First-principles study of the optical absorption spectra of electrically gated bilayer graphene

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Inducing a band gap in graphene without degrading its high mobility of free carriers is of importance for graphene-based devices. Recent theoretical and experimental studies have discovered a desired band gap in bilayer graphene by applying perpendicular electric field. Here we have performed first-principles calculations on the electronic structure and optical response of such electrically gated bilayer graphene. We have obtained the induced band gap that is in good agreement with experiment when the applied electric field is less than 1.5 V/nm. The infrared optical absorbance is calculated within the single-particle excitation picture and its fine structures are presented. In addition, the calculated infrared optical absorbance is found to be strongly depending on stacking styles of bilayer graphene and the polarization direction of the incident light, which provides efficient ways to identify the electric-field intensity and stacking styles in experiment. Finally, many-electron effects are discussed.