Controlling Orientation, Edge Geometry and Thickness of High Quality Large-area CVD Graphene

Adrian Murdock, Antal Koos, Benjamin Britton, Lothar Houben, Tim Batten, Tong Zhang, Angus J Wilkinson, Rafal Dunin-Borkowski, Christina E Lekka, Nicole Grobert

The industrial exploitation of chemical vapour deposition (CVD) graphene crucially depends on the ability to generate large-area sheets with selected thicknesses, predefined domain orientations, edge geometries, and grain boundaries which govern the electronic structure, chemical activity, and mechanical strength. While attention has been directed at understanding the CVD growth mechanism on polycrystalline Cu, the precise control of CVD graphene remains unsolved. Here we show, both experimentally and theoretically, the implementation of structurally defined Cu substrates in conjunction with low-pressure CVD to generate high quality, tailored graphene with controlled shape, orientation, edge geometry, thickness, and quality. For example, the substrate's crystallographic orientation can be exploited to preferentially orient domain edges parallel to the <110> direction while generating high quality single layer graphene on Cu(111) and bilayer graphene on Cu(001). This research provides a new avenue towards the controlled production of high quality large-area graphene sheets for implementation in transparent conducting electrodes, sensors, and nanoelectronic device applications.