Electronic Supplementary Information

Enhancing Thermoelectric Performance of Bi_2Te_3-based Nanostructures through Rational Structure Design

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Fig. S1 is the XRD pattern of as-syntehsized nanopowders. As can be seen, all peaks can be assigned to the trigonal structured Te (JCPDS No. 36-1452), suggesting no detectable impurities in the product. Fig. S2 low-magnification SEM image of Te nanopowders, from which randomly aligned one-dimensional nanotubes with smooth surface can be seen, and their length ranges from ~ 2 to 6 μm. The inset of Fig. S2 exhibits the cross-sectional view, demonstrating the hollow hexagonal prism structure of the nanotubes, with a diameter of ~200 nm and a wall thickness of ~30 nm.

Fig. S3a is the TEM image of a typical nanotube, and Fig. S3b is the energy dispersive spectroscopy profile confirming the nanotube is Te (Note that the Cu peak is due to the Cu TEM grid). The Te nanotube shows a dark solid area in the middle of this tubular structure, which stems from the initially formed Te seeds during the growth of Te nanotubes.[1] To understand the crystal structure and the growth direction of the nanotube, we employed the high resolution TEM (HRTEM). Fig. S3c and d are the HRTEM image and the corresponding selected area electron diffraction (SAED) pattern, which reveals the high quality single-crystalline feature of as-synthesized nanotubes. In addition, the zone axis is determined to be $[\bar{1}2\bar{1}0]$, and lattice spacings of ~0.39 and 0.59 nm respectively corresponding to $(10\bar{1}0)$ and (0001) planes for trigonal Te are identified. To exclusively determine the growth direction, we took another set of $[1\bar{1}00]$ zone-axis HRTEM and SAED, as shown in Fig. S3e and f. To obtain these images, we tilted the nanotube along the axis direction with ~30°. Considering both HRTEM and SAED, (0001) and $(11\bar{2}0)$ planes can be identified. On this basis, we can conclude that the growth direction of as-synthesized Te nanotubes is along [0001].

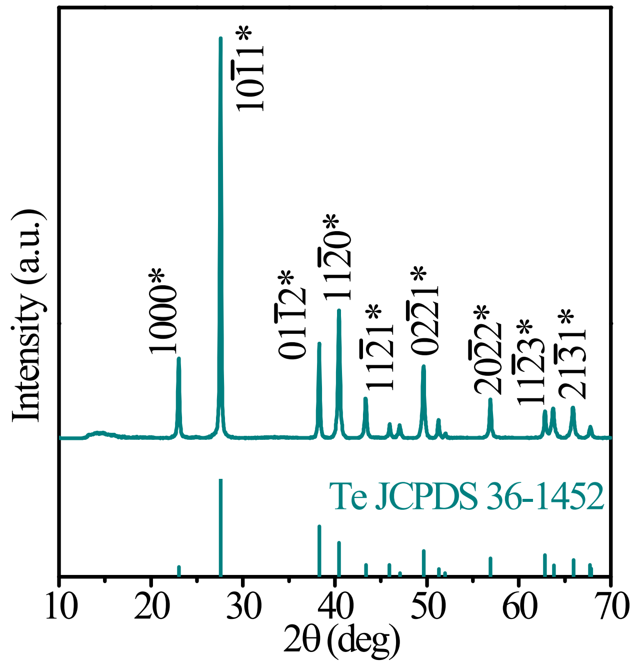

Fig. S1 XRD pattern of as-synthesized Te nanotubes.

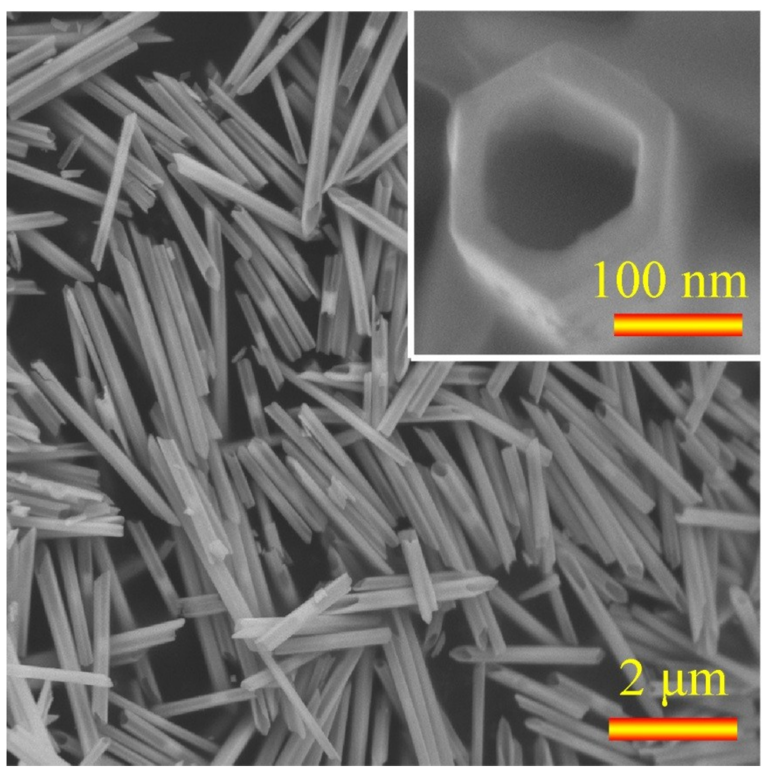

Fig. S2 Low-magnification SEM image of as-synthesized Te nanotubes with inset showing the cross-section view of a typical nanotube.

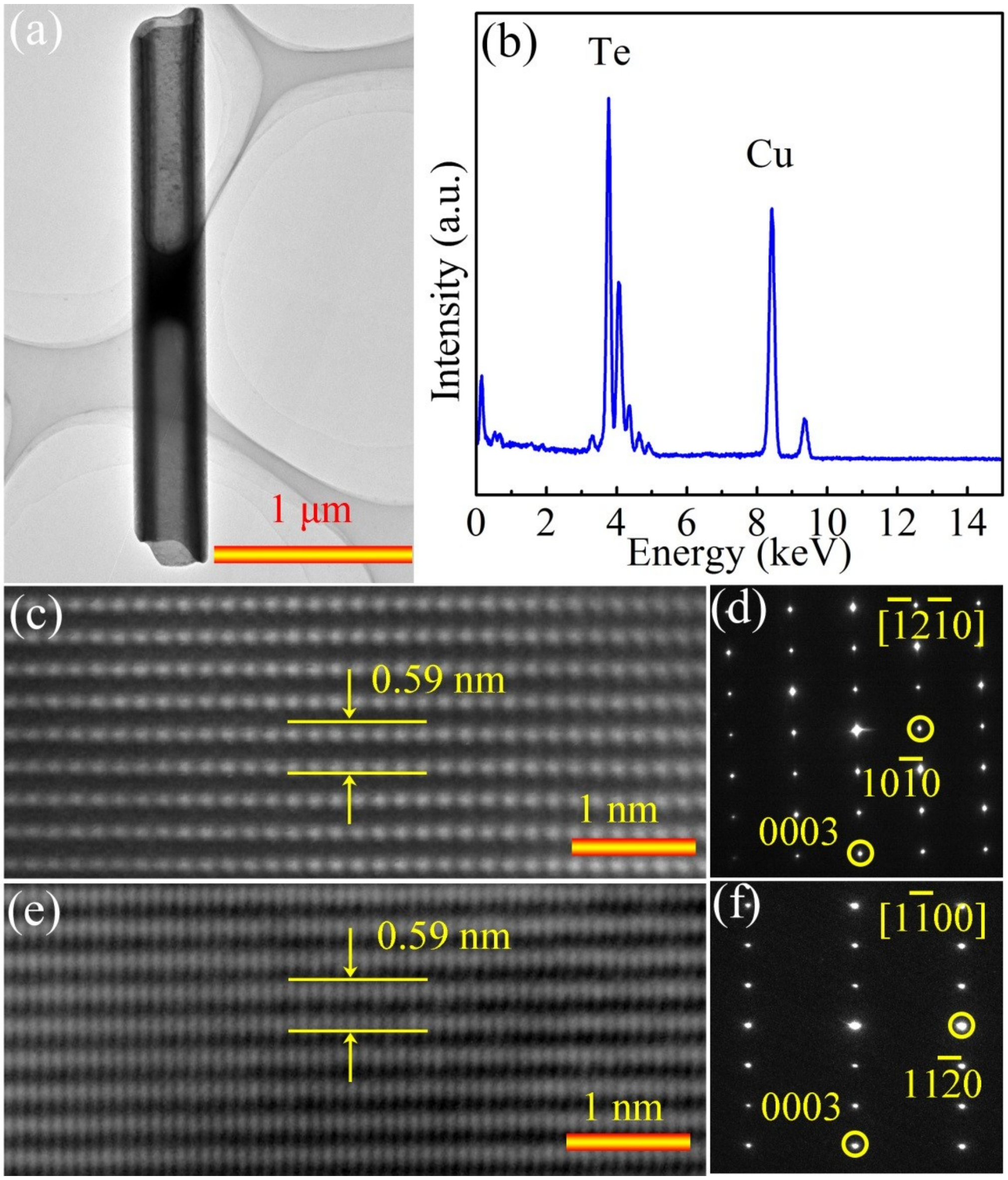

Fig. S3 (a) TEM image of a typical Te nanotube. (b) EDS profile taken from this Te nanotube. (c) HRTEM, and (d) corresponding [$\bar{1}2\bar{1}0$] zone-axis SAED pattern. (e) HRTEM, and (f) corresponding [$1\bar{1}00$] zone-axis SAED pattern.

Notes and references

1. B. Mayers and Y. Xia, *Adv. Mater.*, 2002, **14**, 279-282.