Supporting Information

Surface-Facet-Dependent Phonon Deformation Potential in Individual Strained Topological Insulator Bi_2Se_3 Nanoribbons

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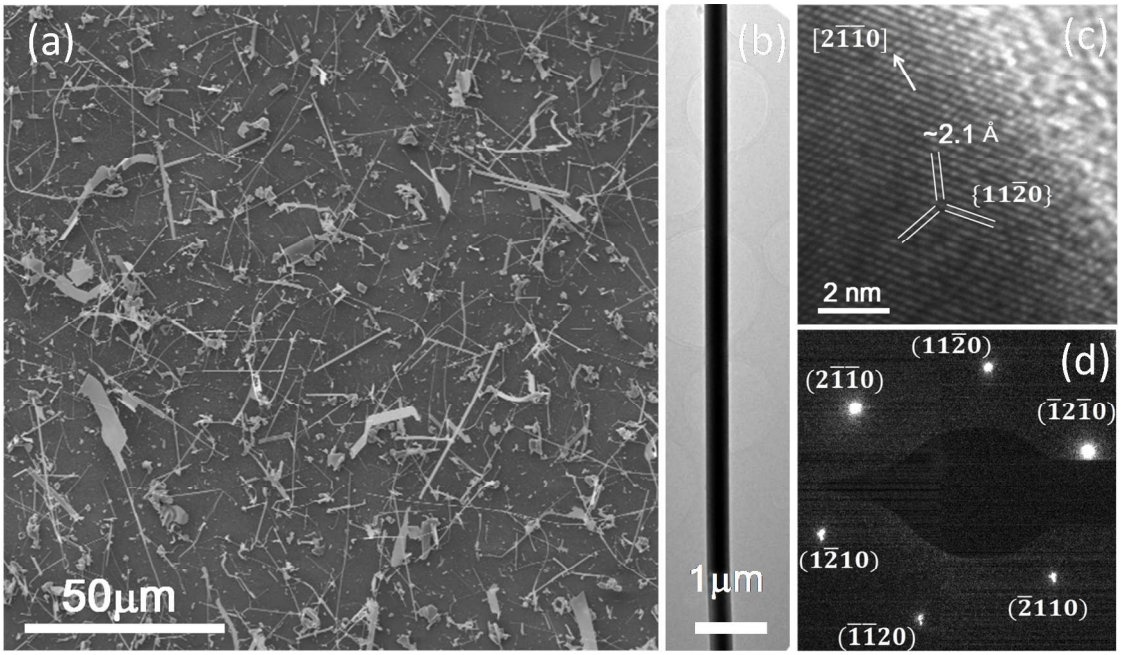

Figure S1. Characterization of as-grown Bi_2Se_3 nanoribbons. (a) SEM, (b) TEM, (c) HRTEM images and (d) SAED pattern of as grown Bi_2Se_3 nanoribbons.

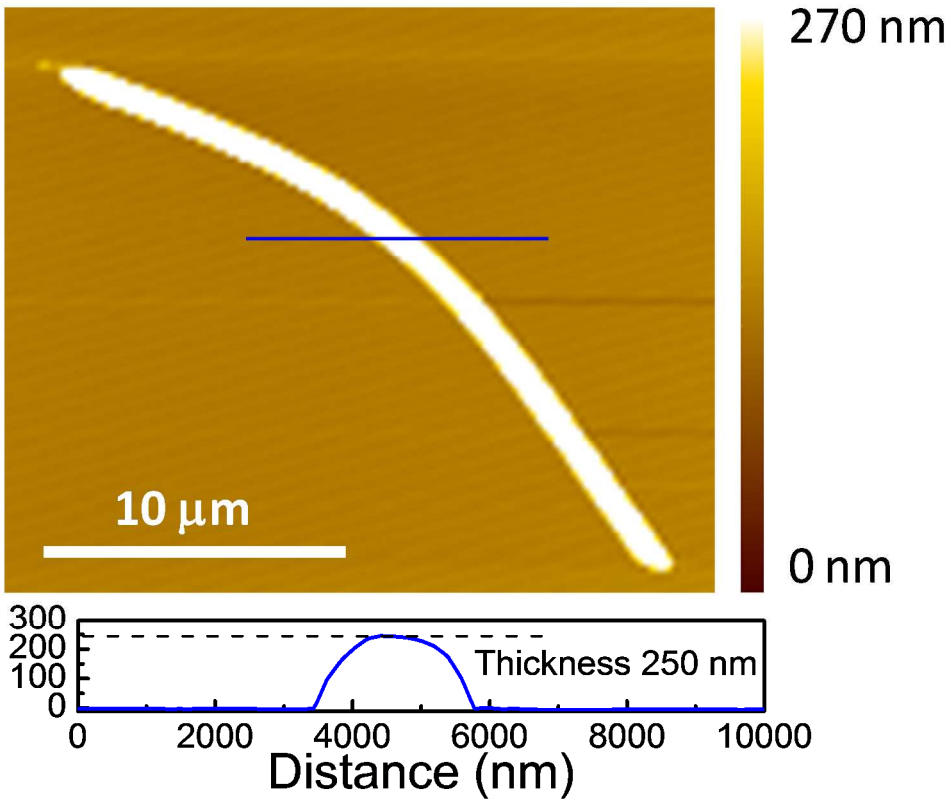

Figure S2. Atomic force microscopy (AFM) characterization of a representative Bi_2Se_3 nanoribbon after Raman measurements. The thickness is 250 nm.

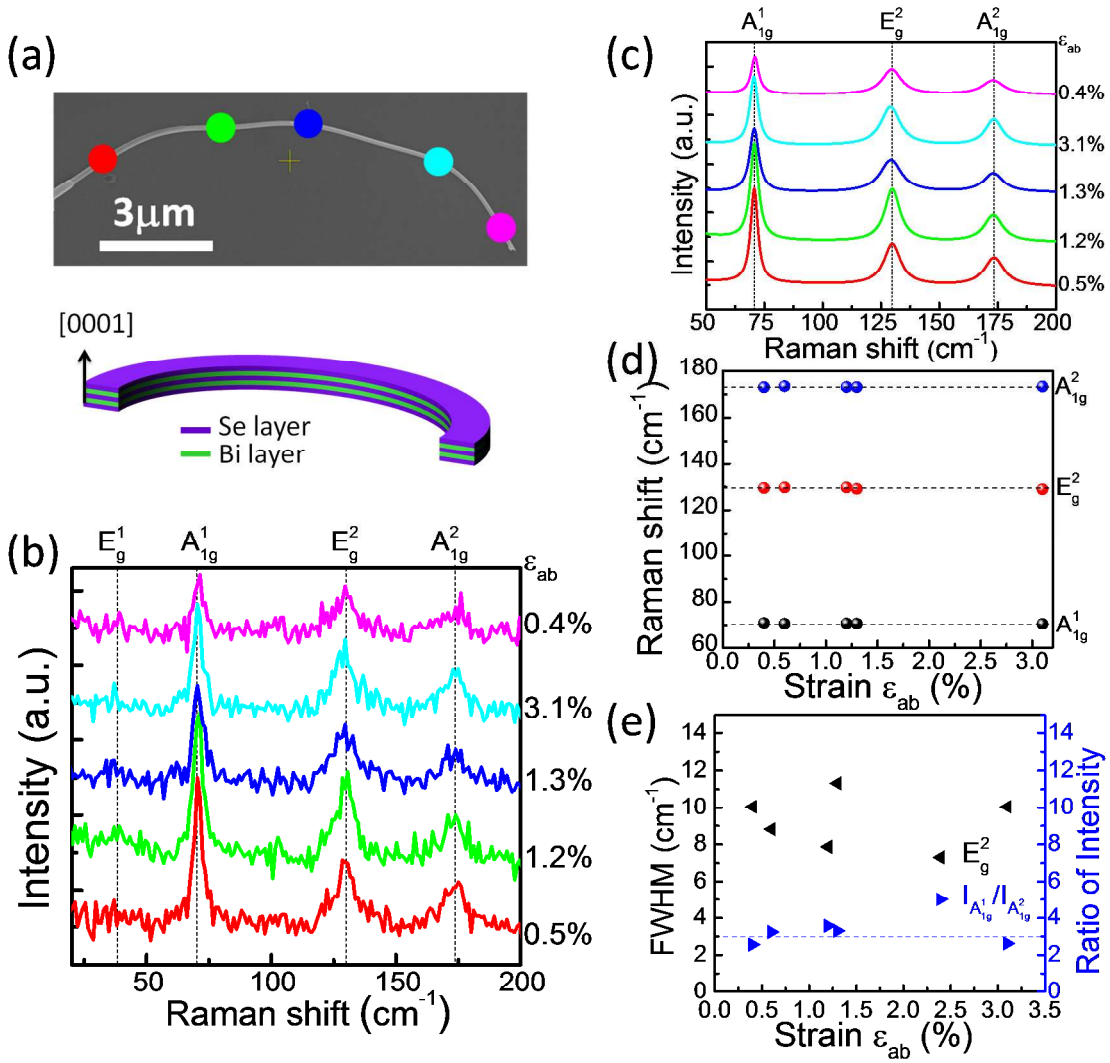

Figure S3. Raman spectra of a strained Bi_2Se_3 nanoribbon with the {0001} surface parallel to the substrate plane. (a) SEM image and schematic illustration of a bent Bi_2Se_3 nanoribbon with a width of 145 nm and a thickness of 130 nm. (b) Raman spectra and (c) Lorentzian fitted Raman spectra collected at different positions along the Bi_2Se_3 nanoribbon. The colored curves correspond to five different positions on the Bi_2Se_3 nanoribbon. Frequencies of the vibrational modes are indicated by dashed lines. (d) Raman shift of the vibrational modes (A_{1g}^1, E_g^2, A_{1g}^2) *versus* strain. (e) FWHM of E_g^2 mode and ratio of intensities $I_{A_{1g}^1}/I_{A_{1g}^2}$ as a function of strain.

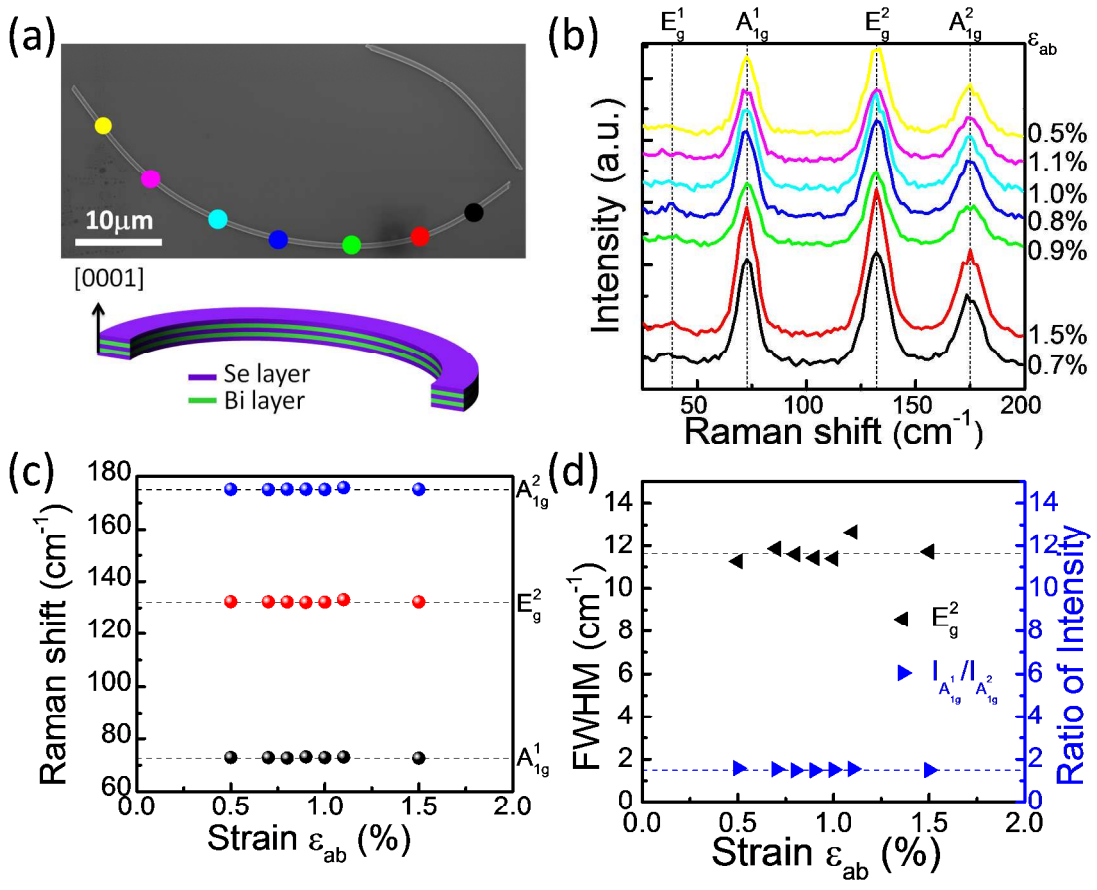

Figure S4. Raman spectra of a strained Bi_2Se_3 nanoribbon with the {0001} surface parallel to the substrate plane. (a) SEM image and schematic illustration of a bent Bi_2Se_3 nanoribbon with a width of 320 nm and a thickness of 250 nm. (b) Raman spectra collected at different positions along the Bi_2Se_3 nanoribbon. The color of each curve corresponds to seven different points on the Bi_2Se_3 nanoribbon. Frequencies of each vibrational mode are indicated by dashed lines. (c) Raman shift of the vibrational modes (A_{1g}^1, E_g^2, A_{1g}^2) *versus* strain. (d) FWHM of E_g^2 mode and ratio of intensities $I_{A_{1g}^1}/I_{A_{1g}^2}$ as a function of strain.

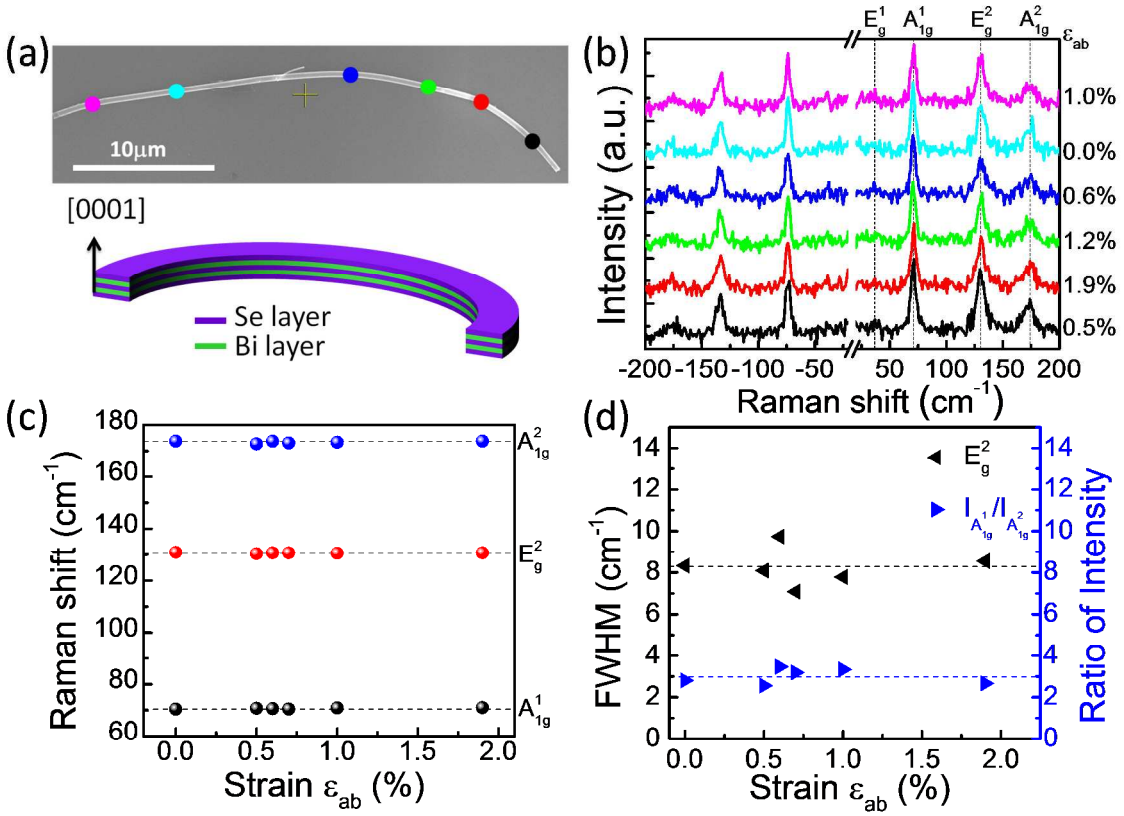

Figure S5. Raman spectra of a strained Bi_2Se_3 nanoribbon with the {0001} surface parallel to the substrate plane. (a) SEM image and schematic illustration of a bent Bi_2Se_3 nanoribbon with a width of 425 nm and a thickness of 170 nm. (b) Raman spectra collected at the different positions along the Bi_2Se_3 nanoribbon. The color of each curve corresponds to six different points on the Bi_2Se_3 nanoribbon. Frequencies of each vibrational mode are indicated by dashed lines. (c) Raman shift of the vibrational modes (A_{1g}^1, E_g^2, A_{1g}^2) *versus* strain. (d) FWHM of E_g^2 mode and ratio of intensities $I_{A_{1g}^1}/I_{A_{1g}^2}$ as a function of strain.

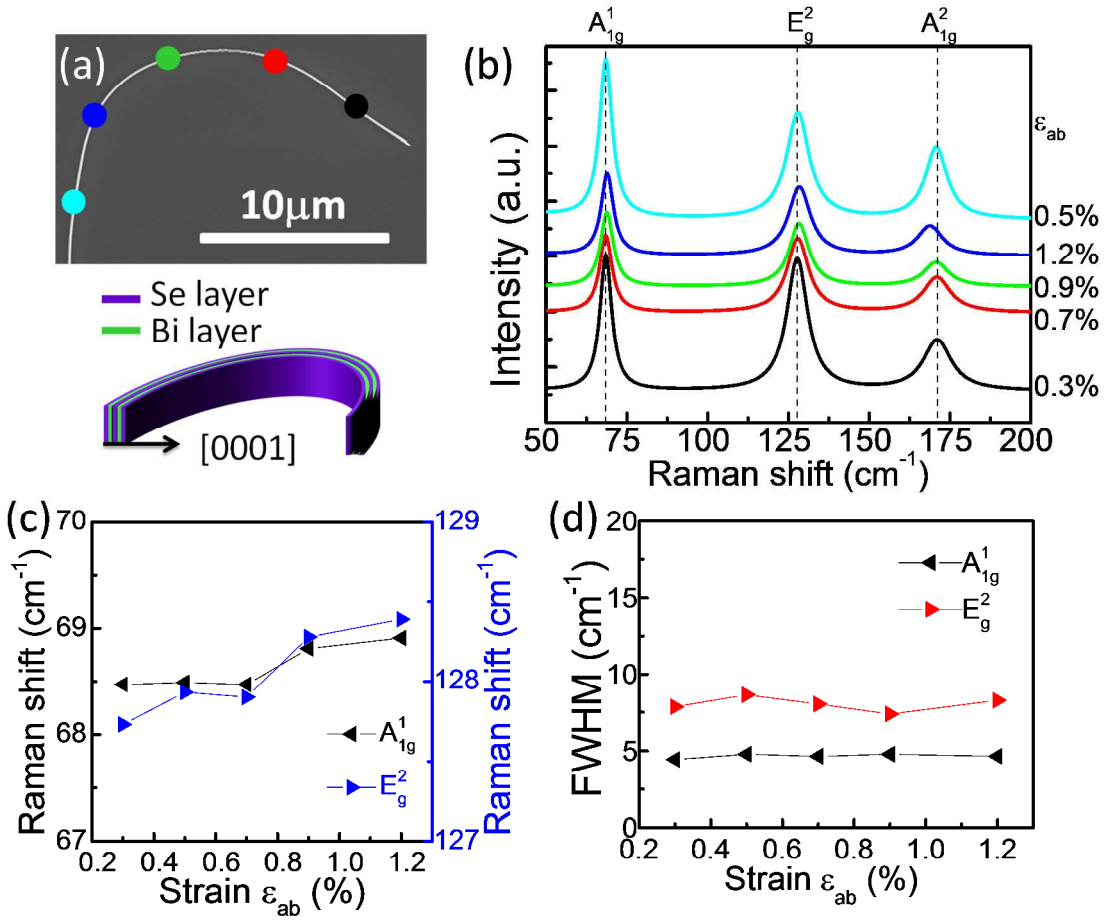

Figure S6. Raman spectra of a strained Bi_2Se_3 nanoribbon with the {0001} surface perpendicular to the substrate plane and the exposed $\{01\bar{1}5\}$ top surface. (a) SEM image and schematic illustration of a bent Bi_2Se_3 nanoribbon with a thickness of 120 nm. (b) Lorentzian fitted Raman spectra collected at the different positions along the Bi_2Se_3 nanoribbon. The color of each curve corresponds to five different points on the Bi_2Se_3 nanoribbon. (c) Raman shift and (d) FWHM of A^1_{1g} and E^2_g modes *versus* strain.

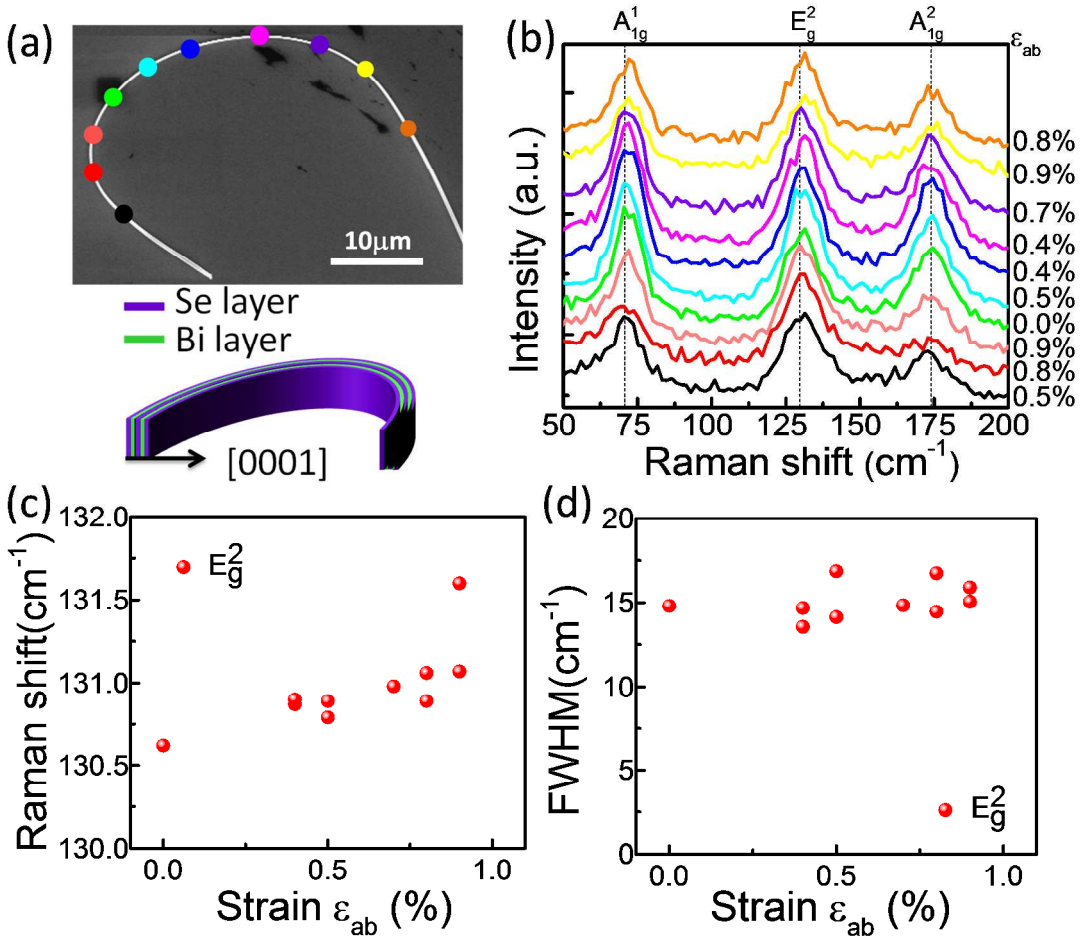

Figure S7. Raman spectra of a strained Bi_2Se_3 nanoribbon with the {0001} surface perpendicular to the substrate plane and the exposed $\{01\bar{1}5\}$ top surface. (a) SEM image and schematic illustration of a bent Bi_2Se_3 nanoribbon with a thickness of 190 nm. (b) Raw Raman spectra collected at the different positions along the Bi_2Se_3 nanoribbon. The color of each curve corresponds to ten different points on the Bi_2Se_3 nanoribbon. (c) Raman shift and (d) FWHM of E_g^2 mode *versus* strain.