Optical Switching of Hole Transfer in Graphene-Perovskite Heterostructure

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Graphene (Gr) - semiconductor heterostructure has emerged as promising building blocks for optoelectronics due to its unique combination of ultrahigh charge mobility in Gr and strong optical absorption of semiconductors. [1-2] The performance and functionality of heterostructures rely crucially on the charge transfer (CT) efficiency, as well as the CT direction and thus the local gating field across the interface. Controlling the interfacial CT efficiency has been well reported e.g. by tuning the optical excitations,[3] while the direction of CT is usually fixed. We report an intriguing optical switching in the hole transfer direction across graphene/metal halide perovskite (Gr/MHP) heterostructures, by simply tuning the excitation conditions. Such an effect endows Gr/MHP heterostructures a new degree of freedom to control the local gating electrical field, and thus to control the light detection capacities of Gr/MHP hybrids over a wide range of electromagnetic spectra.

References

[1] Xiong, Yifeng, et al. *Advanced Materials* 32.9 (2020): 1907242.
[2] Konstantatos, Gerasimos, et al. *Nature nanotechnology* 7.6 (2012): 363-368.
[3] Fu, Shuai, et al. *Science advances* 7.9 (2021): eabd9061.

Figures

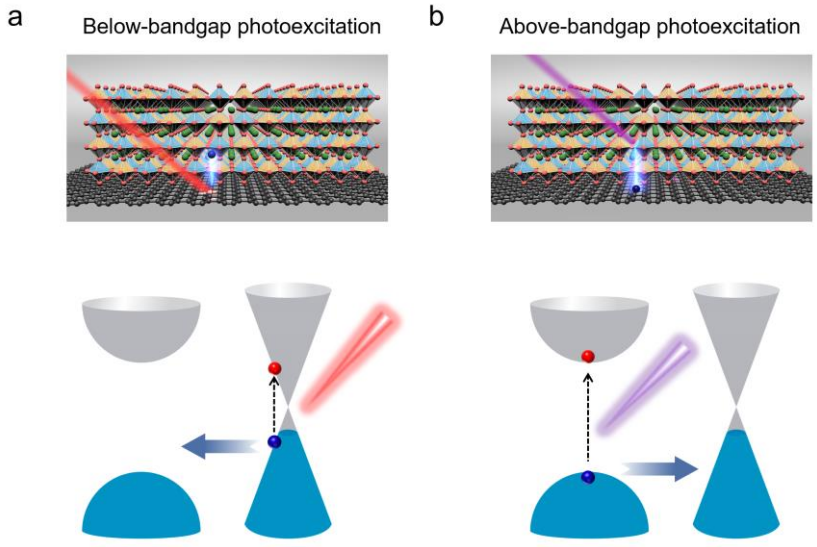

Figure 1: Schematic illustration of optically controlled hole transfer in DP/Gr heterostructure in both real (upper panel) and momentum (lower panel) spaces. **a.** For the photoexcitation with photon energies below the bandgap of DP, the photoexcited hot holes in Gr are transferred to DP. **b.** For the photoexcitation with photon energies above the bandgap of DP, hole transfer from DP to Gr is dominant over the transfer process.