Surface Layer Contacted Tin Disulfide Transistors with Graphene Electrodes for Performance Comparison

Onejae Sul (Presenting Author)
Jiyoung Bang, Seong-oh Yeom, Gunwoo Ryu, Hyung-bin Joo, Sun-jin Kim, Heewon Yang, Jusin Lee, Gunwoo Lee, Eunsuk Choi, and Seung-Beck Lee (Co-authors)

Hanyang University, 222 Wangshimni-ro, Seongdong-gu, Seoul, Republic of Korea 22008

ojsul@hanyang.ac.kr, sblee22@hanyang.ac.kr (Corresponding Author)

2-dimensional layered materials such as transition metal dichalcogenides (TMDC) have non-uniform electrical current density across the channel cross-section due to their layered structure [1]. Thus there will be performance difference between TMDC transistors depending on the location of the current passing layer. We investigated the performance improvement of the tin disulphide (SnS_2) channel transistors by graphene contact locations. From its two dimensional nature, graphene can make electric contacts only at the outermost layers of the channel. For intralayer channel current, two graphene flakes contacted the channel's top or bottom layer. For interlayer channel current, one flake contacted at the top and the other at the bottom layer each. (Fig. 1) We compared the transistor performance in terms of current magnitude, mobility, and subthreshold swing between the configurations. From such observations, we deduced that device characteristics depend on resistivity or doping level of individual graphene flakes. (Fig. 2(a), (b), (c)) We also found that interlayer flow excels in the on-current magnitude and the mobility, and that top-contact configuration excels in the subthreshold swing. (Fig.2 (d))

References

[1] Das, S. and Appenzeller, J., Nano Letters, Vol. 13, (2013) 3396

Figures

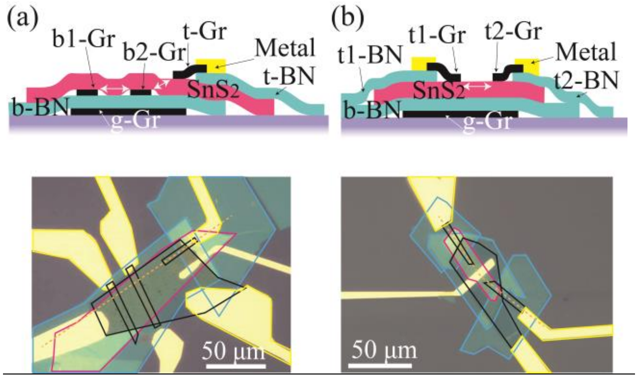

Figure 1: (a) Schematic cross-section of an optical microscopic view of a device with two bottom contact graphene (b1-Gr, b2-Gr) and a top contact graphene (t-Gr). (Black: Graphene, Pink: SnS_2, Blue: hexagonal Boron Nitride) (b) Another device with two top contact graphene (t1-Gr, t2-Gr). White arrows display current flows.

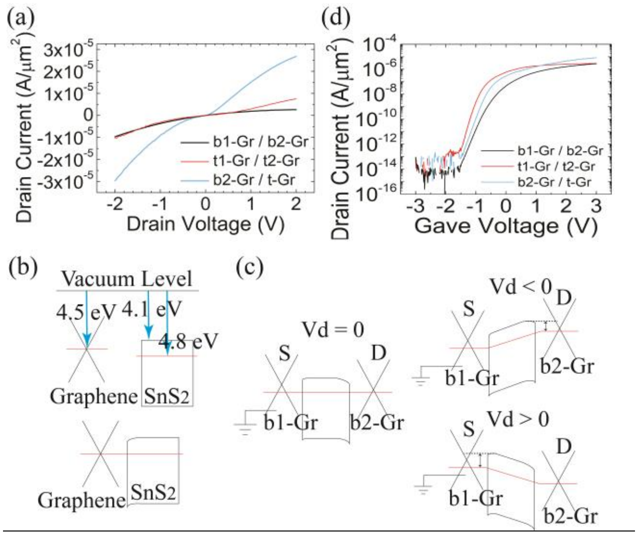

Figure 2: (a) Drain voltage – drain current measurements from the three contact configurations. Interlayer configuration (b2-Gr and t-Gr) gives the largest current amplitude.
(b) Band bending of SnS2 by graphene contact.
(c) Asymmetries observed in (a) originate from the Schottky barrier height difference between the graphene contacts. (d) In the transfer characteristics, the interlayer configuration gives the largest on-current and mobility, where intralayer configurations give the smallest subthreshold swing (t1-Gr and t2-Gr).