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标题: Graphene applications in electronics and photonics
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来源出版物: MRS BULLETIN 卷: 37 期: 12 页: 1225-1234 DOI: 10.1557/mrs.2012.206
出版年: DEC 2012
在 Web of Science 中的被引频次: 0
被引频次合计: 0
引用的参考文献数: 88
摘要: Graphene is a material with outstanding properties that make it an excellent candidate for advanced applications in future electronics and photonics. The potential of graphene in high-speed analog electronics is currently being explored extensively because of its high carrier mobility, its high carrier saturation velocity, and the insensitivity of its electrical-transport behavior to temperature variations. Herein, we review some of the key material and carrier-transport physics of graphene, then focus on high-frequency graphene field-effect transistors, and finally discuss graphene monolithically integrated circuits (ICs). These high-frequency graphene transistors and ICs could become essential elements in the blossoming fields of wireless communications, sensing, and imaging. After discussing graphene electronics, we describe the impressive photonic properties of graphene. Graphene interacts strongly with light over a very wide spectral range from microwaves to ultraviolet radiation. Most importantly, the light-graphene interaction can be adjusted using an electric field or chemical dopant, making graphene-based photonic devices tunable. Single-particle interband transitions lead to a universal optical absorption of about 2% per layer, whereas intraband free-carrier transitions dominate in the microwave and terahertz wavelength range. The tunable plasmonic absorption of patterned graphene adds yet another dimension to graphene photonics. We show that these unique photonic properties of graphene over a broad wavelength range make it promising for many photonic applications such as fast photodetectors, optical modulators, far-infrared filters, polarizers, and electromagnetic wave shields. These graphene photonic devices could find various applications in optical communications, infrared imaging, and national security.
入藏号: WOS:000311491900011
语种: English
文献类型: Article
KeyWords Plus: SCANNING-TUNNELING-MICROSCOPY; WAFER-SCALE GRAPHENE; LAYER GRAPHENE; EPITAXIAL-GRAPHENE; HIGH-FREQUENCY; BORON-NITRIDE; LARGE-AREA; INFRARED-SPECTROSCOPY; SUSPENDED GRAPHENE; OPTICAL MODULATOR
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出版商: CAMBRIDGE UNIV PRESS
出版商地址: 32 AVENUE OF THE AMERICAS, NEW YORK, NY 10013-2473 USA
Web of Science 类别: Materials Science, Multidisciplinary; Physics, Applied
研究方向: Materials Science; Physics
IDS 号: 042SS
ISSN: 0883-7694

29 字符的来源出版物名称缩写: MRS BULL
ISO 来源出版物缩写: MRS Bull.
来源出版物页码计数: 10