Detection of cyclotron resonance using bulk-contacted graphene device

◦Sabin Park [1], Rai Moriya [1], Yuta Seo [1], Yijin Zhang [1], Satoru Masubuchi [1]

Kenji Watanabe [2], Takashi Taniguchi [2,1], and Tomoki Machida [1,3]

IIS Univ. Tokyo [1], NIMS [2], CREST-JST [3]

E-mail: sabinp@iis.u-tokyo.ac.jp

Owing to the large photo-thermoelectric effect (PTE), cyclotron resonance (CR) in graphene (Gr) has been receiving much attention for infrared photo-detection. Here we demonstrate photo-thermoelectric response in quantum Hall states (QHS) by utilizing bulk-contacted (BC) Gr device. Device structure of BC *h*-BN/Gr/WSe_2/*h*-BN structure is illustrated in Figs. 1(a,b). Inner contact geometry of this device prohibits edge-channel transport of the QHS; thus demonstrate the detection of CR only through bulk region of the QHS. For comparison, conventional edge-contacted (EC) device [Figs. 2(a,b)] is also fabricated. Dual back gate (global Si gate and local graphite gate) is used to detect PTE for single metal/Gr junction.

Image plots of photovoltage (V_{ind}) measured as a function of magnetic field B and carrier density n_e at T = 3 K for these two devices are shown in Figs. 1(c) and 2(c). Strong enhancement of V_{ind} in the high B region due to the CR is observed. Horizontal cross-sections at the resonance B = 8.76 T [Figs. 1(d) and 2(d)] revealed clear difference between the two devices. The BC device exhibited large V_{ind} signal only at the QHS state with filling factor $\nu = \pm 2$. In contrast, in the EC device, V_{ind} signal mainly appear around Dirac point (smaller signal observed at $\nu = \pm 2$) and the amplitude of the signal tends to be smaller than the BC device. Further, we found that the BC device exhibited V_{ind} signal at much higher temperature than the EC device (16.6 μV@150 K and 1.6 μV@42 K, respectively). These clearly demonstrate that different photovoltaic mechanism presented in these two devices.