Thermoelectric effect with band offset at lateral junction between ABA and ABC tri-layer graphene

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Abstract

Photocurrent generated at a junction between ABA (Bernal) and ABC (Rhombohedral) stacking in tri-layer graphene has been observed. The Raman spectra of ABA- and ABC- stacked tri-layer graphene have been studied [1], but the photocurrent in tri-layer graphene has not yet been investigated. The photocurrent and the Raman spectra of the tri-layer graphene were measured simultaneously to identify the exact position of the photocurrent and the ABA/ABC junction. We investigated the mechanism of the photocurrent by measuring the back-gate bias dependence of the photocurrent in vacuum. In general, there are two mechanisms for photocurrent without an external bias: the photovoltaic effect from Fermi energy difference and the thermoelectric effect from the Seebeck coefficient difference. Here, we studied the dominant mechanism of the photocurrent in the ABA/ABC stacking junction in tri-layer graphene. We calculated the Fermi energy and the Seebeck coefficients of ABA and ABC stacked tri-layer graphene in order to explain the mechanism of the photocurrent at the junctions. The Fermi energy as a function of the number of electrons is calculated by the density functional theory. The Seebeck coefficient is calculated by the density functional theory and the Boltztrap program. In addition, we measured the photocurrent at junctions between single- and bi-layer graphene for comparison. The experimental photocurrent behavior is consistent with the calculated Seebeck coefficient difference if a band offset of 90 meV (240 meV) is assumed for the ABA/ABC (Single/Bi) junction.

References

[1] T. A. Nguyen, J.-U. Lee, D. Yoon, H. Cheong, Scientific Reports, **4** (2014) 4630.

Figures

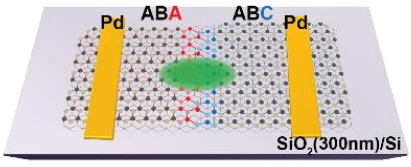

Figure 1 Schematic of ABA/ABC photodevice

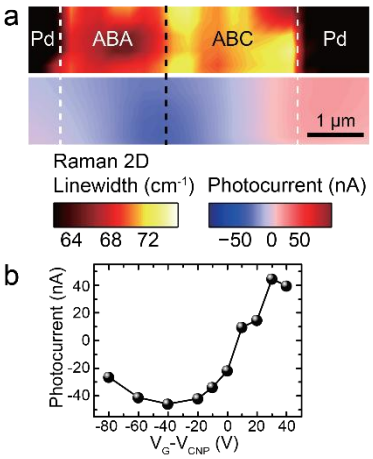

Figure 2 (a) Raman and photocurrent image of ABA/ABC photodevice (b) Gate bias dependence of photocurrent at the lateral ABA/ABC junction