Suhyun Kim
Sooyeoun Oh and Jihyun Kim
Department of Chemical and Biological Engineering, Korea University, Anam-dong 5-ga, Seongbuk-gu, Seoul 02841, Korea

shk1216@korea.ac.kr

Multi-channel (NIR, DUV) Photodetectors Based on Quasi-Two-Dimensional Graphene/β-Ga_2O_3 Schottky Junction

Photodetectors are considered one of the most widely applied optoelectronic devices. As the demand for solar-blind ultraviolet (UV) photodetectors in various military and civilian applications increases, wide bandgap semiconductor materials have gained significant attention. Beta-gallium oxide (β-Ga_2O_3) is one of the promising materials for such applications. It has an ultrawide bandgap of 4.8-4.9 eV and therefore intrinsic solar-blindness. Its high chemical and thermal stabilities and superior breakdown field are some of other advantages in fabricating optoelectronic devices [1]. Integrating with other semiconductor materials can help β-Ga_2O_3-based devices overcome limitations such as low responsivity and thermal conductivity. Interestingly, bulk β-Ga_2O_3 can be mechanically exfoliated into microflakes although it is not a van der Waals material. Its unique lattice structure allows mechanical cleavage along (100) direction, and this provides quasi-two-dimensional (quasi-2D) property [2]. β-Ga_2O_3 can now be easily stacked with other 2D materials using dry-transfer method. In this experiment, 2D graphene was applied to form heterojunction with quasi-2D β-Ga_2O_3 flakes. Based on graphene/β-Ga_2O_3 Schottky junction, metal-semiconductor field-effect phototransistors were fabricated. The phototransistors showed excellent performance and high response to UV light (254 nm). The highly transparent graphene gate was efficient in controlling the photodetector parameters and achieved very low dark current while the rejection ratio and detectivity were superior among other solar-blind UV photodetectors. In addition to deep-UV photodetection by β-Ga_2O_3, near-IR detection from graphene was enabled through graphene/β-Ga_2O_3 Schottky diode. Further results and discussion will be presented in detail.

References

[1] H. He, R. Orlando, M.A. Blanco, R. Pandey, E. Amzallag, I. Baraille, M. Rérat, Phys. Rev. B, 74 (2006) 195123.
[2] J. Kim, S. Oh, M. A. Mastro, J. Kim, Phys. Chem. Chem. Phys., 18 (2016) 15760.

Figures

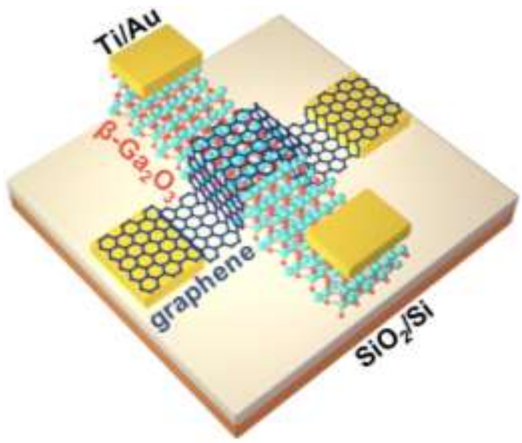

Figure 1: Schematic of metal-semiconductor phototransistor based on graphene/β-Ga_2O_3 heterojunction