Selective carrier injection to two dimensional semiconductors utilizing tunable graphene contacts

Junyoung Kwon
Gwan-Hyoung Lee

Department of material science & engineering, Yonsei university, Seoul 120-745, Korea

gwanlee@yonsei.ac.kr

Abstract

Two dimensional(2D) materials have emerged as key materials for realization of flexible electronics since first isolation of graphene. These materials show high carrier mobility and unique physical phenomenon as well as their flexibility and transparency due to their atomically thin structure. Other 2D materials, including semiconductors such as transition metal dichalcogenides(TMDs) and insulators like h-BN, have been discovered recently. Combination of these materials by straightforward stacking has opened up possibilities for "all-2D" electronics and we call this structure as the 2D heterostructure.[1-2] High performance transistors, photodetectors based on the 2D heterostructures have been already realized.[3[However, optoelectronic devices such as light emitting diodes(LEDs) made of 2D materials still show low efficiency. The p-n junction is the basic structure for the optoelectronics but the layer decoupling at the p-type and n-type 2D heterointerface and large exciton binding energy may cause deterioration of the efficiency of the devices. In this study, we utilize graphene contacts for selective carrier injection. Electrostatic work function tunability as well as low contact resistance to 2D materials of graphene increase carrier injection efficiency at contacts. By controlling Schottky barrier height for electrons or holes at each contact using electric field, selective carrier injection becomes possible. If opposite type of carriers are injected from different electrodes, it can be applied to various applications such as two dimensional light emitting transistors(2D LETs).

References

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Figures

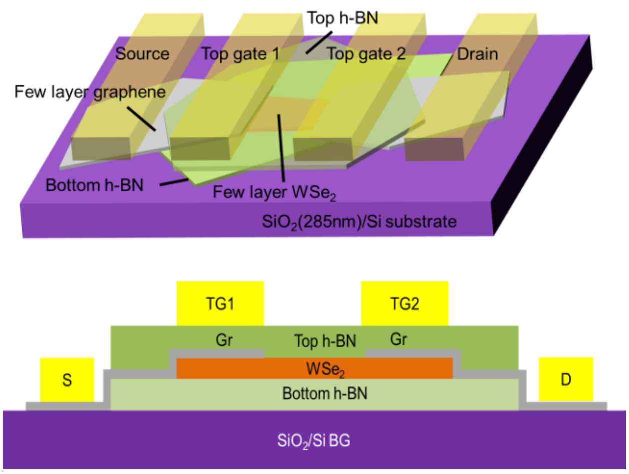

Figure 1: Schematic of device structure