A Numerical Study of the Electronic Properties of Graphene Bilayer with Local Disorder

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We show that the optical conductivity of bilayer graphene can reveal clearly the metal-insulator transition driven by disorder. We choose the rhombohedral stacking configuration to characterize the graphene bilayer, and introduce the kernel polynomial method (KPM) to provide numerical results of the effect of local disorder on the behaviors of optical conductivity for lattices of considerable size. The Drude weight is found to decrease very rapidly with the increase of disorder and drop to zero at a critical strength W_c, suggesting that Anderson metal-insulator transition can take place. In the superconducting case, the distribution of the inhomogeneous superconducting gap is obtained by solving self-consistently the Bogoliubov-de Gennes equations under the mean-field description, and we see no appreciable change for the critical strength W_c in the superconducting phase. However, the optical conductivity is found to drop significantly as predicted, especially in the weak disorder region.