Electronic Supplementary Material (ESI) for Nanoscale.

Electronic Supplementary Information

The surface-to-volume ratio: a key parameter in the thermoelectric transport of topological insulator Bi_2Se_3 nanowires

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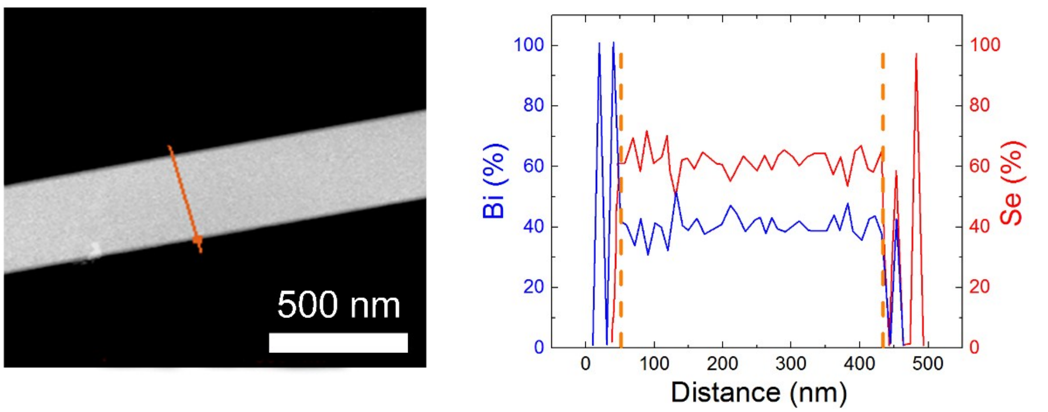
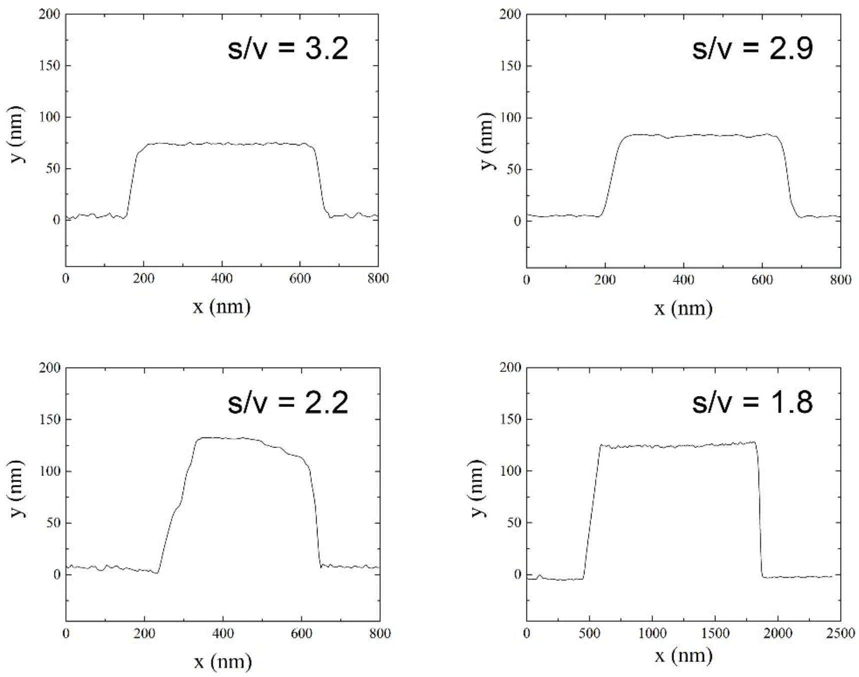
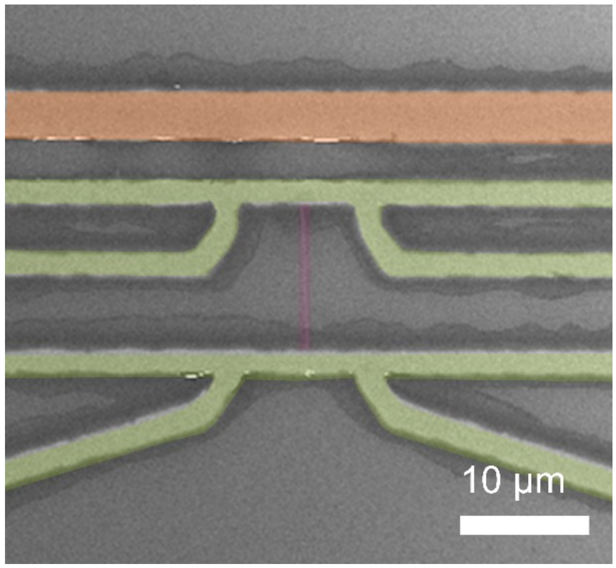


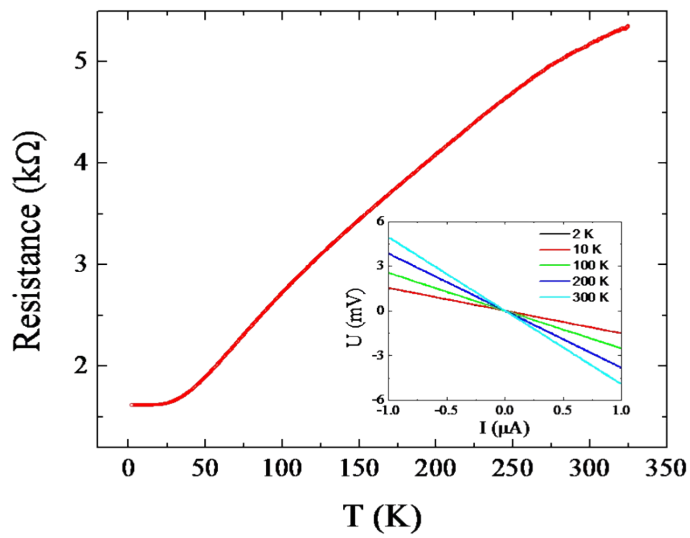
S1. A scanning TEM image of a Bi_2Se_3 NW (left) and an EDX line profile (right) across the width. Within the error limit, the chemical composition of the Bi_2Se_3 NW was identified to be 2:3 stoichiometric phase. There is no meaningful change in composition between the NW's core and the edges.



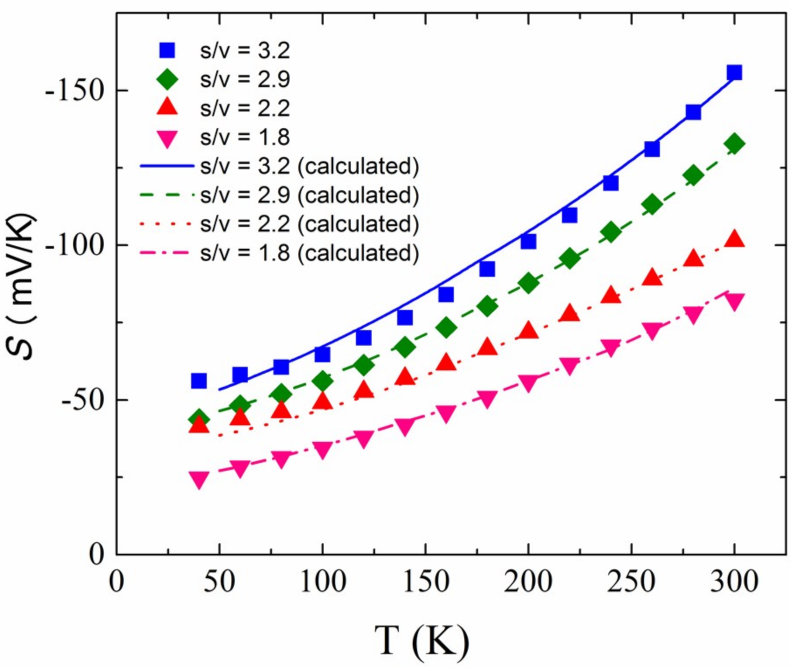
S2. AFM profiles used for determining the s/v of Bi_2Se_3 NWs. The *s/v* of 3.2×10^{-2} nm^{-1} for the NW1 was confirmed by TEM cross-section imaging. Due to the fact that AFM cannot measure steep walls or overhangs, the uncertainty of the *s/v* becomes larger as the dimensions of NWs decrease, as shown in Figure 3.



S3. SEM image of the microdevice used for thermoelectric measurement. The heating line (light orange) generates a temperature gradient along the NW, and two pairs of 4-point thermometer (light green) read the temperature difference at the hot and cold end of the NW from their resistance change. The Seebeck voltage is measured as the voltage difference between the hot and cold end.



S4. A typical temperature-dependent resistance of Bi_2Se_3 NWs from 300 K to 2 K. The resistance decreases with decreasing temperature and seems saturated below 20 K. Considering the Fermi level of 47 meV off the Dirac point, the metallic R-T behavior is attributed to a surface-dominated transport due to the large *s*/*v* of the NWs. The inset shows the V-I curves measured at different temperatures. The linear slopes indicate Ohmic contact in the measurement temperature range.



S5. Temperature-dependent Seebeck coefficients of Bi_2Se_3 NWs (symbols). The lines are the simulated Seebeck coefficients for the Bi_2Se_3 NWs with the same *s*/*v* at a Fermi level of 200 meV based on the two-channel model.