Graphene Topical Conference
Room: Hall 3 - Session GR-TuP

Graphene Topical Conference Poster Session

GR-TuP1 Reduction of Graphene Oxide using Electron Beam Generated Plasmas,
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Graphene and graphene oxide are the subject of intense research because of their unique structural and electronic properties which are advantageous in a large number of applications including nano-electronic and sensing devices. The amount of oxygen present in graphene oxide sheets strongly modifies their properties. Processes aiming to the reduction of oxygen are a current research interest. Wet-chemical approaches have been successful, but these methods have critical drawbacks in terms of scalability and time consumption. Plasma-based processes are an attractive replacement. The electron beam generated plasma developed by the Naval Research Laboratory provides a unique low electron temperature (< 1 eV) plasma and thus any ions leaving the plasma will do so with low ion kinetic energies at substrates. This novel plasma processing technique allows surface modification without excessive etching or surface damage. Experimental investigation of the reactions between plasmas produced in different gases (Ar, CH_4 and/or H_2 mixtures) and graphene oxide in an effort to reduce the concentration of oxygen will be presented. Material characterizations (chemistry, surface energy and surface roughness) and in-situ plasma diagnostics (electron temperature, plasma density) will also be discussed. This work was supported by the Office of the Naval Research. M.B and E.L. appreciate the support of the National Research Council.

GR-TuP2 Covalent Immobilization of Graphene on Solid Substrate,
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Graphene, a two-dimensional atomic thin layer of carbon nanostructure, has emerged as a unique nanoscale material with promising applications in various areas due to its excellent mechanical, electrical, thermal and optical properties. Recently, much attention has been focused on graphene based devices. There is a growing need for developing new, simple, and cost-effective techniques to obtain stable graphene sheets on substrate. We present a simple and efficient method to covalently immobilize graphene on silicon wafers. Large graphene sheets were covalently attached to functionalized wafer surface by a simple heat treatment under ambient condition. The formation of single and multiple layers of graphene were confirmed by Raman spectroscopy, optical and atomic force microscopy. Evidence of covalent bond formation was given by X-ray photoelectron spectroscopy and solvent sonication treatment. In addition, this method can be readily applied to other substrates. This provides a facile approach to the construction of graphene-based integrated circuits on a wide range of substrates. The method offers immense opportunities to investigate how surface and interface chemistry affect the electronic properties and performance of graphene-based electronic devices.

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GR-TuP3 Edge Structures of Graphene Nano-Patches Grown on the 6H-SiC(0001) Surface,
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Graphene nanoribbons (GNR) are currently considered as one of the most promising materials for future nanoelectronic devices due to its exceptional physical properties . We investigated the possibility of the growth of GNR on the vicinal 6H-SiC(0001) surface using Scanning Tunneling Microscopy. We observed the formation of the ribbon-like single-layer graphenes with sharp edge structures at the initial stage of thermal graphitization process of the SiC(0001) surface. However, the overall long-range ordering of the steps of the bare vicinal surface was found out to be lost during graphitization process, and only the local short range ordering of the steps with graphene layer patches existed on the entire surface. From the atom-resolved STM images, we clearly identified the armchair and zigzag edge structure for several ribbon-like graphene nanostructures, and found out that the zigzag structure were more frequently observed than the armchair structure. Scanning tunneling spectroscopy experiment was also carried out over the graphene nano-patches to examine the local electronic states at the edge structures.

GR-TuP4 Graphene on Demand,
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The ultrahigh vacuum (UHV) scanning tunneling microscope (STM) has been utilized for controllably patterning regions of pristine graphene at the nanometer scale from an otherwise hydrogen saturated surface. We have found that the hydrogen saturation of graphene epitaxially grown on 4H:SiC(0001) is stable at room temperature and completely alters the original electronic properties which are no longer graphene-like. In addition to characterizing the structural and electronic properties of the surface at the atomic-scale, we have utilized the STM as a patterning tool via electron stimulated desorption of hydrogen, leaving behind regions of graphene. The STM enables a significant level of control and subsequent characterization of the graphene patterns at the highest resolution. With spectroscopic techniques we are able to extract electronic information of the patterned graphene regions. For patterned regions that are roughly 20 nm or greater, the inherent electronic properties of graphene are completely recovered. Below 20 nm we start to see dramatic variations in the electronic properties of the graphene as a function of pattern size.

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