Graphene and Boron Nitride for Atomically Thin Circuitry

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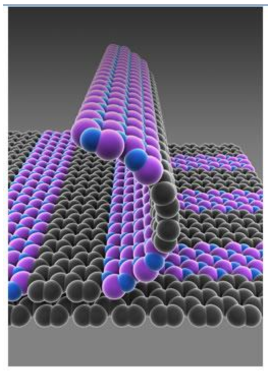
The development of large scale growth methods based on chemical vapor deposition (CVD) has enabled production of single-atom-thick films with diverse electrical properties, including graphene (conductor), *h*-BN (insulator), and MoS_2 (semiconductor). Precise vertical stacking and lateral stitching of these 2D materials will provide rational means for building ultrathin heterostructures with complex functionality. However, large scale production and control of these structures requires new characterization and fabrication approaches.

In this talk, I will first discuss the structure and physical properties unique to polycrystalline CVD graphene. Using the atomic-resolution imaging as well as a dark-field transmission electron microscopy (TEM) technique, our group investigated the structure of grain boundaries in CVD graphene and its impact on the mechanical, electrical, and chemical properties. This allowed us to produce CVD graphene with optimized electrical properties. More recently, we reported a new patterned regrowth method to fabricate 2D lateral heterojunctions entirely made of graphene and *h*-BN, which enables the development of atomically thin integrated circuitry. Our characterization and growth approach would ultimately allow the fabrication of electrically isolated active and passive elements embedded in continuous, one-atom-thick sheets, which could be manipulated and stacked to form complex devices at the ultimate thickness limit.



[1] M. P. Levendorf, C.-J. Kim, L. Brown, P. Y. Huang, R. W. Havener, D. A. Muller, and J. Park, "Graphene and Boron Nitride Lateral Heterostructures for Atomically Thin Circuitry", ***Nature***, 488, 627-632 (2012).

[2] R. W. Havener, H. Zhuang, L. Brown, R. Hennig, and J. Park, "Angle-Resolved Raman Imaging of Interlayer Rotations and Interactions in Twisted Bilayer Graphene", ***Nano Letters***, 12, 3162-3167 (2012).

[3] A. W. Tsen, L. Brown, M. P. Levendorf, F. Ghahari, P. Y. Huang, C. S. Ruiz-Vargas, R. W. Havener, D. A. Muller, P. Kim, and J. Park, "Tailoring Electrical Transport across Grain Boundaries in Polycrystalline Graphene", ***Science***, 336, 1143-1146 (2012).

[4] P. Y. Huang, C. S. Ruiz-Vargas, A. M. van der Zande, W. S. Whitney, M. P. Levendorf, J. W. Kevek, S. Garg, J. S. Alden, C. J. Hustedt, Y. Zhu, J. Park, P. L. McEuen, D. A. Muller, "Grains and Grain Boundaries in Single-Layer Graphene Atomic Patchwork Quilts," ***Nature*** 469, 389-392 (2011).