O 15: Graphen: Adsorption, intercalation and doping I (joint session O/TT)

Time: Monday 15:00–16:30 Location: MA 043

O 15.1 Mon 15:00 MA 043

Intercalation of epitaxial graphene: possible mechanisms — •Mikolaj Lewandowski[1], Ewa Madej[2], Zygmunt Milosz[1], Dorota Wilgocka-Slezak[2], Michal Hermanowicz[3], Nika Spiridis[2], Jozef Korecki[2], Stefan Jurga[1], and Feliks Stobiecki[1] — [1]NanoBioMedical Centre, Adam Mickiewicz University, Umultowska 85, 61-614 Poznan, Poland — [2]Jerzy Haber Institute of Catalysis and Surface Chemistry, Polish Academy of Sciences, Niezapominajek 8, 30-239 Krakow, Poland — [3]Institute of Physics, Poznań University of Technology, Piotrowo 3, 60-965 Poznan, Poland

Intercalation of epitaxial graphene (EG) with atoms of various elements may modify EG's structure and electronic properties, which is related both to the weakening of the graphene-support interaction, as well as the interaction of graphene with the intercalated material. We used scanning tunneling microscopy (STM), low energy electron microscopy (LEEM) and low energy electron diffraction (LEED) to study the mechanisms of intercalation of epitaxial graphene (EG) grown on Ru(0001) by thermal decomposition of ethylene (C_2H_4). The results revealed direct influence of graphene's preparation method on its structure and the intercalation mechanisms. The experimental results were supported by theoretical ab initio calculations.

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O 15.2 Mon 15:15 MA 043

Modification of the graphene/SiC(0001) interface by intercalation of antimony — •Susanne Wolff[1], Florian Speck[1], Martina Wanke[1], Felix Timmermann[2], Manfred Albrecht[2], and Thomas Seyller[1] — [1]Professur für Technische Physik, TU Chemnitz, Reichenhainer Str. 70, D-09126 Chemnitz, Germany — [2]Lehrstuhl für Experimentalphysik IV, Universität Augsburg, Universitätsstr. 1 Nord, D-86159 Augsburg, Germany

Sublimation growth of graphene on SiC(0001) in argon atmosphere is a well-established method for the preparation of graphene. The first grown carbon layer is partially covalently bound to the Si atoms of the substrate. This so-called buffer layer lacks the electronic properties of graphene. A decoupling of the buffer layer from the SiC substrate can be achieved by intercalation, resulting in quasi-freestanding graphene, with electronic properties tuned by the choice of the intercalant.

We use x-ray photoelectron spectroscopy and angle-resolved photoelectron spectroscopy to investigate the intercalation of antimony. Antimony was deposited on the buffer layer by molecular beam epitaxy. Subsequent annealing in argon at atmospheric pressure results in an intercalation of metallic and oxidized antimony. A pre-intercalation annealing in argon enables an intercalation of metallic antimony only, resulting in a moderate n-type doping of the quasi-freestanding graphene.

O 15.3 Mon 15:30 MA 043

Sulfur intercalation underneath single-layer graphene on Ru(0001) — •Lars Buss[1], Moritz Ewert[1,2], Jens Falta[1,2], and Jan Ingo Flege[1,2] — [1]Institute for Solid State Physics, University of Bremen, Germany — [2]MAPEX Center for Materials and Processes, University of Bremen, Germany

The strong binding of epitaxially grown single-layer graphene to a wide range of transition metals has detrimental influence on its electronic properties. However, by lifting the interlayer coupling, e. g., via intercalation routes, its unique electronic properties can be restored. We have investigated the interaction of sulfur with single-layer graphene grown on Ru(0001) by ethylene exposure under UHV conditions with *in situ* low-energy electron microscopy (LEEM) and micro-diffraction (μLEED). At elevated temperature and under dimethyl disulfide background pressure, we observe that sulfur intercalates through the open edges of the graphene islands and proceeds along the substrate steps. Prolonged exposure to sulfur is also seen to induce cracking of the graphene islands perpendicular to the substrate steps, consistent with substantial relief of tensile strain after successful sulfur insertion underneath the graphene. This interpretation is backed by μLEED patterns collected from single graphene islands that consist of an incoherent superposition of the LEED patterns observed individually for pure graphene as well as pure sulfur adsorption on the clean Ru surface, indicating that the graphene layer is virtually decoupled from the substrate.

O 15.4 Mon 15:45 MA 043

Photoemission study of the intercalation of transition metals underneath graphene on silicon carbide — •Richard Hönig, Philipp Espeter, Peter Roese, Karim Shamout, Ulf Berges, and Carsten Westphal — Experimentelle Physik I, TU Dortmund, Otto-Hahn-Strasse 4a, 44227 Dortmund, Germany

Silicon carbide (SiC) is among the most promising substrates on the route to real-life graphene (G) applications. While the basic properties of G/SiC were well elucidated during the past decade, present research is focused on G/SiC as a building block of multilayer systems. In our study we analyze the interaction of G/SiC with magnetic transition metals in order to explore the potential for spintronic applications. Here, cobalt and nickel are most interesting due to a well-matched lattice constant.

The 6H-SiC(0001) samples are prepared by annealing in argon gas at atmospheric pressure leading to large-area growth. Then the sample is covered with thin transition metal films with thicknesses up to a few nanometers. Our main characterization methods are threshold photoemission electron microscopy (PEEM) and synchrotron based photoelectron spectroscopy (PES).

We performed a film thickness and temperature dependent study for Co on G/SiC and will present series of PEEM images acquired during in-situ sample annealing. Furthermore, on the basis of PES spectra we discuss the electronic structure of our sample system. Finally, we are looking forward to present first PEEM images of this sample system acquired with circularly polarized soft x-rays.

O 15.5 Mon 16:00 MA 043

Decoupling of the graphene/ferromagnet interface by gold intercalation: Effect on optical constants — •Christine Jansing[1], Hans-Christoph Mertins[1], Markus Gilbert[1], Maxim Krivenkov[2], Andrei Varykhalov[2], Oliver Rader[2], Andreas Gaupp[2], Andrey Sokolov[2], Hud Wahab[3], Heiko Timmers[3], Dominik Legut[4], and Peter M. Oppeneer[5] — [1]Münster University of Applied Sciences, Stegerwaldstr. 39, D-48565 Steinfurt — [2]Helmholtz-Zentrum Berlin für Materialien und Energie, Albert Einstein Str. 15, D-12489 Berlin — [3]University of New South Wales, Canberra, ACT 2600, Australia — [4]IT4Innovations Center, VSB-Technical University of Ostrava, CZ-708 33 Ostrava, Czech Republic — [5]Department of Physics and Astronomy, Uppsala University, S-75120 Uppsala, Sweden

X-ray absorption and reflectance spectroscopy of linearly polarized synchrotron radiation across the carbon 1s edge of graphene/Co/W and graphene/Ni/W is utilized to investigate the effect of gold intercalation on the complex optical constants of these systems. The p_z-orbitals of graphene hybridize strongly with the $3d$ states of the ferromagnetic substrate. Hybridization effects can be reduced by intercalation of gold which also leads to a change in the optical constants. A complete set of optical constants was determined, describing the π*- and σ*- resonances of graphene. The absorption index k was directly deduced from the measured absorption spectra whereas the refractive index n has been extracted from k via a Kramers-Kronig transformation. Based on these optical constants reflection spectra have been simulated that are in good agreement with our experimental data.

O 15.6 Mon 16:15 MA 043

Graphene protected surface state on Ir(111) with adsorbed lithium — •Predrag Lazic[1] and Petar Pervan[2] — [1]Rudjer Boskovic Institute, Zagreb, Croatia — [2]Institute of Physics, Zagreb, Croatia

It is well known that electronic surface states get strongly perturbed upon the chemical adsorption of very small amount of adsorbates. Adsorption of lithium atoms on Ir(111) is no expection to that rule. Iridium surface state get strongly perturbed and is practically eradicated - it can not be seen as a sharp peak in the ARPES measurement. However, if the graphene is added on top of Ir/Li system the iridum surface state magically reapears. We present a combined experimental and theoretical study of the described system. Using the density funcional theory calculations for large unit cells with disordered lithium atoms geometries on the (111) surface of iridium we were able to reproduce the results of the ARPES measurements -showing clearly that the surface state signal is strongly suppresed when lithium is adsorbed, while it is almost unchanged when lithium is intercalated (i.e. with graphene on top of it). Looking at the projected density of states we constructed a rather simple model explaining this behavior which seems to be general.