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Development of epitaxial graphene based electronics

WALT DE HEER, Georgia Institute of Technology

Epitaxial graphene (EG) has demonstrated a great potential for novel electronic devices [1]. In micron-sized structures graphene is essentially a gapless semimetal, consequently reasonable on-to-off rations can be achieved, but digital electronics is precluded. There are essentially two methods to introduce a bandgap in graphene. One is to make very small structures [1], and the other is to chemically modify the graphene itself [2]. Electron beam lithography is not commercially viable and the graphene is severely degraded by this method. Graphene's conductivity depends on the doping density. For interconnects, reliable methods need to be developed to highly dope graphene without deteriorating the mobility. Furthermore, metallic interconnects are required for all but the simplest structures and they need to be incorporated without defeating graphene's favorable properties. Finally, in the more distant future, EG device architectures that rely on wave properties of the electrons that go beyond diffusive electronics are envisioned [1]. These will require interconnected, nanoscopic graphene structures. An overview and perspective of these issues will be given. I will present new directions, involving multilayer epitaxial graphene, interconnect schemes, non-conventional patterning methods (templated graphene growth [3] and related methods), as well as methods to chemically modify and dope EG.

[1] Berger et al. "Ultrathin Epitaxial Graphite: 2D Electron Gas Properties and a Route toward Graphene-based Nanoelectronics", J. Phys. Chem. B 108, 2004,19912 (2004); W.A.de Heer http://smartech.gatech.edu/handle/1853/31270
[2] E. Bekyarova, et al, JACS 131, 1336 (2009).
[3] M. Sprinkle, et al., "Epitaxial graphene: Templated graphene growth" Nature NanoTechnology 5, 727, (2010)]