Fundamental Properties of Graphene Revealed for Device Applications

Supporting/Contributing Agencies: NIST, NSF

Combining a broad range of nanoscale measurement and modeling methods, NIST has revealed fundamental properties of graphene, providing industry with critical knowledge needed to evaluate this potentially revolutionary new material. Graphene is an atomically thin carbon semiconductor—as thin as a sheet one carbon atom thick—predicted to have a unique combination of properties with game-changing applications, ranging from "post-CMOS" electronics to sensitive chemical detectors to transparent electrodes for solar cells. Before these applications can be developed, graphene's fundamental properties must be measured and understood, and practical methods developed to integrate the material into devices without destroying its unique properties. NIST is working closely with the Nanoelectronics Research Initiative (NRI), a consortium of companies, universities, and federal agencies, to address these challenges. Focusing on graphene grown on silicon carbide (SiC), a possible "wafer scale" method of making the material, NIST has combined world-class scanning tunneling microscopy (STM) and spectroscopy measurements with theoretical analysis to reveal on the atomic scale how electrons move through graphene, interact with the substrate, and are affected by defects. This ground-breaking work indicates that it will be feasible to manufacture high-performance graphene electronics on SiC. Through NIST's partnership with the NRI, these accomplishments are already being incorporated into industry's developing plans for this promising nanomaterial.

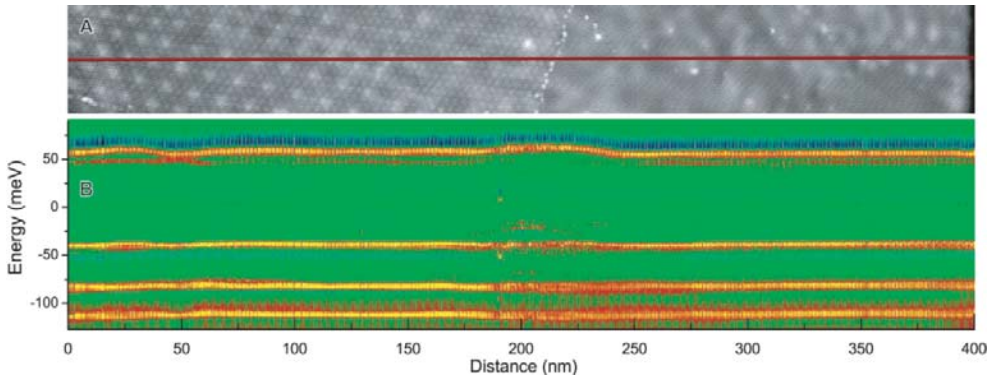

Figure 1. (A) STM image of graphene on SiC, and (B) corresponding spectroscopy of magnetic field-induced electronic levels.

References/Publications/Patents

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