Short Communication Journal of Material Sciences & Engineering 2020
Vol.9 No.7

Advanced Materials 2019: Scanning tunneling microscopy and spectroscopy of wet chemically synthesized porous graphene nanoribbons- Kaitlyn Parsons, University of Illinois at Urbana-Champaign

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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. Atomically precise porous GNRs are a replacement chemically synthesized variation that the fabrication procedures yielding multiple pores during a single ribbon and therefore the electronic details of the ribbon haven't been reported. during this study, porous GNRs are dry contact transferred in ultrahigh vacuum to wash 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 singular electronic feature at the graphene nanopores and STS measurements indicate a 2.0 eV band gap. These results are compared to first-principles DFT simulations during which an increased local density of states at the pores is predicted. A GW correction predicts a 2.89 eV band gap. 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.

Moore's law is that the observation that the transistor density during a chip will double approximately every two years. Scaling below the 10nm node limit for silicon transistors introduces excessive heating and quantum effects, like tunneling of electrons that degrade the performance of the logic device. New materials are required so as to continue scaling and increasing microprocessor chip performance. Two-dimensional materials possess an inherent advantage for continued scaling and have promising electrical properties. Two-dimensional atomic crystals were first experimentally isolated from bulk material in 2004 by K. S. Novoselov, A. K. Geim, et al. during this work, mechanical exfoliation using tape was wont to pull apart layers of highly oriented pyrolytic graphite. This highly reliable procedure leads to a two-dimensional monolayer of carbon atoms during a hexagonal lattice, a cloth referred to as graphene. before this work, free-standing two-dimensional films were thought to be thermodynamically unstable below a critical thickness consisting of a couple of atomic layers. Typically, thin films segregate or decompose thanks to the decreasing film thickness and decreasing melting temperatures. Despite this fact, Novoselov et al. prepared a spread of two-dimensional films using micromechanical cleavage under ambient conditions following the success of graphene. Van der Waals forces hold the layers together within the three-dimensional form. Repeated micromechanical cleavage breaks these weak bonds to make two-dimensional films.

This work is partly presented at 23rd International Conference on Advanced Materials & Nanotechnology, August 19-20, 2019 in Tokyo, Japan