Supplementary Information

A novel glass-fiber-aided cold-press method for fabrication of n-type Ag_2Te nanowires thermoelectric film on flexible copy-paper substrate

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1. Phase and morphology characterization of Ag_2Te NWs film on glass fiber sheet

The phase and morphology characterization of Ag_2Te NWs have been displayed in XRD pattern, TEM image and HRTEM image. Fig. S1a shows the XRD pattern of glass fiber sheet based Ag_2Te film. All of the peaks can be indexed to the monoclinic phase of Ag_2Te (JCPDF card number: 01-081-1820), which indicates that Te NWs have transformed to Ag_2Te NWs. Fig. S1b and Fig. S1c show TEM and HRTEM images of Ag_2Te NWs before being pressed, and the samples were scraped off from Ag_2Te NWs film on glass fiber sheet. In Fig. S1b, the Ag_2Te NWs showed curved shape, which is similar to the previous article. The diameters of Ag_2Te NWs vary from 9 nm to 16 nm, and the average diameter and length are 13 nm and 1 μm, respectively. The interplanar distances of 2.32 Å and 3.37 Å in Fig. S1c correspond to the lattice spaces of (011) and (200) planes for monoclinic Ag_2Te, respectively.

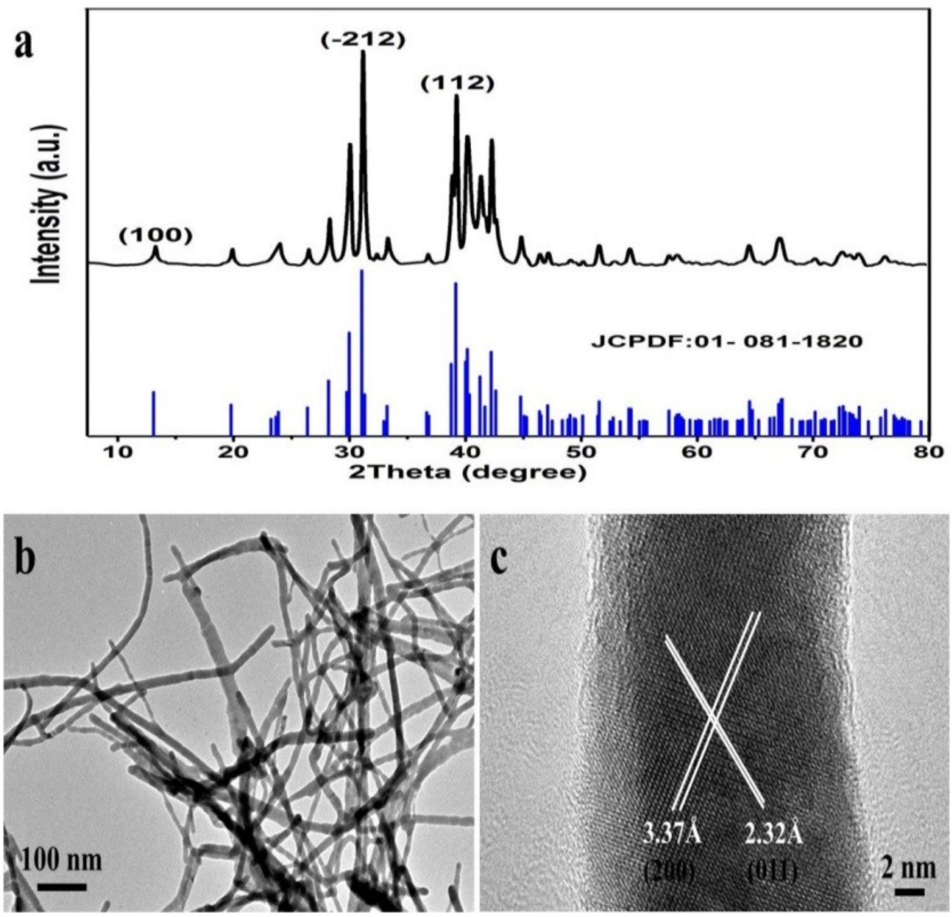

Figure S1. XRD pattern (a), TEM image (b) and HRTEM image (c) of Ag_2Te NWs.

2. HRTEM and STEM images and STEM-EDX maps of Ag_2Te NWs films prepared at certain pressure

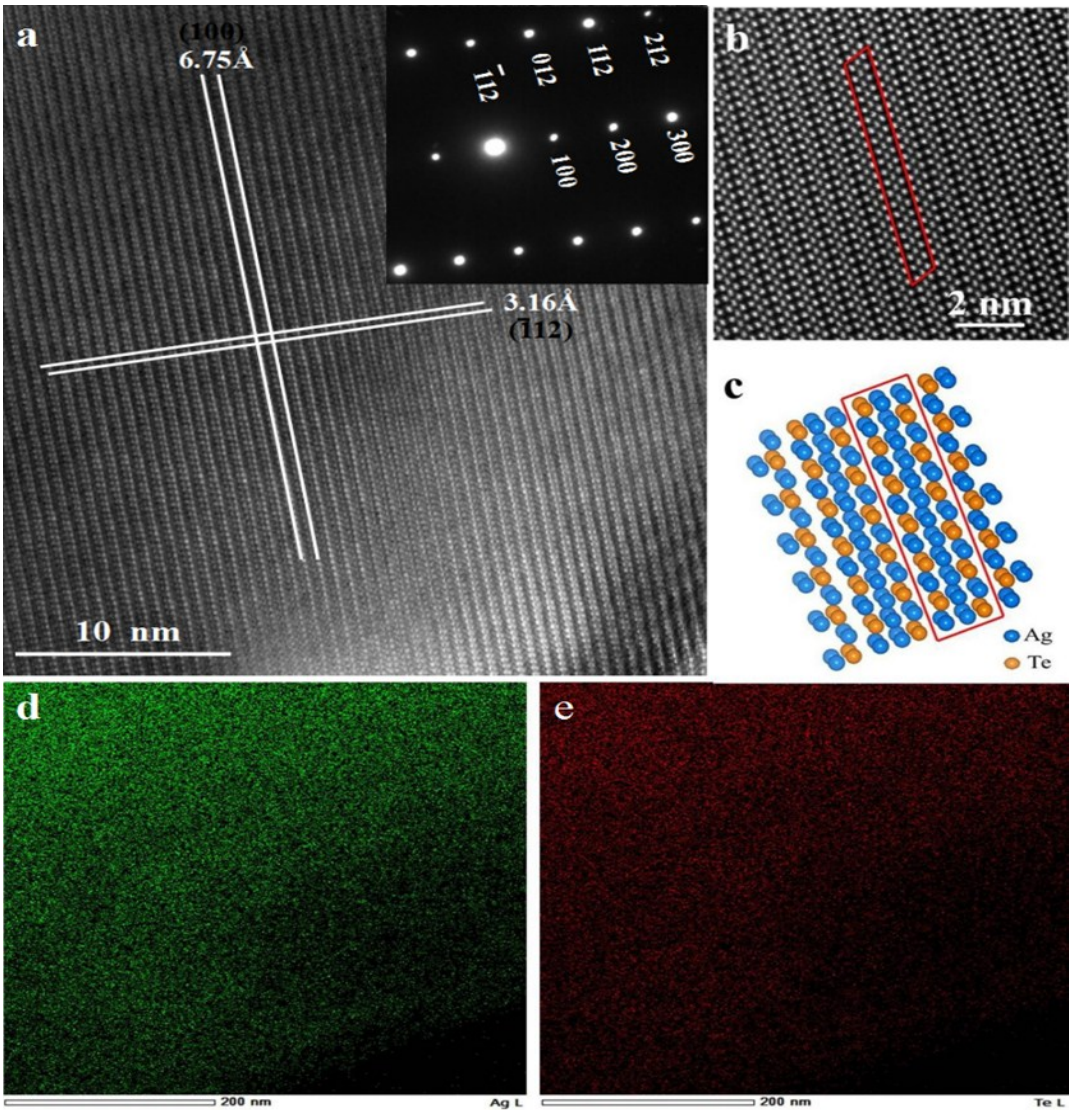

Figure S2. HRTEM image inserted with SAED pattern of Ag_2Te pellet prepared under 5 MPa (a), HAADF image of the Ag_2Te pellet in STEM mode (b), structure model of layered structure of Ag_2Te (c) and STEM-EDX maps of Ag (d) and Te (e).

To investigate the fine crystal structure of Ag_2Te film prepared under a certain pressure, two small Ag_2Te pellets which had been compressed under 5 MPa and 30 MPa were observed through HRTEM and STEM. Fig. S2a displays HRTEM image inserted with the corresponding SAED pattern of Ag_2Te prepared under 5 MPa. This region exhibits highly ordered single crystalline structure, and the Ag_2Te NWs grow along the [100] direction for this area. The interplanar distances of 6.75 Å and 3.16 Å correspond to the lattice spaces of (100) and (-112) planes, and the angle between these two planes is 89.6°. Fig. S2b is a high-angle annular dark-field (HAADF) image of this region. As marked with a red parallelogram, alternating combinations of a triple layer and an unoccupied layer form the crystal structure of Ag_2Te. A structure model of this layered crystal structure is shown in Fig. S2c, and the projection vector is [001]. In the triple layer marked with a red parallelogram, a Ag layer is in the middle while the top and bottom layer are occupied by alternating pairs of Ag and Te atoms, similar structure has also been reported in a previous article. The STEM-EDX maps in Fig. S2d and Fig. S2e directly prove that Ag and Te uniformly distribute throughout this sample, and no Ag aggregation is observed even though this sample has been annealed at 200 °C for 30 min.

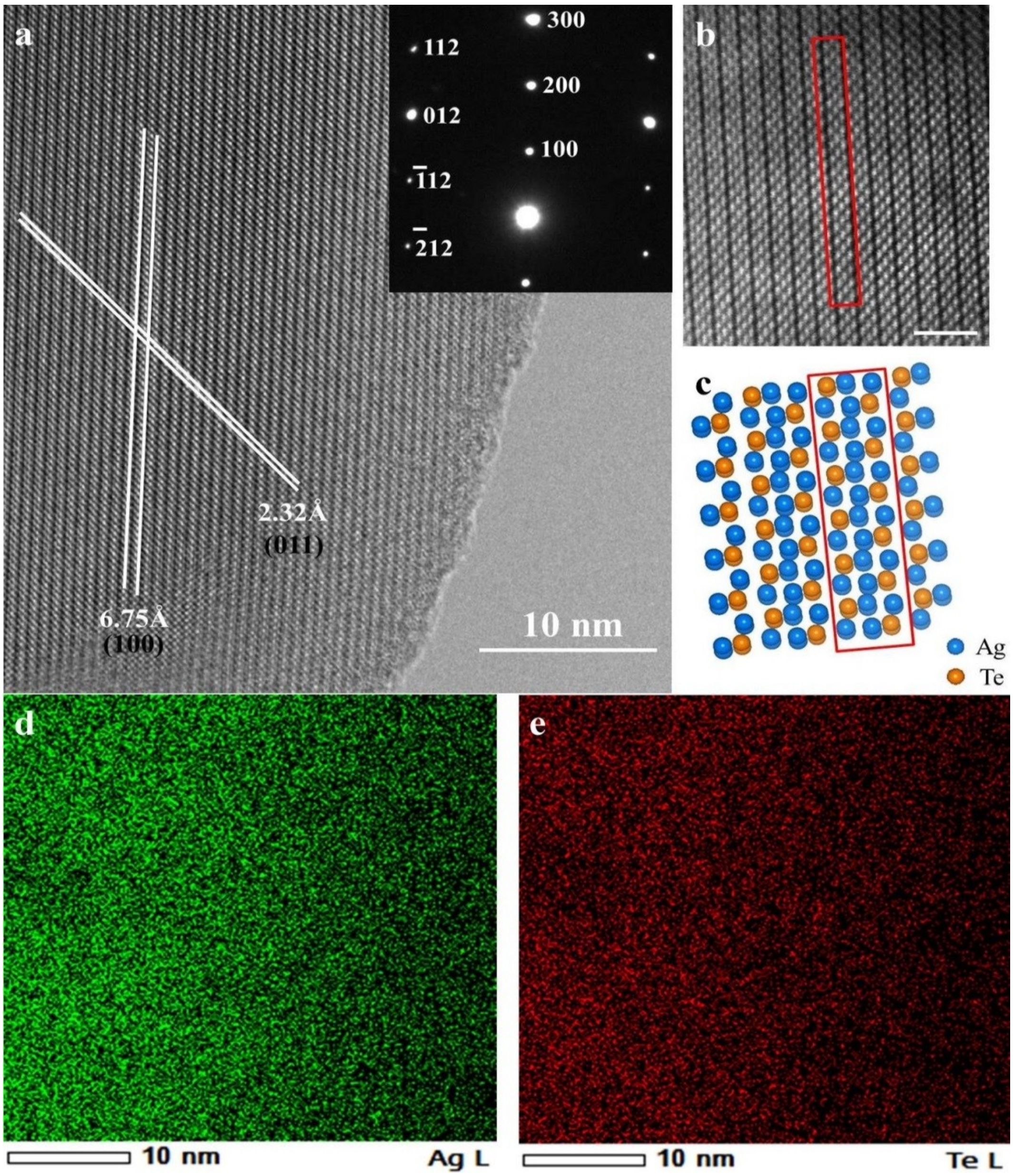

Figure S3. HRTEM image inserted with SAED pattern of Ag_2Te pellet prepared under 30 MPa (a), HAADF image of the Ag_2Te pellet in STEM mode (b), simulation of layered structure of Ag_2Te (c) and STEM-EDX maps of Ag (d) and Te (e).

Fig. S3a displays HRTEM image inserted with SAED pattern of Ag_2Te pellets prepared under 30 MPa. This region exhibits highly ordered single crystalline structure, and the SAED pattern indicates in this area, the Ag_2Te NWs grow along the [100] direction. The interplanar distances of 6.75 Å and 2.32 Å correspond to the lattice spaces of (100) and (0-11) planes, and the angle between these two planes is 69.3^o. Fig. 3b is a high-angle annular dark field (HAADF) image of this region. As marked with a red parallelogram, alternating combinations of a triple layer and an unoccupied layer form the crystal structure of Ag_2Te. A simulation of this layered crystal structure is showed in Fig. S3c, and the projection vector is [001]. In the triple layer marked with a red parallelogram, a Ag layer is in the middle while the top and bottom layer are occupied by alternating pairs of Ag and Te atoms. The STEM-EDX maps in Fig. S3d and Fig. S3e directly prove that Ag and Te uniformly distribute throughout this sample, and no Ag aggregation is observed even though this sample has been annealed at 200^{o}C for 30 min.

4. Thicknesses of paper-supported Ag_2Te NWs films

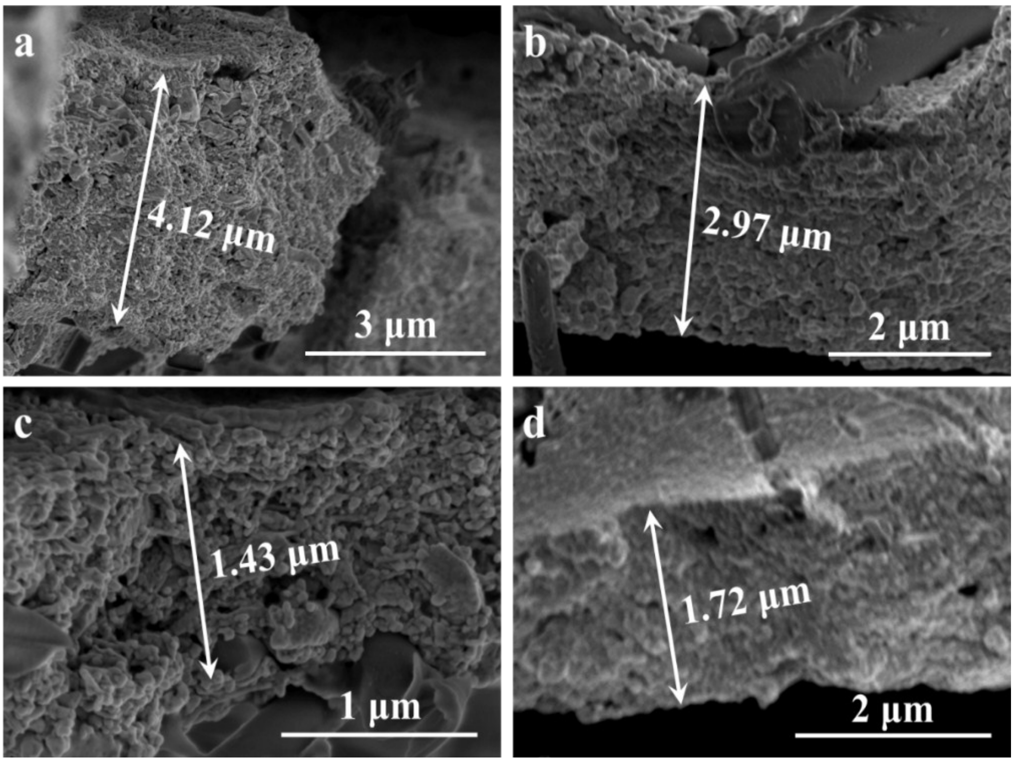

Figure S4. Cross-sectional SEM images of Ag_2Te NWs films prepared under 5 MPa (a), 10 MPa (b), 20 MPa (c) and 30 MPa (d).

As shown in Figure S4, the thicknesses of these films are measured to be 4.12 μm (5 MPa), 2.97 μm (10 MPa), 1.43 μm (20 MPa) and 1.72 μm (30 MPa).