

## Barrier Lowering in Contacts between Graphene and Semiconductor Materials

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**Abstract :** Graphene-semiconductor contacts have been extensively studied recently, both as a stand-alone diode device for potential applications in photodetectors and solar cells, and as a building block to vertical transistors. Graphene is a two-dimensional nanomaterial with vanishing density-of-states at the Dirac point, which differs from conventional metal. In this work, image-charge-induced barrier lowering (BL) in graphene-semiconductor contacts is studied and compared to that in metal Schottky contacts. The results show that despite of being a semimetal with vanishing density-of-states at the Dirac point, the image-charge-induced BL is significant. The BL value can be over 50% of that of metal contacts even in an intrinsic graphene contacted to an organic semiconductor, and it increases as the graphene doping increases. The dependences of the BL on the electric field and semiconductor dielectric constant are examined, and an empirical expression for estimating the image-charge-induced BL in graphene-semiconductor contacts is provided.

**Keywords :** graphene, semiconductor materials, schottky barrier, image charge, contacts

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