Supporting Information

General Solvothermal Approach to Synthesize Telluride Nanotubes for Thermoelectric Applications

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Conversion to Ag_2Te or CuTe nanotubes

The conversion to Ag_2Te or CuTe nanotubes follows a different procedure as Ag or Cu atoms are easily united to nanoparticles, which hardly alloy with Te nanotube. Thus, the fabrication for Ag_2Te and CuTe nanotube is modified. After the synthesis of tellurium nanotube, the solution is cooled down to room temperature naturally and, following centrifuged and washed with double-distilled water and absolute ethanol several times. Following, the produce is dissolved in 40 ml EG in a beaker and stirred at room temperature. Meanwhile, the silve precursor, 0.509 (3 mmol) $AgNO_3$ is dissolved in 5 ml EG individually and, stirred slightly by glass rod for 5 mins. Then, the $AgNO_3$ solution is added to the Te nanotube slowly by dropper and, the mixed

solution is reacted for 0.5 h. The products are washed several times with double-distilled water and absolute ethanol and, dried in a vacuum oven at room temperature. The conversion to CuTe is similar with that of Ag_2Te, except that $AgNO_3$ is replaced by 0.3488g (1.5 mmol) $Cu(NO_3)_2 \cdot 5H_2O$, and 5 ml of 1.89 M ascorbic acid in water is added to promote the formation of Cu atoms.

Synthesis method of Bi_2Te_3 nanowires

A two-step approach was adopted to synthesize Bi_2Te_3 nanowires. Firstly, 0.2394 g (1.5 mmol) of TeO_2, 0.75 g PVP and 0.56 g (10 mmol) KOH were dissolved in 15 ml EG in a 100 ml three-necked bottle, and after vigorous stirring at room temperature for 10 min, the mixed solution was heated up to 150 ºC. Then 1 ml of $N_2H_4 \cdot H_2O$ was rapidly injected into the solution and, the solution turned black instantly. The reaction was done for 3h in flowing N_2 to avoid oxidation, and Te nanowires were prepared. The process is similar to that adopted to synthesize Te nanotubes, but higher reaction temperature and higher concentration of reductant were adopted to suppress the outwards diffusion of Te atoms. Secondly, 0.485 g (2 mmol) $Bi(NO_3)_3 \cdot 5H_2O$ were dissolved in 5 ml EG at room temperature. The solution of Bi precursor was injected into the reaction solution of Te nanowires which are used as the templates, and the temperature of the mixed reaction solution was cooled down to 120 ℃, maintained for 3 hours. By this way, Bi_2Te_3 nanowires are prepared.

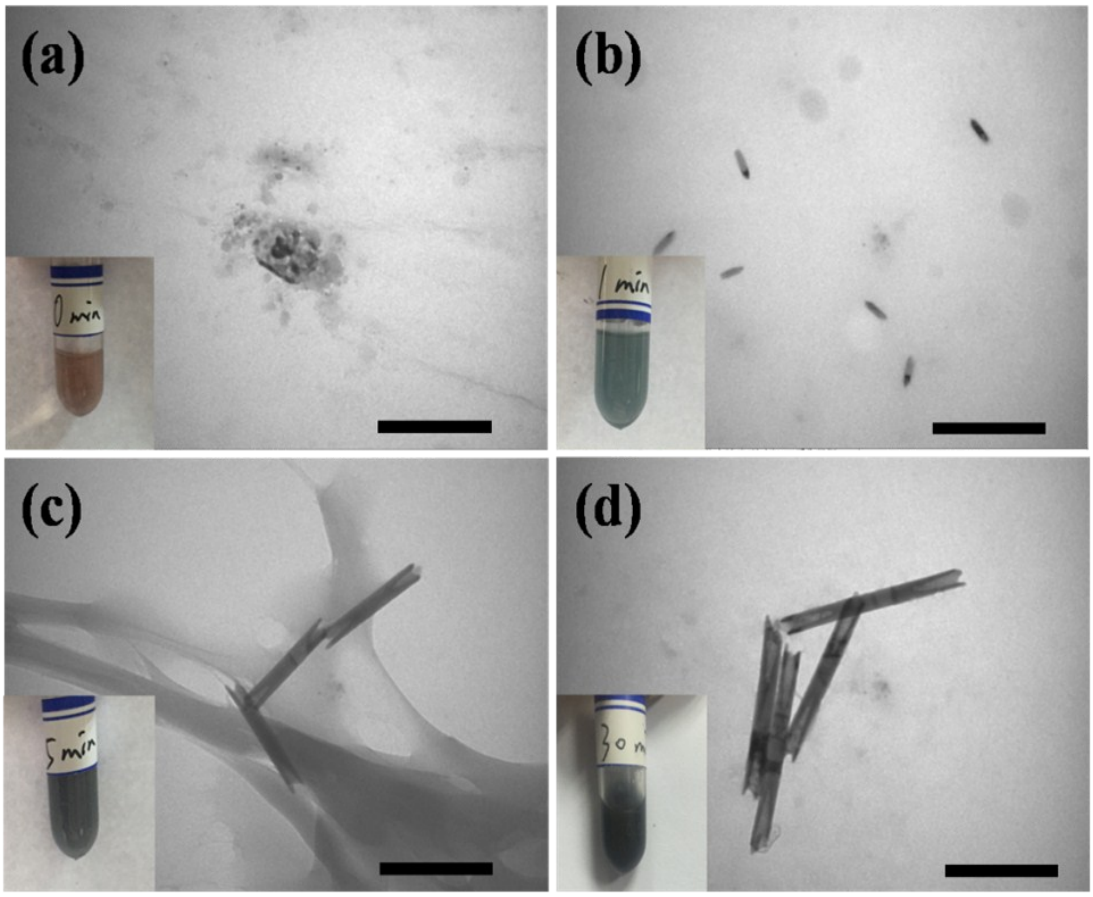

Figure S1 TEM images of aliquots taken at various times during the Te nanotube synthesis step: (a) 0 min; (b) 1min; (c) 5 min; (d) 30 min. Scale bars represent 200 nm. Insets show the changing in color at different recation time

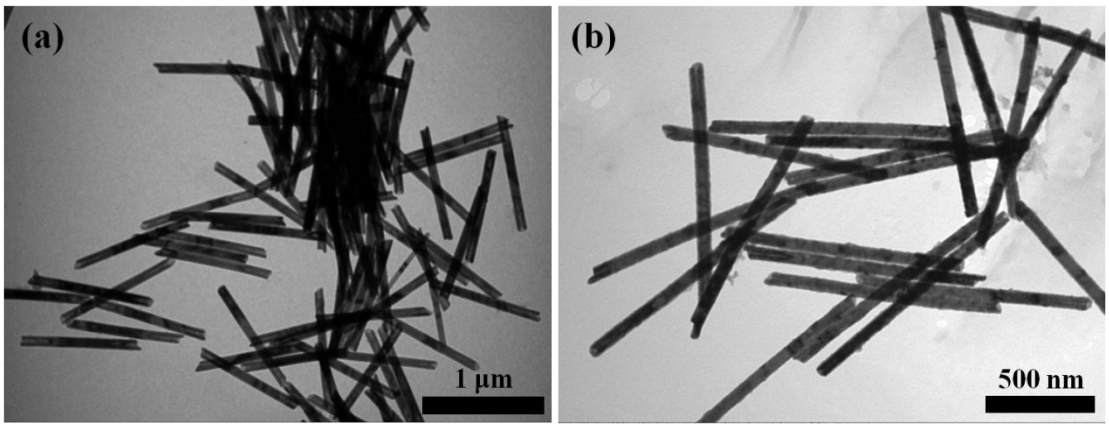

Figure S2 Low-magnification TEM image of (a) Te nanotubes and (b) Bi_2Te_3 nanotubes, respectively.

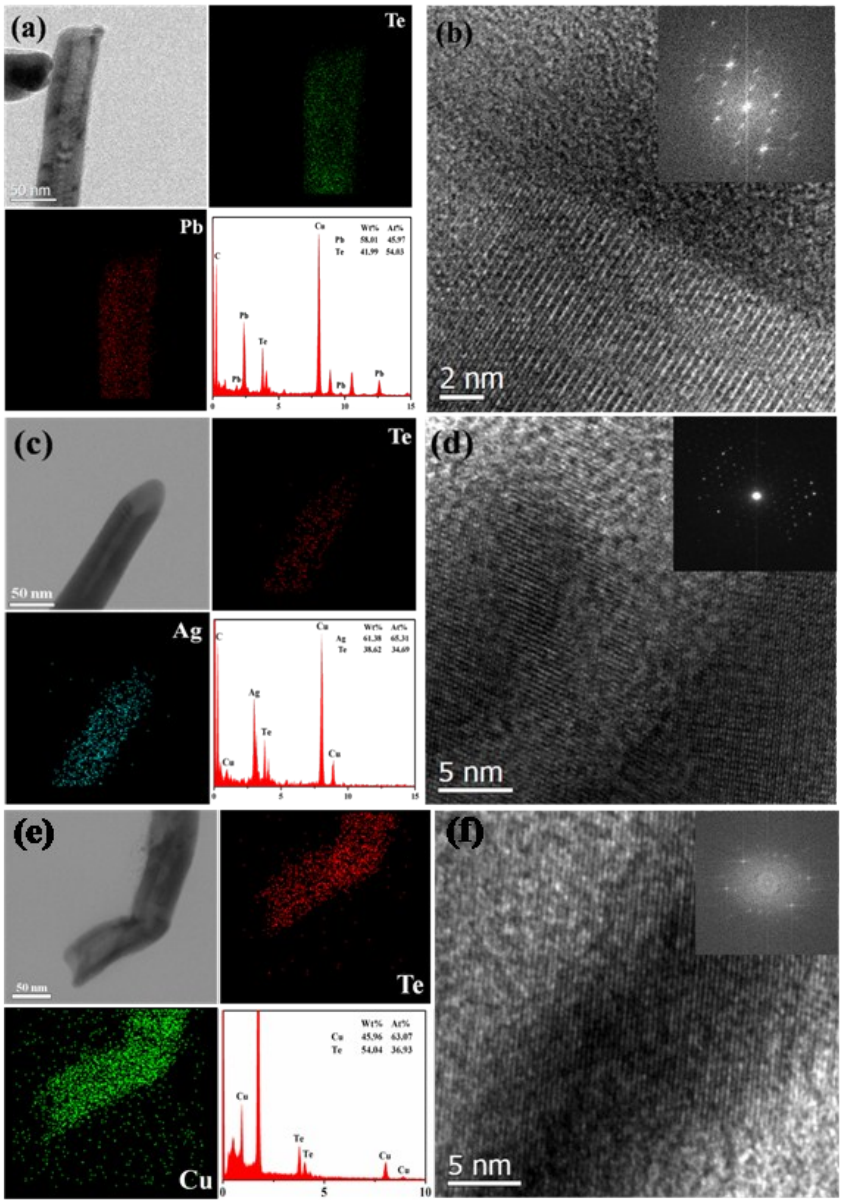

Figure S3 Low-magnification TEM analysis of nanotube materials, EDS profile with EDS mappings and HRTEM image with SAED pattern inset. (a-b) PbTe; (c-d) Ag_2Te; (e-f) Cu_2Te

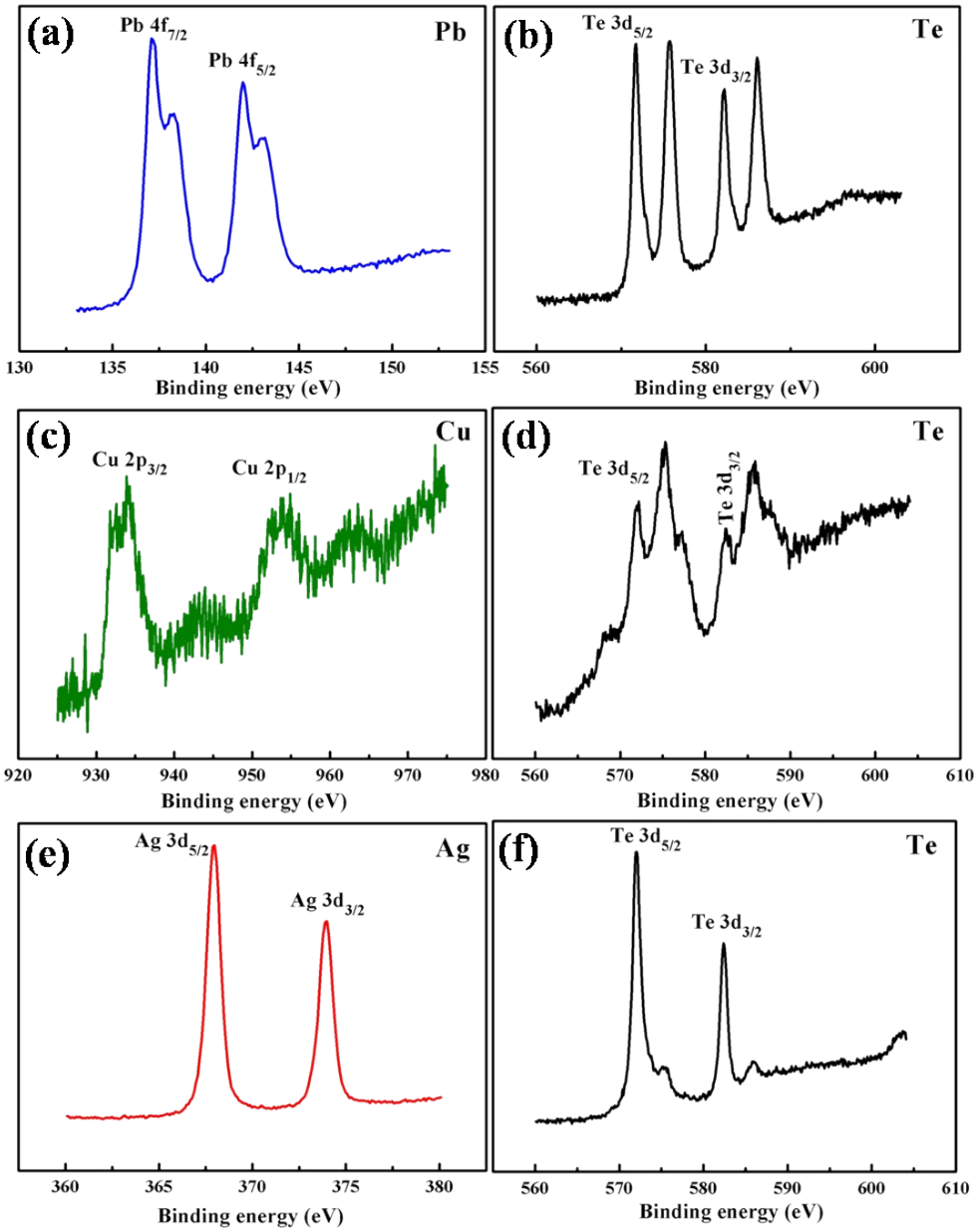

Figure S4 XPS spectra of as-prepared nanotube materials (a-b) PbTe; (c-d) CuTe; (e-f) Ag_2Te

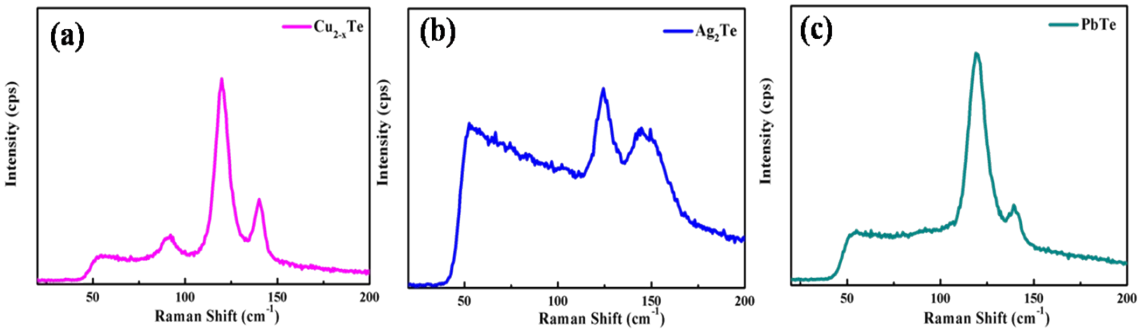

Figure S5 Raman spectra of as-prepared nanotube materials (a) Cu_xTe; (b) Ag_2Te; (c) PbTe.

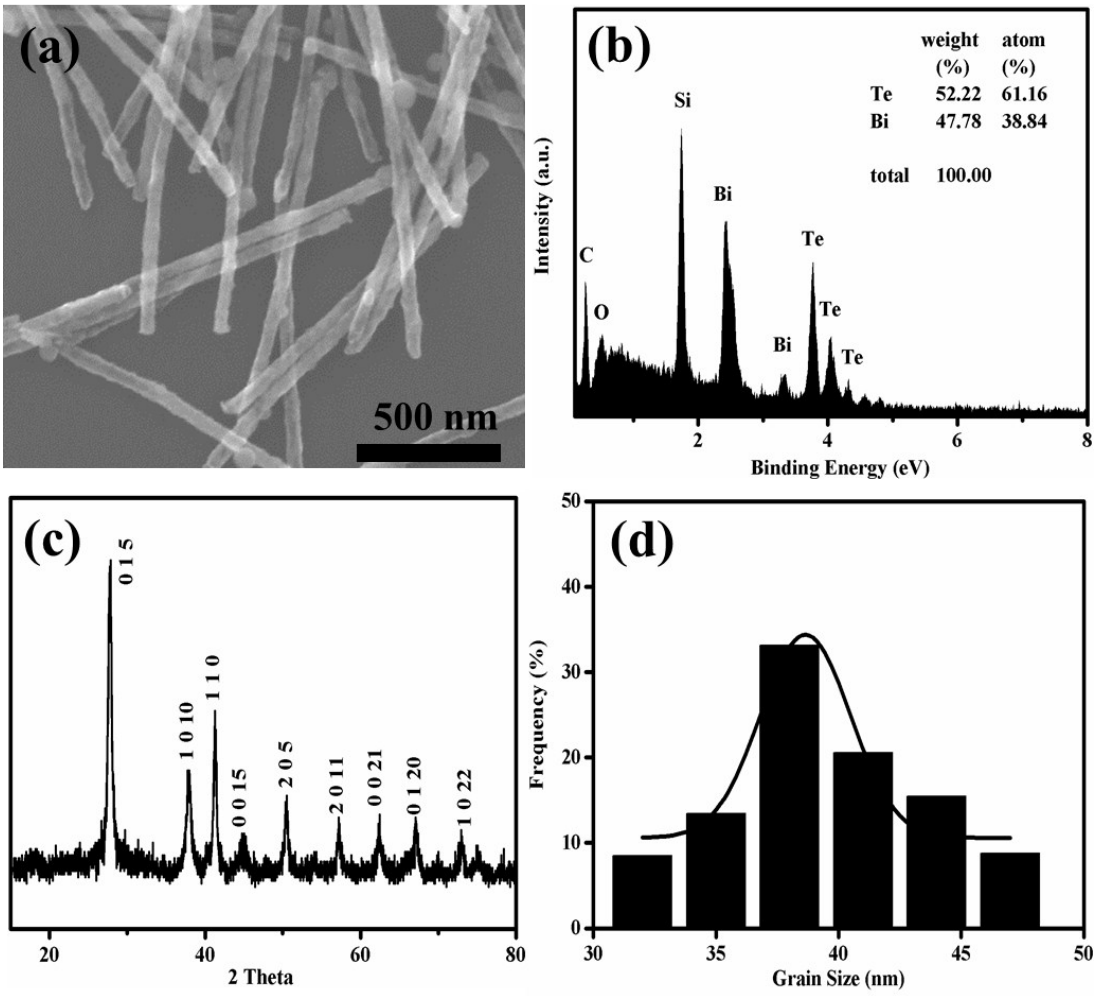

Figure S6 The SEM image (a), EDS spectrum (b), XRD pattern (c) and distribution of the diameter (d) of as-synthesized Bi_2Te_3 nanowires.