O 80: Poster Session - Graphene: Adsorption, Intercalation and Doping

Time: Wednesday 18:15–20:00 Location: P2/EG

O 80.1 Wed 18:15 P2/EG

Low-energy ion implantation of Cobalt in graphene investigated by scanning tunneling microscopy — •Anna Sinterhauf[1], Manuel Auge[2], Felix Junge[2], Philip Willke[3], Hans Hofsäss[2], and Martin Wenderoth[1] — [1]IV. Physikalisches Institut, Universität Göttingen, Germany — [2]II. Physikalisches Institut, Universität Göttingen, Germany — [3]Center for Quantum Nanoscience, Institute for Basic Science (IBS), Republic of Korea

To tailor the properties of a graphene sheet by band structure engineering, the issue of doping is decisive to turn graphene into a true device material. For this purpose, a direct incorporation of foreign atoms into the graphene layer by low-energy ion beam implantation has shown to be a versatile method [1] as demonstrated for B and N. Here, we report on the successful implantation of Cobalt atoms into the graphene lattice achieved by low-energy Cobalt implantation at an ion energy of 20eV. After transfer through air, reinsertion into UHV and annealing at 400°C for 30 minutes, the structural and electronic properties of the ion implanted epitaxial graphene are investigated by scanning tunneling microscopy and spectroscopy (STS). Contrary to B and N [1], we find a negligible charge transfer from Co to graphene in agreement with theoretical considerations [2]. In addition, at the topographic position of the defects, STS reveals a pronounced peak in dI/dV-spectra at zero bias voltage. Financial support by the DFG through project We 1889/13-1 is gratefully acknowledged.

[1] P. Willke et al., Nano Lett. 15(8), 5110-5115, 2015
[2] E. J. G. Santos et al., Phys. Rev. B 81, 125433, 2010

O 80.2 Wed 18:15 P2/EG

Doping of ta-C by ultra-low energy implantation — •Felix Junge, Manuel Auge, and Hans Hofsäss — II. Institute of Physics, Georg-August-University Göttingen, 37077 Göttingen, Germany

Doping of graphene to change its electrical properties is highly desirable. To achieve this, we use a unique mass-selected ion beam deposition system, which makes it possible to work in an energy range of $10 < E < 600\,\mathrm{eV}$ for implantation and thus to implant into a 2D-lattice. In order to test the possible implantion in graphene with different elements, we perfomed ultra low-energy (10-25 eV) implantation in layers of tetrahedral amorphous carbon (ta-C) on silicon. Fluence and retention rate were measured after implantation with RBS using a 860 keV He^{2+}-beam and NRA to analyze the light elements using a 430 keV proton beam. With this setup a detection limit for e.g. boron of about $6 \cdot 10^{13}$ B/cm^2 in 1000 s could be achieved. Furthermore, the measurement results were compared with simulations done with SDTrimSP. Successful implantation was possible for e.g. He, B, N, Ne, P, Ar, Cr, Mn, Fe, Co, Se and Au.

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O 80.3 Wed 18:15 P2/EG

Structural and local electronic properties of clean and Li-intercalated graphene on SiC(0001) — •Maryam Omidian[1], Nicolas Néel[1], Eberhard Manske[2], Jörg Pezoldt[3], Yong Lei[1], and Jörg Kröger[1] — [1]Institut für Physik, Technische Universität Ilmenau, D-98693 Ilmenau, Germany — [2]Institut für Prozess- und Sensortechnik, Technische Universität Ilmenau, D-98693 Ilmenau, Germany — [3]Institut für Mikro- und Nanoelektronik, Technische Universität Ilmenau, D-98693 Ilmenau, Germany

A low-temperature scanning tunneling microscope has been used to study the graphene-SiC(0001) interface before and after Li intercalation. For clean graphene, spectroscopy of the differential conductance corroborates previous theoretical findings for the interfacial electronic structure (M. Kajihara et al., Surf. Sci. 647, 39 (2016)). An unambiguous relation between the spectroscopic onset of the interface states with changes in STM images is presented. Li intercalation induces a shift of the Dirac point to lower energies and efficiently suppresses the interface states.

O 80.4 Wed 18:15 P2/EG

Intercalation of silver between graphene and silicon carbide studied by PEEM and AFM — •Philipp Weinert[1,2], Richard Hönig[1,2], Ulf Berges[1,2], and Carsten Westphal[1,2] — [1]TU Dortmund, Dortmund, Deutschland — [2]DELTA, Dortmund, Deutschland

Due to its outstanding electronic and mechanical properties graphene is of particular interest for many applications, for example as a new material in transistor applications, or constructing microscale structures.

In this study the intercalation of silver between one layer of graphene, the so called buffer layer, and the silicon carbide substrate is investigated. Other studies have shown, that covalent bounds between the silicon carbide and the buffer layer are released by intercalation, which leads to quasi free standing graphene.

To achieve the intercalation, samples have been coated with thin silver-films of different thicknesses. Subsequently, the samples were annealed to initiate the intercalation. In different steps of the annealing process, photoemission electron microscopy (PEEM) has been carried out to investigate the work function of the surface. This investigation has proven that silver intercalated underneath the buffer layer during the annealing. Furthermore, atomic force microscopy (AFM) has been carried out to investigate the topography of the samples after the intercalation. This study has shown that a small part of the silver does not intercalate, but forms islands on the surface.

O 80.5 Wed 18:15 P2/EG

Proximity superconductivity in hydrogen-intercalated graphene on 6*H*-SiC(0001) — •Tobias Birk[1], Fabian Paschke[1], Ulrich Starke[2], and Mikhail Fonin[1] — [1]Fachbereich Physik, Universität Konstanz, 78457 Konstanz, Germany — [2]Max Planck Institute for Solid State Research, Heisenbergstr. 1, 70569 Stuttgart, Germany

Here we investigate the superconducting proximity effect in hydrogen-intercalated graphene on 6*H*-SiC(0001) by means of scanning tunneling microscopy and spectroscopy. We epitaxially grow Pb islands (width 10-50 nm, thickness 4-15 monolayers) on top of the quasi-free standing monolayer graphene. Low bias tunneling spectra measured at 1.8 K show a bulk-like BCS gap on top of the islands. The critical field of the Pb islands is found to strongly correlate with size and number of monolayers. The variations of the proximity-induced superconducting gap is measured on graphene in the vicinity of Pb islands, both as function of spatial position and magnetic field strength. Our study provides a foundation for realization of graphene-superconductor heterostructures on large-scale SiC(0001) wafers suitable for future technological applications.

O 80.6 Wed 18:15 P2/EG

Hydrogen treatment of bilayer graphene — •Claus F. P. Kastorp[1], Andrew M. Cassidy[1], Anders L. Jørgensen[2], Marta Scheffler[1], Paolo Lacovic[3], Silvano Lizzit[3], Liv Hornekaer[1], and Richard Balog[1] — [1]Dept. of Physics and Astronomy, Aarhus University, Aarhus, Denmark — [2]The Mads Clausen Institute, SDU NanoSYD, Sønderborg, Denmark — [3]Elettra Sincrotrone Trieste, Basovizza, Italy

In single layer graphene on Ir(111), hydrogenation causes a tunable band gap, [1]. Starting with bilayer graphene on Ir(111), one may produce diamane, a 2D equivalent of diamond [2], with the same approach.

I will present the results of STM and XPS measurements of MBE grown bilayer graphene on Ir(111) exposed to either excited H_2 molecules or hot atomic hydrogen under different conditions.

The processes leading to different hydrogenated structures will be investigated and explained.

[1] Balog, et al. Nature materials 9.4 (2010): 315.
[2] Leenaerts, et.al., Phys. Rev. B, 80.24 (2009): 245422.