Scanning tunneling microscopy and spectroscopy of wet chemically synthesized porous graphene nanoribbons

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The bottom-up wet chemical synthesis of graphene nanoribbons (GNRs) opens interesting opportunities for tailoring the GNR structure with atomic precision [1]. Atomically precise porous GNRs are a new chemically synthesized variation for which the fabrication procedure yielding multiple pores in a single ribbon and the electronic details of the ribbon have not been reported.

In this work, porous GNRs are dry contact transferred in ultrahigh vacuum to clean silicon and III-V semiconducting substrates and examined using UHV scanning tunneling microscopy (STM) and spectroscopy (STS). STM imaging confirms the expected porous structure and indicates a unique electronic feature at the graphene nanopores, and STS measurements indicate a 2.0 eV bandgap.

These results are compared to first-principles DFT simulations in which an increased local density of states at the pores is predicted. A GW correction predicts a 2.89 eV bandgap. Illumination of pore effects in GNRs contributes to an increased understanding of the tunability of GNR electronic structure. Porous GNRs have potential applications in molecular filtration, detection and DNA sequencing.

References

[1] Vo, T. H., Shekhirev, M, Kunkel, D. A., Morton, M. D., Berglund, E., Kong, L., Wilson, P. M., Dowben, P. A., Enders, A., and Sinitskii, A., Nat. Commun., 5 (2014) 3189.

Figures

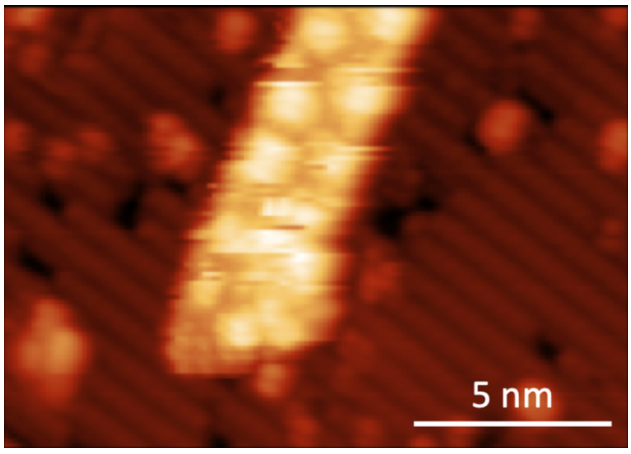

Figure 1: STM image of porous graphene nanoribbon on H:Si(100) (V_{bias} = - 2 V, I = 0.1 nA).