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**Ballistic nanostructures for epitaxial graphene nanoelectronics**

WALT DE HEER, Georgia Institute of Technology

Graphene nanoelectronics [1] was inspired by carbon nanotube electronics. While carbon nanotubes demonstrated advantageous electronic properties, like room temperature ballistic transport, immunity to electromigration and significant bandgaps, manufacturability remains a problem. Independent of other graphene work research at Georgia Tech evolved from the premise that epitaxial graphene on silicon carbide could serve as viable platform for graphene based electronics. Epitaxial graphene (EG), known since the 1970's, is produced by sublimation of Si from the SiC surface. The 2D electronic and structural properties of EG are significantly superior to transferred graphene and, in contrast to transferred graphene, EG is scalable[2]. Nanopatterning is achieved by selective high temperature graphene growth on the sidewalls of structures that are etched in the SiC. These annealed graphene nanostructures demonstrate a host of remarkable properties. Recently 10 $\mu$m scale single channel room temperature ballistic transport ($R=h/e^2 \approx 26$ kOhm) has been observed in neutral graphene sidewall nanoribbons [3] (in contrast, similarly sized exfoliated graphene ribbons are insulators due to disorder). These ballistic nanoribbons, as well as other nanostructures are readily and reliably produced using optical lithography. Remarkably, the ballistic transport does not depend on the microstructure of the ribbon edges, thereby precluding current models for the effect. These ballistic ribbons can be used as quantum wires in graphene nanoelectronics. This breakthrough discovery has revitalized efforts towards the development of high-performance graphene nanoelectronics. In this talk I will present the status quo of this effort. The experiments that demonstrate ballistic transport will be discussed, include recent development of EG transistors with room temperature on-off ratios exceeding $10^6$ and the development of semiconducting EG [4].

[1] C. Berger, et al, Ultrathin epitaxial graphite: 2D electron gas properties and a route toward graphene-based nanoelectronics, J Phys Chem B 108, 19912-19916 (2004).

[2] M. Sprinkle, et al. Scalable templated growth of graphene nanoribbons on SiC, Nat Nanotechnol 5, 727-731 (2010).

[3] J. Baringhaus, et al Exceptional ballistic transport in epitaxial graphene nanoribbons, Nature 506, 349-354 (2014).

[4] J. Kunc, et al. Planar Edge Schottky Barrier-Tunneling Transistors Using Epitaxial Graphene/SiC Junctions, Nano Letters 14, 5170−5175 (2014).