An epigraphene platform for coherent 1D nanoelectronics

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Graphene grown epitaxially on electronics grade single crystal silicon carbide wafers (epigraphene) can be grown reproducibly and reliably at very large scale with atomic scale control [1]. Textbook electronic properties of graphene are measured in epigraphene on SiC with no need for transfer. Moreover, narrow ribbons grown on the sidewalls of trenches etched in the SiC substrate are charge neutral, which gives access to the rich physics at the Dirac-point. Epigraphene ribbons on these SiC facets show single channel quantized ballistic conduction on distances greater than 15 µm even at room temperature [2]. We now show [3] that these properties manifest in micron scale epigraphene structures that are conventionally patterned on SiC substrates. In addition, robust quantum coherence and non-local transport are also observed. These properties are explained in terms of a ballistic edge state, as predicted in early theoretical studies. The epigraphene platform allows interconnected nanostructures to be patterned, using standard microelectronics methods, to produce phase coherent 1D ballistic networks.

References

[1] C. Berger, E. Conrad, W. A. de Heer, *Epigraphene*, in: P.C. G. Chiarotti (Ed.) Physics of Solid Surfaces, Landolt Börstein encyclopedia Springer-Verlag, (2018) 727. arXiv:1704.00374.
[2] J. Baringhaus, M. Ruan, F. Edler, A. Tejeda, M. Sicot, A. Taleb-Ibrahimi, A.P. Li, Z.G. Jiang, E.H. Conrad, C. Berger, C. Tegenkamp, W.A. de Heer; Nature 506, (2014) 349.
[3] V. Prudkovskiy, Y. Hu, K. Zhang, Y. Hu, P. Ji, G. Nunn, J. Zhao, C. Shi, A. Tejeda, A. De Cecco, C. Winkelmann, Y. Jiang, T. Zhao, Z. Jiang, L. Ma, C. Berger, W. A. de Heer, arXiv:1910.03697

Figures

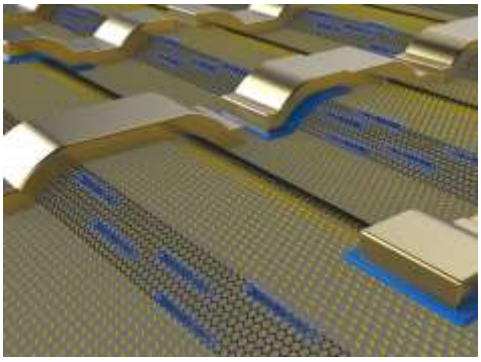

Figure 1: Schematic illustration of a network of ballistic graphene ribbons