2D-materials-based heterostructures and device applications

Suk-Ho Choi
Department of Applied Physics, Kyung Hee University, Yongin 17104, Korea
sukho@khu.ac.kr

Abstract

Recently, Integrating low-dimensional materials have widened the spectrum of building blocks for creating hybrid heterostrucuture systems with unique functionalities and excellent performance [1, 2, 3]. In this talk, I review overview, fabrication, characterization, novel phenomena, and perspective of the reported two-dimensional (2D)-materials-based low-dimensional heterostructures, highly attractive for next-generation advanced electronic and photonic device applications. In our work, we successfully employ low-dimensional materials such as graphene, Si quantum dots (QDs), graphene QDs, MoS_2, 2D perovskites in their low-dimensional heterostructures for photodiodes, solar cells, and light-emitting diodes showing novel functional behaviors, which are discussed based on the electrical/optical characterizations and possible physical mechanisms. The emergence of low-dimensional heterostructures will make graphene/2D materials a long live hotspot, which might help to find their killer application, ultimately leading to significant breakthroughs in new physics as well as commercialization of graphene/2D materials devices.

References

[1] Y. Liu, Y. Huang, and X. Duan, Naure, 567 (2019) 323.
[2] S.-H. Bae, H. Kum, W. Kong, Y. Kim, C. Choi, B. Lee, P. Lin, Y. Park, and J. Kim, Nature Materials, 18 (2019) 550.
[3] D. Akinwande, C. Huyghebaert, C.-H. Wang, M. I. Serna, S. Goossens, L.-J. Li, H.-S. Philip Wong, and F. H. L. Koppens, Nature, 573 (2019) 507.

Figures

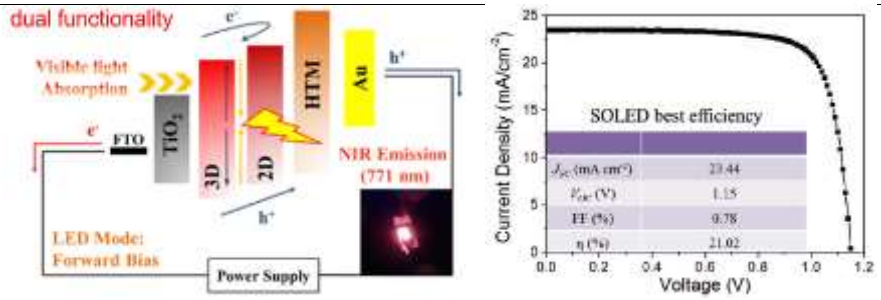

Figure 1: Photovoltaic/light-emitting bifunctionality of perovskite 2D/3D heterostructure

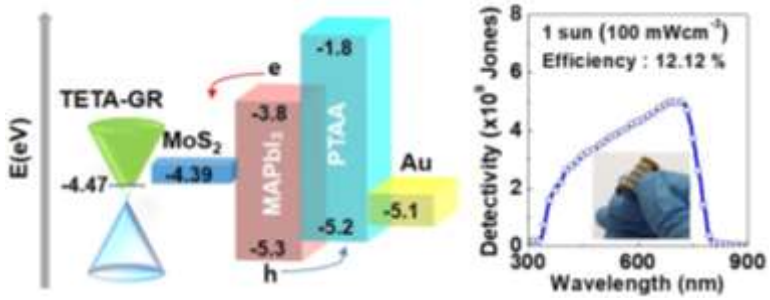

Figure 2: Doped graphene/2D MoS_2/perovskite heterostructure for photodiode-solar cell nanosystem