Graphene Nanoelectronics at the Edge

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From the start of graphene electronics research, the primary goal has been to succeed silicon and to develop a graphene platform for 21st century nanoelectronics, analogous to the transition from vacuum tubes to solid state electronics. This requires a graphene platform that is compatible with large scale nanoelectronics processing, and a new electronics paradigm. The pioneering Georgia Tech epigraphene electronics program established 2001 [1] was based on this principle. Originally funded by Intel, it has since produced numerous important breakthroughs [2] including a demonstration of large scale device production [3], and the discovery of elusive edge state with extraordinary electronic properties [4], predicted decades ago. Epigraphene, is graphene that is grown epitaxially on silicon carbide (SiC) crystals. The edge state is a unique coherent 1D topologically protected electronic mode involving both edges of graphene ribbons. It is observed in lithographically patterned, non-polar epigraphene but not in deposited graphene because of pervasive edge disorder. In this talk I will present an overview of the epigraphene program and very recent developments on conventionally patterned epigraphene showing that:

• The transport in graphene ribbons is dominated by the 1D ballistic edge state whose conductance is 1 e^2/h.
• Mean free paths exceed 40 µm even at room temperature, more that 1000 times greater than the 2D bulk.
• The edge state appears to be spin polarized.
• Branched gated edge state networks can be patterned for quasi 1D coherent ballistic nanoelectronics.

Epigraphene is currently the only graphene nanoelectronics platform that is at the edge of being realized. Coherent graphene nanoelectronics has become a distinct possibility.

References

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