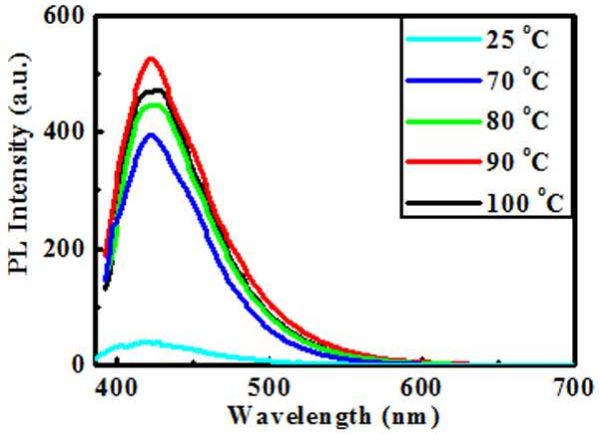

Figure S5. Effects of the heating temperature on PL properties of ZnTe-OA nanorods. The heating duration was 4 h.

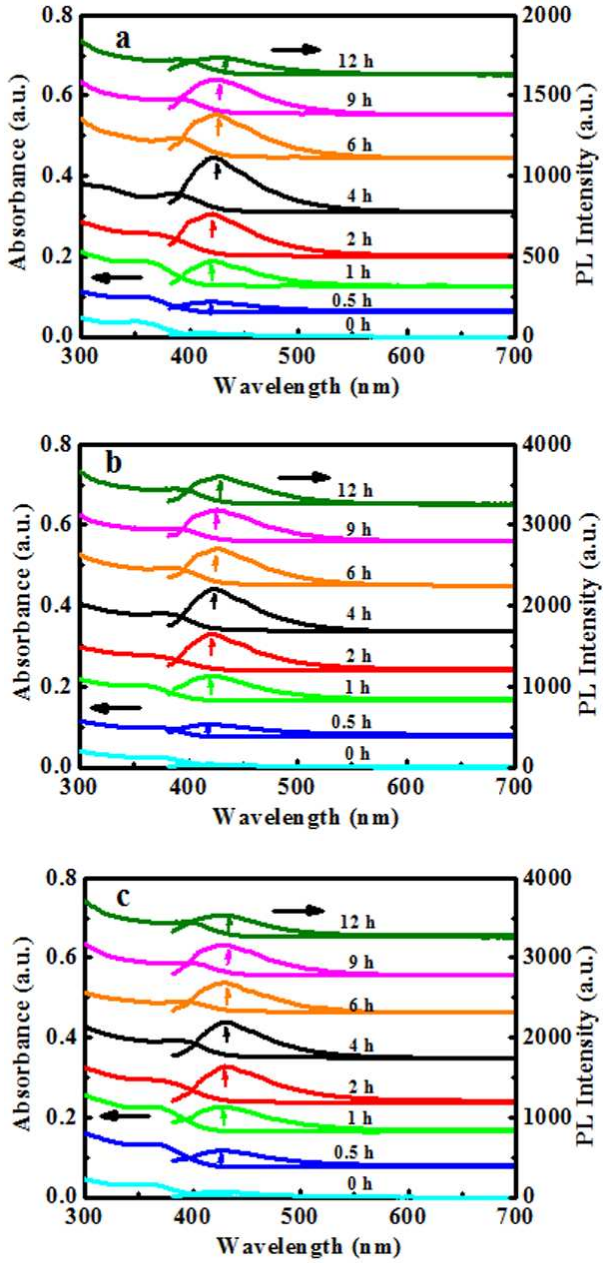

Figure S6. Temporal evolution of UV-Vis absorption and PL spectra of (a) ZnTe-UA, (b) ZnTe-OA and (c) ZnTe-SA nanorods. The heating temperature was 90 ^{o}C.

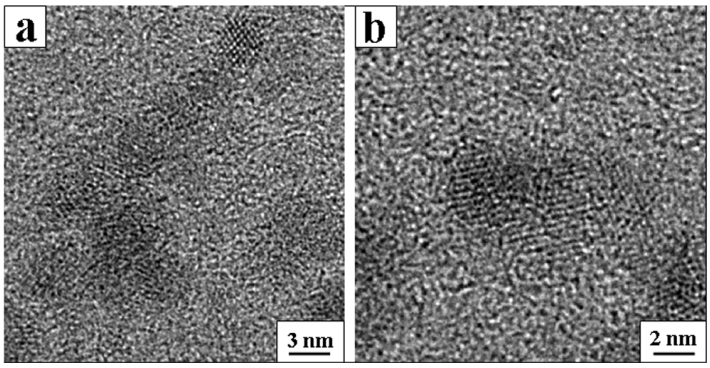

Figure S7. HRTEM images of the intermediates showing the oriented attachment of ZnTe-OA NCs. The heating temperature and duration were 90 ^{o}C and 2 h, respectively.