Graphene Electronics and Optoelectronics

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Graphene is a two-dimensional, zero-gap semiconductor with linear electron dispersion and rather unique electrical, optical and thermal properties. Despite the absence of a band-gap, the small electric field tuning of its conductance made possible by its linear density-of-states and the exceptionally fast carrier transport make graphene very promising for high-frequency electronic and optical devices. I will first discuss the fabrication and operation of field-effect devices in the GHz range, along with corresponding device physics issues, such as transport mechanisms, role of the metal contacts, chemical doping and energy dissipation. Both extended graphene and nanoribbon devices will be discussed. I will then focus on the use of the photoconductivity of graphene, ultra-wide spectral response, and fast carrier transport in optoelectronic applications in the 100GHz range. Comparisons between the merits of graphene and nanotube devices will be made.