Supporting Information

Two-Dimensional SnS: A Phosphorene Analogue with Strong In-Plane Electronic Anisotropy

Zhen Tian,[1,2,3] Chenglei Guo, [1,2,3] Mingxing Zhao,[2,3] Ranran Li, [2,3] and Jiamin Xue[1,2,3,4]*

[1]Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences, Shanghai 201800, China

[2]School of Physical Science and Technology, ShanghaiTech University, Shanghai 201210, China

[3]University of Chinese Academy of Sciences, Beijing 100049, China

[4]Center for Excellence in Superconducting Electronics (CENSE), Chinese Academy of Sciences, Shanghai 200050, China

*xuejm@shanghaitech.edu.cn
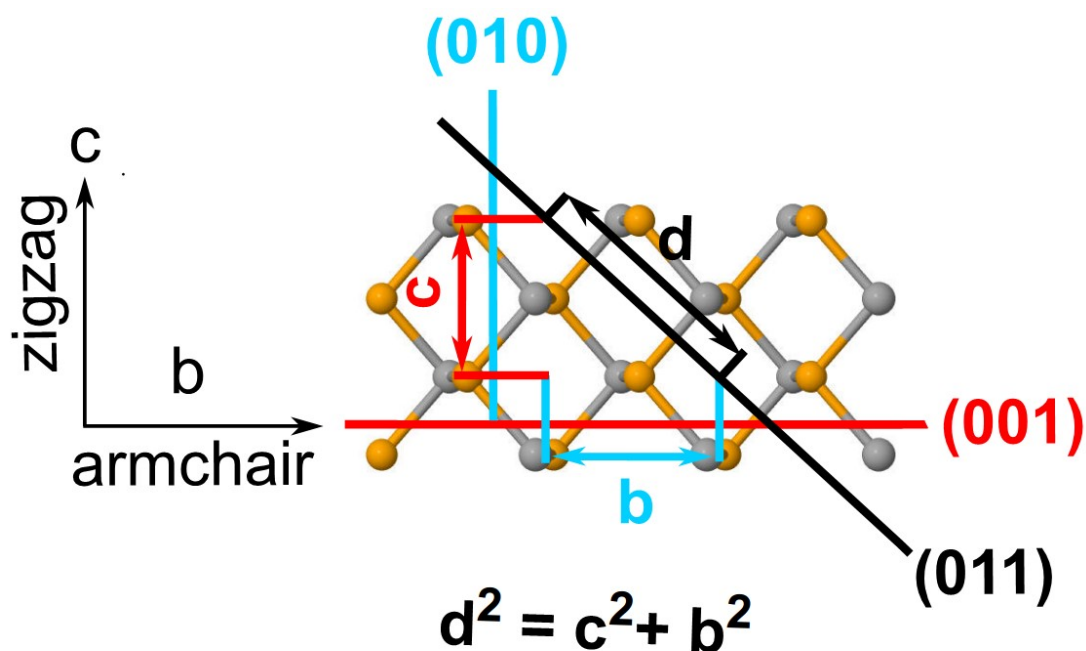
$$d^2 = c^2 + b^2$$

density of dangling bonds:

$$2/c > 2/b > 2/d$$

Figure S1. Procedure for calculating the density of dangling bonds at different planes. At the (010) plane, we can see that every two bonds take a length of c. While for the (001) and (011) planes, every two bonds take a length of b and d, respectively. Since c, b and d form a right triangle, we have $d^2 = c^2 + b^2$. Then the density of dangling bonds at the (011) planes is the lowest, hence thermodynamically most stable.
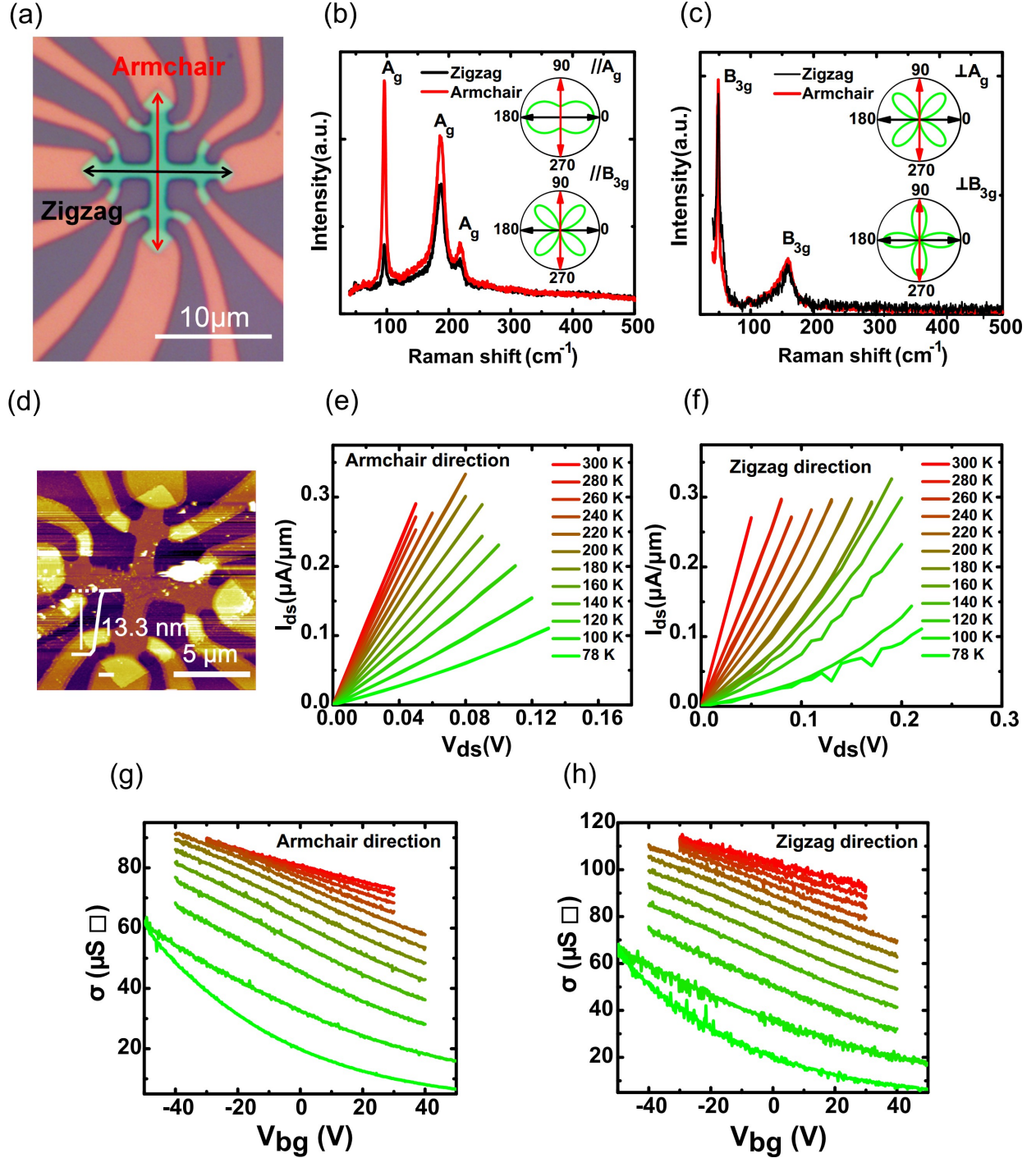
Figure S2. (a, d) OM and AFM images of a 13.3 nm SnS FET device on 300 nm SiO_2 substrate. (b, c) Raman spectra of the SnS FET device shown in (a) and (d) with the polarization of incident and scattered light parallel (b) and perpendicular (c), respectively. (e, f) The I_{ds}-V_{ds} plots at various T along the armchair and zigzag directions respectively with the back gate grounded.

(g, h) The channel sheet conductivity σ versus V_{bg} at different T along the armchair and zigzag directions. Again it is easy to see that the zigzag direction has the higher mobility.
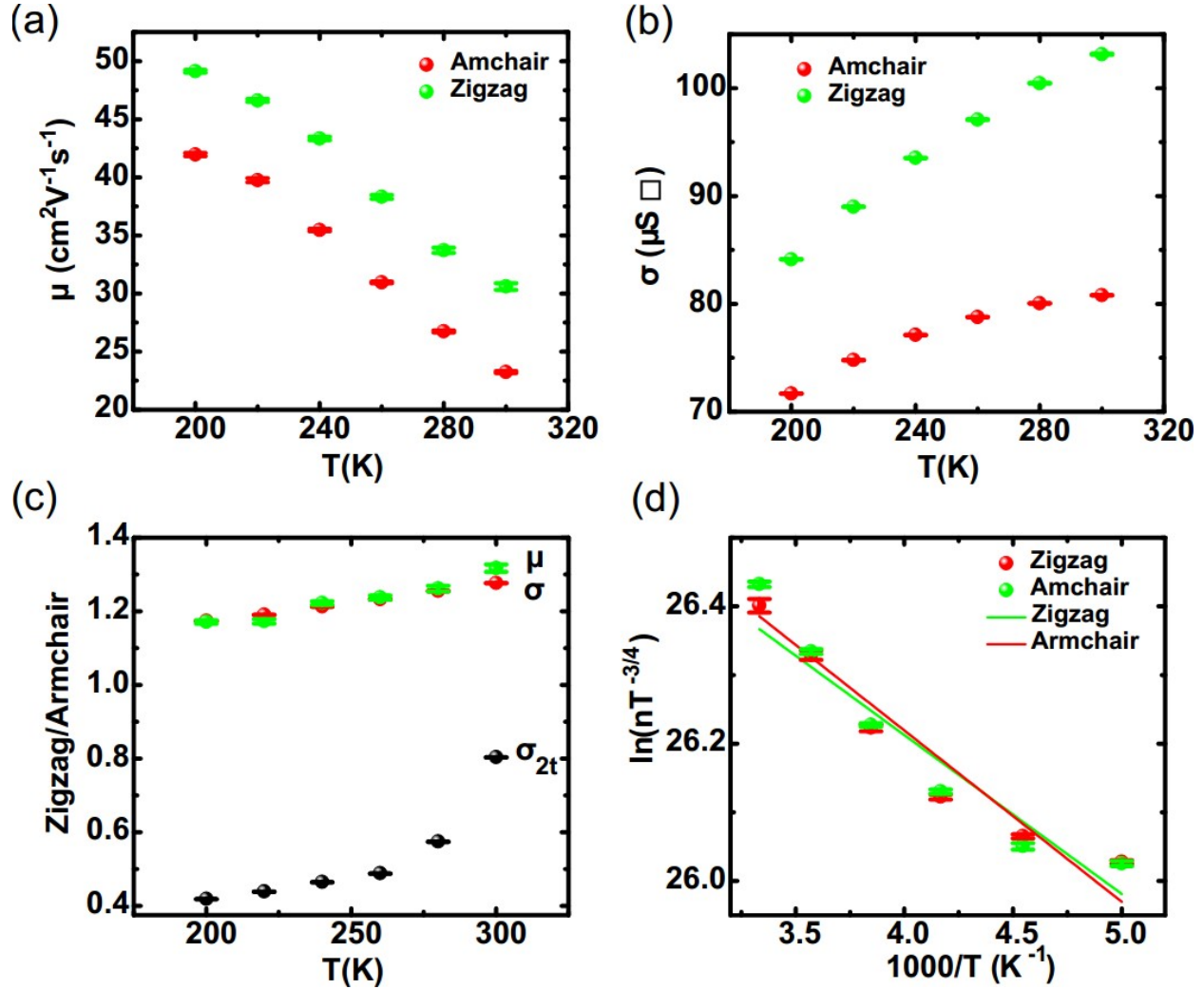

Figure S3. (a, b) The mobility μ and the four-terminal sheet conductivity σ extracted from Figures S2(g) and (h) at zero gate voltage. (c) The ratios of μ, σ and two-terminal conductivity σ_{2t} between zigzag and armchair directions at various T. (d) $\ln nT^{-3/4}$ as a function of $1000/T$. The solid lines are linear fits of the data with activation energy E_a of 43 ± 2 meV along the armchair direction and 41 ± 2 meV along the zigzag direction.