Supporting Information

Environmentally benign synthesis of band gap-tunable Te/Se alloyed nanowires with high-quality homogenous

Chongjian Zhou[1], Ke Wang[1], Chaochao Dun[3], Qiong Wang[1], Zhongqi Shi[1,1], Guiwu Liu[2,*] and Guanjun Qiao[1,2]

[1] State Key Laboratory for Mechanical Behavior of Materials, Xi'an Jiaotong University, Xi'an 710049, China

[2] School of Materials Science and Engineering, Jiangsu University, Zhenjiang 212013, China

[3] Center for Nanotechnology and Molecular Materials, Department of Physics, Wake Forest University, Winston-Salem NC 27109, USA

■ Experimental Sections

The synthesis of *t*-Te/Se nanowires was accomplished as follows: Te nanowires with the average diameter around 6 nm was synthesized first: 3 mmol tellurium dioxide (TeO_2), 0.75 g polyvinylpyrrolidone (PVP, M_w~40000), and 10 mmol KOH are dissolved in 30 mmol ethylene glycol (EG) with vigorous stirring that result in a cloudy white solution. A transparent yellow solution was obtained after heating to 120 °C. Then 6 ml 1.89 M aqueous solution of ascorbic acid was rapidly injected and the solution turned opaque black within 1 min. The reaction proceeded 3 h under N_2 protection to let the Te precursor converted to ultrathin Te nanowires. To prepare Se precursor, 3 mmol Selenic acid (H_2SeO_3) and 0.1 g PVP dissolved in 10 ml EG was heated to ~80 °C in a separate vial. Meanwhile, the Te solution was cooled down to 90 °C. The Se solution was injected to the Te reaction solution, and then 2.5 ml 18 M

* Correponding authors at: State Key Laboratory for Mechanical Behavior of Materials, Xi'an Jiaotong University, Xi'an 710049 , China (Z. Shi)
E-mail addresses: zhongqishi@mail.xjtu.edu.cn (Z. Shi), gwliu76@ujs.edu.cn (G. Liu)

hydrochloric acid (HCl) dissolved in 2.5ml EG was injected to the solution. Finally, the solution temperature was raised to 110°C for another hour, after which the reaction solution was cooled down to room temperature naturally. The Te/Se alloyed nanowires with tunable compositions can be synthesis with yields higher than 90%.

To synthesis the Te/Se alloy nanowires with Se percentage exceed 60%, only 2.0 ml HCl dissolved in 3ml EG needs to be injected into the solution after Se precursor injection. To synthesis Te/Se nanowires with different aspect ratio, Te nanowires with different length were used. Here, it is very simple to get Te nanowires with different length by adjusting the amount of PVP using in Te nanowires synthesis step. For example, 0.3 g PVP corresponded to synthesis of Te nanowires with the length of 400 nm.

■ Characterizations

The size and morphology of the products were investigated using transmission electron microscopy and high resolution transmission electron microscopy (TEM and HRTEM, JEOL JEM 2100F). The phase purity and crystallization structure were analyzed by X-ray powder diffraction (XRD, Shimadzu XRD7000, Cu-Kα: λ¼=0.154 nm). The chemical compositions were measured by energy dispersive spectroscopy (EDS). The Raman spectra were performed in a Horiba JOBIN YVON machine under 514 nm laser. The UV-vis was taken out in UV-1800PC (MAPADA Company) with wavelength from 280 to 1000 nm.

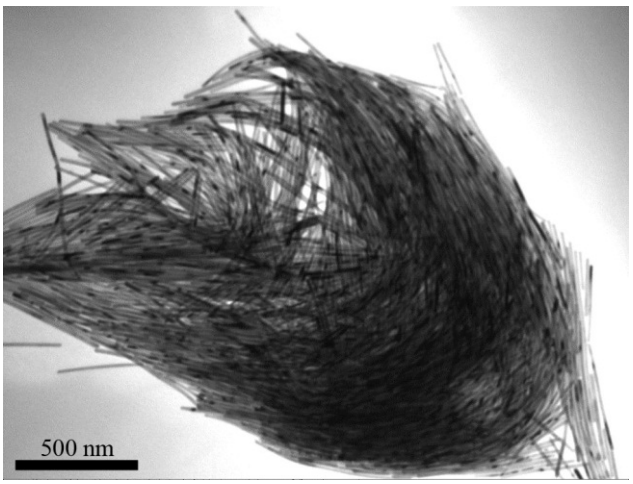

Figure S1.Te/Se nanowire synthesized by using a shorter Te nanowire (~400nm) as sacrifice template. The length of the synthesized Te/Se nanowire reaches ~650nm. Interestingly, the shorter alloyed nanowire has a larger self-assemble tendency.

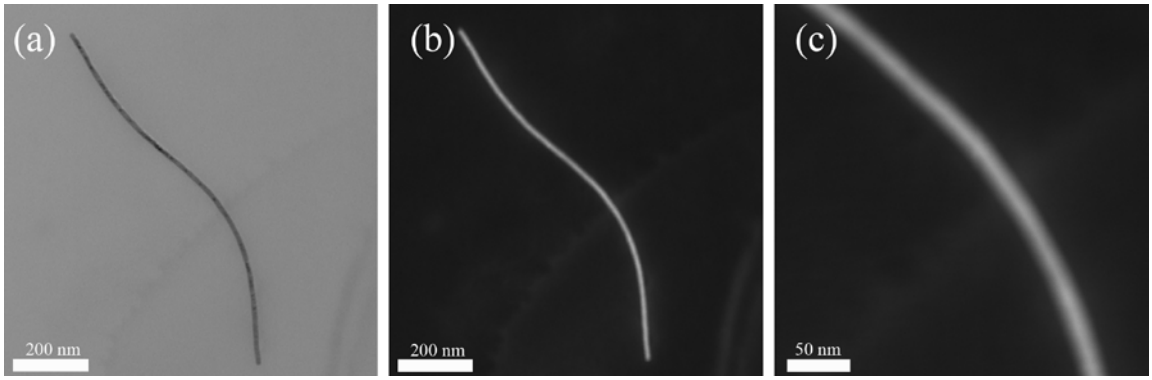

Figure S2. Bright field image of a single $Te_{0.5}Se_{0.5}$ nanowire (a) and its corresponding HAADF image with low magnification (b) and high magnification (c).

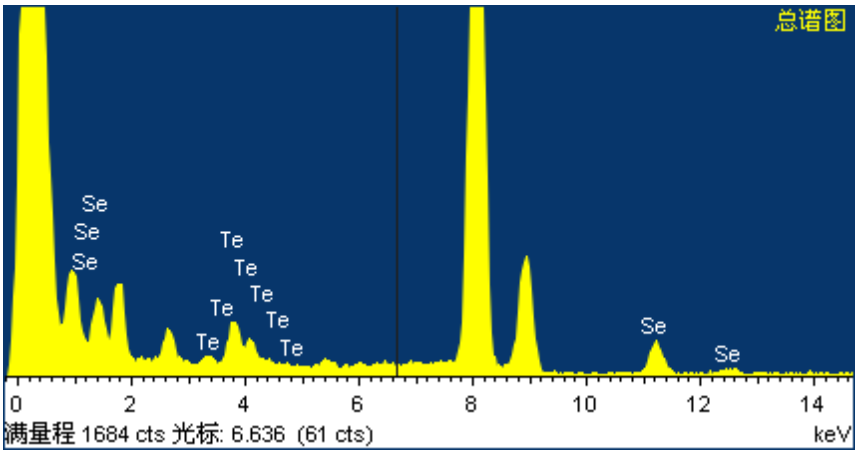

Figure S3. EDS result of $Te_{0.5}Se_{0.5}$ nanowires, which reveals a ratio Te:Se =1:0.9

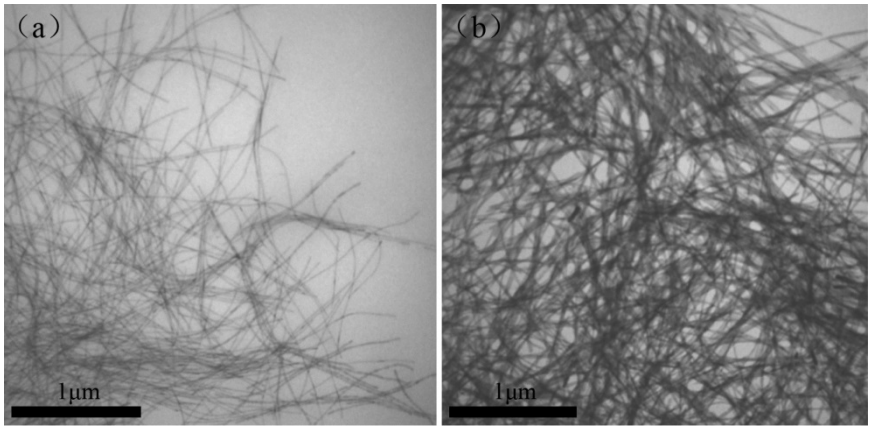

Figure S4. TEM images of Te/Se alloyed nanowires with Te:Se = 2:1 (a) and Te:Se = 1:2 (b) respectively.

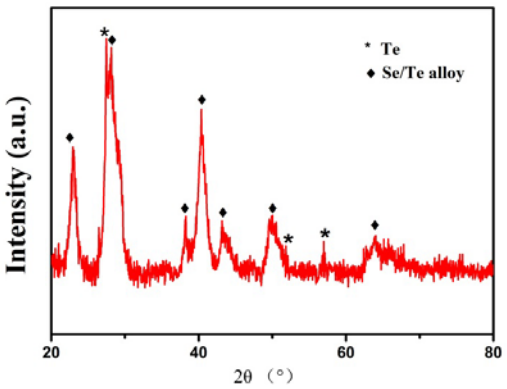

Figure S5. The XRD pattern of Te_xSe_y-Te core-shell nanowire synthesized at 100 °C.

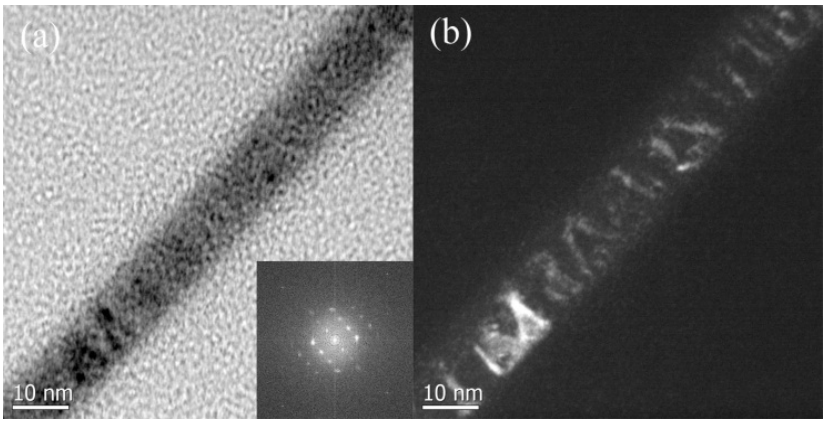

Figure S6. TEM bright field (a) and dark field (b) of a single $Te_{0.5}Se_{0.5}$ nanowire, with the inset showing the corresponding FFT pattern.