Supplementary Information

Electrical and Optoelectronic Anisotropy and Surface Electron Accumulation in ReS_2 Nanostructures

Hemanth Kumar Bangolla[1], Muhammad Yusuf Fakhri[1], Ching-Hsuan Lin[1], Cheng-Maw Cheng[2,3,4,5], Yi-Hung Lu[6], Tsu-Yi Fu[6], Pushpa Selvarasu[1], Rajesh Kumar Ulaganathan[7], Raman Sankar[7] and Ruei-San Chen[1,*]

[1]Graduate Institute of Applied Science and Technology, National Taiwan University of Science and Technology, Taipei 10607, Taiwan

[2]National Synchrotron Radiation Research Center, Hsinchu 30076, Taiwan

[3]Department of Physics, National Sun Yat-sen University, Kaohsiung 80424, Taiwan

[4]Department of Electrophysics, National Yang Ming Chiao Tung University, Hsinchu 300, Taiwan.

[5]Taiwan Consortium of Emergent Crystalline Materials, National Science and Technology Council, Taipei 10601, Taiwan.

[6]Department of Physics, National Taiwan Normal University, Taipei 11677, Taiwan

[7]Institute of Physics, Academia Sinica, Taipei 115201, Taiwan

[*]Email: rsc@mail.ntust.edu.tw

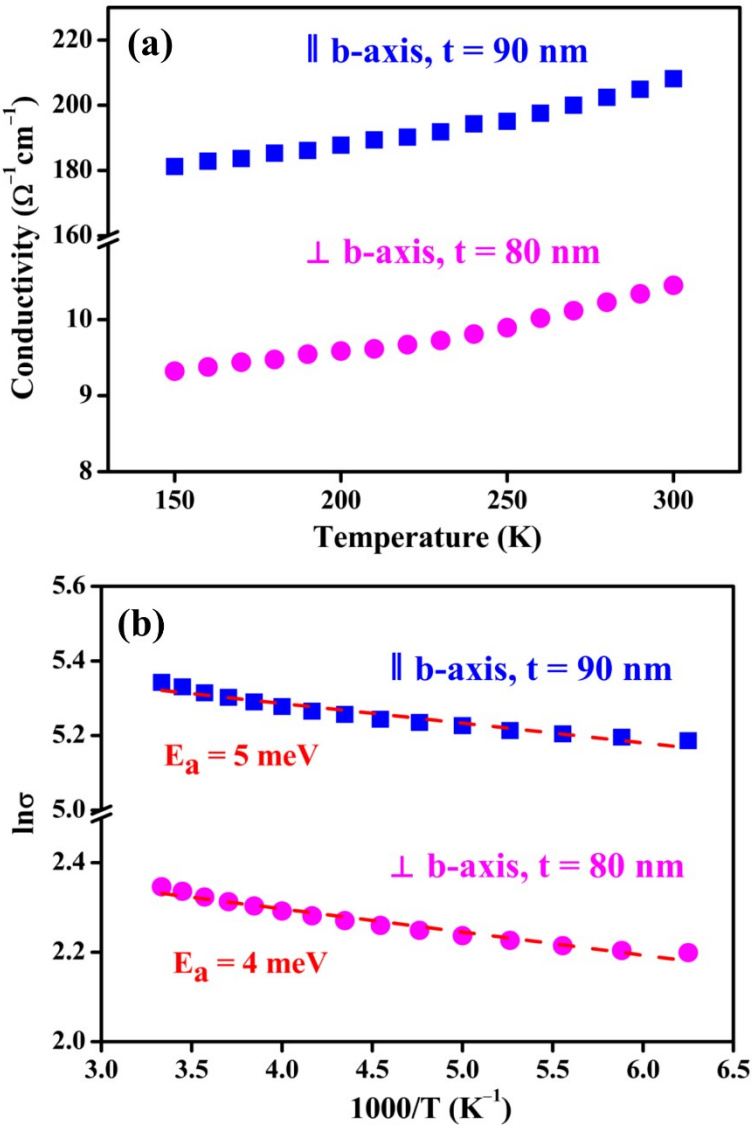

Fig. S1 (a) Conductivity vs. temperature measurements, and (b) Arrhenius plots of ReS_2 nanoflakes $\parallel b$ and $\perp b$ The red dashed lines are the linear fit of respective data for calculating activation energy.

Note S1. The activation energy was calculated for the ReS_2 nanoflakes $\parallel b$ and $\perp b$ to find source carriers of different orientations of ReS_2 nanoflakes. Figure S1a shows the variation in conductivity of nanoflakes $\parallel b$ and $\perp b$ with temperature in the range of 300 −150 K. The activation energy (E_a) was obtained using the equation[1]

$$\sigma(T) = \sigma_0 exp(-E_a/kT), \quad (1)$$

where k is Boltzmann's constant and σ_0 is the conductivity at temperature (T) of 0 K. The E_a value can be calculated from the slope of the Arrhenius plot ($\ln\sigma$ vs. (1000/T) graph). Arrhenius plots of nanoflakes $\parallel b$ and $\perp b$ are shown in Fig. S1b. The obtained activation energy of nanoflakes $\parallel b$ and $\perp b$ are 5 and 4 meV respectively. This result shows almost similar activation energy for both nanoflakes and it is an indication that the charge carriers of these nanoflakes originated from the same source, which is expected due to the two nanoflakes being exfoliated from the same ReS_2 bulk crystal.

Reference:

Ref. 1 R. S. Chen, C. C. Tang, W. C. Shen, and Y. S. Huang, *Nanotechnology,* 2014, **25**, 415706.