Tuning carrier tunneling in van der Waals heterostructures for ultrahigh detectivity

Quoc An Vu
Young Hee Lee, Woo Jong Yu

IBS Center for Integrated Nanostructure Physics, Institute for Basic Science, Sungkyunkwan University, Suwon 440-746, Korea.

quocan@skku.edu

In this study, we demonstrated a highly sensitive photodetector with a MoS_2/h-BN/graphene heterostructure, by inserting a h-BN insulating layer between graphene electrode and MoS_2 photo-absorber, the dark-carriers were highly suppressed by the large electron barrier (2.7 eV) at the graphene/h-BN junction while the photo-carriers were effectively tunnelled through small hole barrier (1.2 eV) at the MoS_2/h-BN junction. With both high photocurrent/dark current ratio (>105) and high photoresponsivity (180 AW^{-1}), ultrahigh photodetectivity of 2.6 × 10^{13} Jones was obtained at 7 nm thick h-BN, about 100 ~ 1000 times higher than that of previously reported MoS_2-based devices.

References

[1] Vu, Q. A.; Lee, J. H.; Nguyen, V. L.; Shin, Y. S.; Lim, S. C.; Lee, K.; Heo, J.; Park, S.; Kim, K.; Lee, Y. H.; et al. Nano Lett. 2016, acs.nanolett.6b04449.

Figures

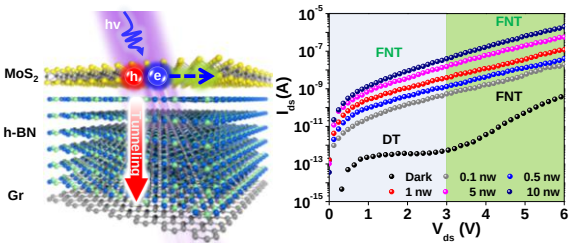

Figure 1: Schematic of the MoS_2/BN/graphene heterostructure photodetector (left) for photon absorber/selective hole tunneling layer/bottom electrode, respectively. Laser was illuminated on the top of the device. Red numbers indicate thickness of h-BN in the MoS2/h-BN/graphene photodetectors. I–V characteristic of the device (right) under the dark and various illumination intensities of 405-nm laser