Large Scale Well Crystalline Bi_2Te_3 Nanotubes through Solution Phase Nanoscale Kirkendall Effect Fabrication

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Detailed synthetic procedure:

i) The synthesis of Te nanowires

In a typical synthesis, a NaOH/ethylene glycol (EG) stock solution was firstly prepared by dissolving 20 mmol NaOH and 0.6 g poly(vinyl pyrrolidone) (PVP, M_S~40000) in 50 ml EG. 3 mmol TeO_2 was then dissolved in the above stock solution at about 120 ^oC. The Te nanowires was synthesized by reducing the dissolved TeO_2 through the addition of 0.3 ml $N_2H_4 \cdot H_2O$ at 160 ^oC. Well crystallized Te nanowires can be obtained after reaction for about 20 min.

ii) The formation of Bi_2Te_3 nanotubes

The Bi precursor solution was prepared by dissolving 2 mmol $BiCl_3$ and 0.1 g PVP in 10 ml EG and heated to 160 ^oC. For the synthesis of Bi_2Te_3 nanotubes, the as-prepared Bi precursor solution was added to the Te nanowire-containing solution obtained in procedure (i) at 160 ^oC with a rate of about 5 ml/min, followed by the addition of another 0.3 ml $N_2H_4 \cdot H_2O$. Well crystallized Bi_2Te_3 nanotubes can be formed after reaction for about 20 min at 160 ^oC.

iii) Characterization of the products

The crystal structure of the obtained products was confirmed through the powder X-ray diffraction (XRD), recorded on a Philips X'Pert Pro Super X-ray diffractometer equipped with graphite monochromatized, Cu-Kα radiation (λ = 1.54178 Å). The morphologies, microstructure and composition analyses of the as-prepared samples were investigated by field-emission scanning electron microscopy (FE-SEM, JEOL JSM-6700F) and high-resolution transmission electron microscopy (HRTEM, JEOL 2010).

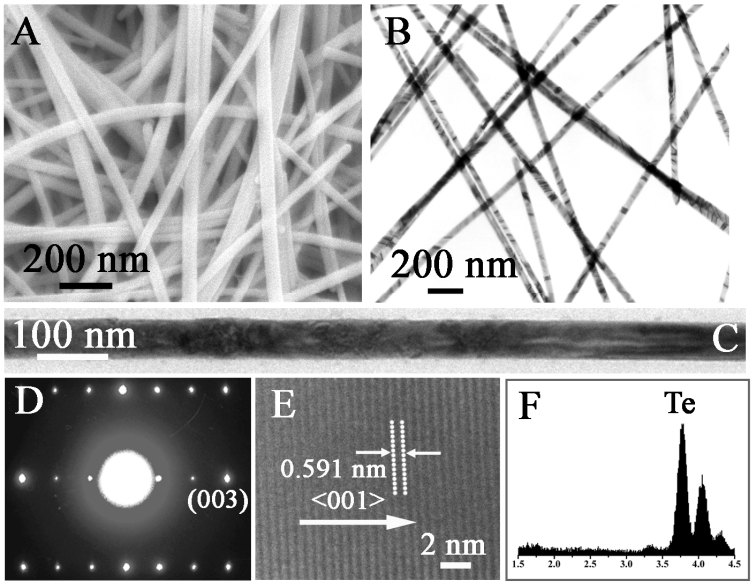

Figure S1. Morphology, microstructure and composition analyses of the Te nanowires obtained by reducing TeO_2 dissolved in ethylene glycol through $N_2H_4 \cdot H_2O$ at 160 ^oC with 0.6 g PVP as surfactant.

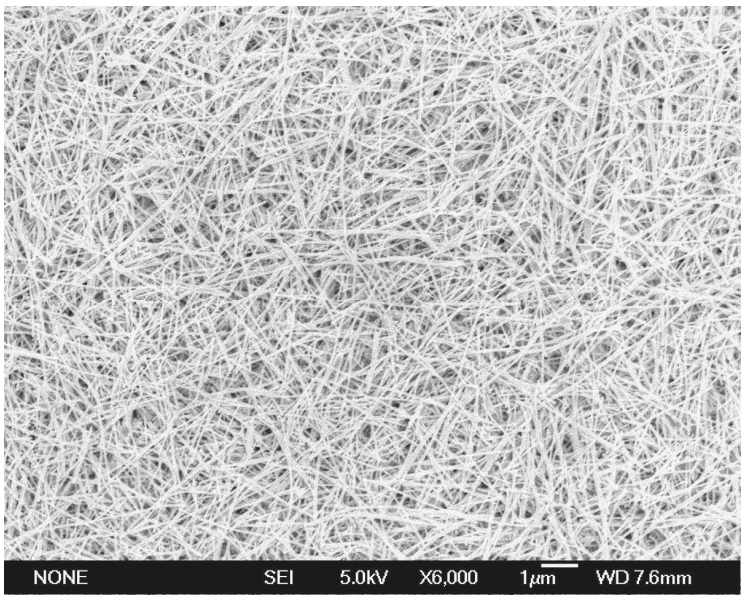

Figure S2. SEM image of the as-prepared large scale Bi_2Te_3 nanotubes.

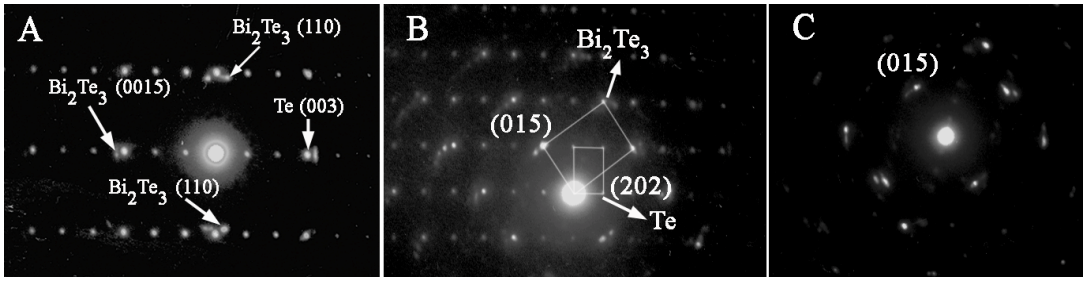

Figure S3. SAED patterns of the time dependent products obtained at different stages (A) reaction for 1 min; (B) reaction for 6 min; (C) reaction for 10 min.