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Fundamental Issues in Graphene: Material Properties and Applications

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Graphene, two-dimensional one-atom-thick planar sheet of carbon atoms densely packed in a honeycomb crystal lattice, exhibits fascinating electrical properties, such as a linear energy dispersion relation and high mobility in addition to a wide-range optical absorption and high thermal conductivity. Graphene's outstanding tensile strength allows graphene-based electronic and photonic devices to be flexible, bendable, or even stretchable. Recently many groups have reported high performance electronic and optoelectronic devices based on graphene materials, i.e. field-effect transistors, gas sensors, nonvolatile memory devices, and plasmonic waveguides, in which versatile properties of graphene materials have been incorporated into a flexible electronic or optoelectronic platform. However, there are several fundamental or technological hurdles to be overcome in real applications of graphene in electronics and optoelectronics. In this tutorial we will present a short introduction to the basic material properties and recent progresses in applications of graphene to electronics and optoelectronics and discuss future outlook of graphene-based devices.

Keywords: graphene, field-effect transistor, gas sensors, nonvolatile memory devices, plasmonic waveguides