Valley Hall effect in gapped bilayer graphene

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Abstract

In contrast to the recent progresses on transition metal dichalcogenide (TMD) [1, 2], the optical and optoelectronic valley physics in graphene has never been experimentally studied before. More importantly, the phenomena of valley optoelectronics in gapped graphene are very different from TMD in visible light range. It is orders of magnitude stronger (due to its small gap) [3] and can be controlled by infrared and terahertz (THz) light.
Here, we present the first experimental study of Berry optoelectronics in gapped bilayer graphene. To achieve a bad gap and a non-zero Berry curvature near Fermi level, we have broken the inversion symmetry of bilayer graphene by creating vertical electrical field with top and bottom gates. The resultant band gaps are evidenced and measured by both electrical and photoelectrical means. Electrically, the band gap lead to >100 M ohm resistivity at 30 K and exponentially temperature-dependent drain current. Photoelectrically, the resonance of exciton states with incident infrared light gives rise to several peaks in photocurrent-gap spectrum. Moreover, we have observed and quantified Valley hall voltage in gapped bilayer graphene by exciting photocarriers at one valley with circular-polarized light as schematically shown in Figure 1. These photocarriers show a transverse movement when driven by a longitudinal in-plane electrical field, which creates a transverse valley Hall voltage [4].

References

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Figures

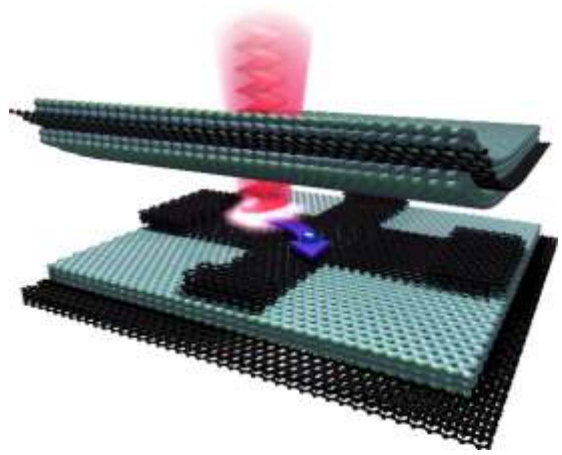

Figure 1: Valley Hall effect in gapped bilayer graphene. Circular-polarized light pumps one valley and generate hall voltage signal.