O 73: Graphene: Growth, structure and substrate interaction – Poster

Time: Wednesday 18:00–20:00 Location: P2

O 73.1 Wed 18:00 P2

Towards enhanced spin-orbit coupling in epitaxial graphene via Pb intercalation — •Markus Gruschwitz[1], Sergii Sologub[1,2], Hoyeon Jeon[3], Saban Hus[3], An-Ping Li[3], and Christoph Tegenkamp[1] — [1]Institut für Physik, TU Chemnitz, Germany — [2]Institute of Physics, NAS of Ukraine, Kyiv, Ukraine — [3]CNMS, ORNL, Oak Ridge, USA

The design of noval quantum phases by combining low dimensional materials poses the next evolution step of electronics. Intercalated epitaxial graphene on SiC embodys a van-der-Waals heterostack with well defined lattice arrangement. Stabilizing monolayers of heavy elements in proximity to graphene, potentially enhances the spin-orbit interaction (SOI) in graphene. Using Pb as intercalant, we reliably decouple and neutralize graphene by minimizing the substrate influence. At the interface coexisting striped and hexagonal superstructures emerge from local strain and density variations in the Pb monolayer. [1] Multiprobe transport measurements, assisted by finite element simulations, revealed a temperature dependent resistance. This emergent behavior was attributed to a gap opening in graphene in the order of 3-5 meV. [2] Tip–sample spacing dependent spectroscopy supports this finding by a clearly reduced density of states at the Dirac point. The desired enhanced intrinsic SOI competes with Rashba-SOI and modulations of the sublattice potential by the Pb superstructure. Although the nature of this gap was not revealed yet, it has potential to stabilize a quantum spin Hall state. [1] Adv. Mater. Interfaces 12, 21: e00617 (2025) [2] Phys. Rev. B 109, 245430 (2024)

O 73.2 Wed 18:00 P2

Graphene-Based Coatings on Titanium Alloy for Implants — •Franziska Gladitz[1], Christof Neumann[1], Guobin Jia[2], Jonathan Plentz[2], and Andrey Turchanin[1] — [1]Friedrich-Schiller-University Jena, Institute of Physical Chemistry, Jena, Germany — [2]Leibniz-Institut of Photonic Technology (Leibniz-IPHT), Jena, Germany

Titanium alloy implants are essential for bone replacement surgeries; however, they are susceptible to infection. To improve their antimicrobial properties, we develop graphene-based coatings on the implant substrates (alloy Ti6Al4V), taking advantage of the antibacterial and biocompatible properties of graphene (G) or graphene oxide (GO). For this purpose, the titanium alloy is coated with G or GO nanosheets using different coating techniques like double self-assembly procedure and electrochemical deposition. The coatings are characterized using complementary characterization techniques including scanning electron microscopy (SEM), X-ray photoelectron spectroscopy (XPS), Raman spectroscopy, atomic force microscopy (AFM) and optical microscopy. The morphological and chemical properties of the obtained graphene coatings are analyzed in respect to their growth conditions to elucidate influences on the quality, uniformity, and possible biofunctional performance.

O 73.3 Wed 18:00 P2

Graphene on 4H-SiC and 6H-SiC: The Influence of the SiC-Polytype onto the Local Transport Properties of Graphene — •Simeon Bode[1], Benno Harling[1], Klaus Pierz[2], Teresa Tschirner[2], and Martin Wenderoth[1] — [1]IV. Physikalisches Institut, Georg-August-Universität Göttingen — [2]Physikalisch-Technische Bundesanstalt (PTB), Braunschweig

Studies of Graphene on silicon carbide have shown a strong dependence of the surface termination of the SiC substrate on the local transport properties. In this study, we investigate the influence of the polytype of the substrate SiC onto the local properties of Polymer Assisted Sublimation Growth (PASG) graphene. It is known that graphene on 6H-SiC displays two distinct surface terminations [1], while on 4H-SiC it is only one dominant surface termination. Here, local characterization is done by AFM and STM, while the local electronic properties are investigated by STS. Graphene on both polytypes present a similar characteristic in multibias topographies. To gain access to local transport properties, we utilized Scanning Tunneling Potentiometry (STP), which revealed two distinct sheet resistances attributed to the different surface terminations. Although PASG graphene on 4H-SiC shows only one surface termination, the spread of the sheet resistance is much larger than the difference of the two distinct sheet resistances on 6H-SiC. This work was financially supported by the DFG through the FOR5242. [1] Sinterhauf et al., Nat Commun 11, 555, 2020

O 73.4 Wed 18:00 P2

Sn intercalation of Zero-Layer Graphene — •Jan-Lucas Hornbostel, Benno Harling, and Martin Wenderoth — IV. Physikalisches Institut, Georg-August Universität Göttingen

Graphene is a 2D material with a wide range of potential applications. Our research area is the intercalation of epitaxial graphene with tin, a system that has recently shown interesting phenomena such as Mott states [1]. To achieve such systems, zero-layer graphene (ZLG) as starting point is intercalated. Tin binds to the SiC substrate transforming the ZLG into quasi-freestanding monolayer graphene. ZLG graphene can be epitaxially grown on SiC using various methods. The intercalation of Sn on polymer assisted sublimation growth (PASG) samples has shown to be strongly influenced by substrate steps [2]. In this study, we grow ZLG samples using resistive heating under UHV conditions on 6H-SiC. Compared to PASG, AFM and KPFM reveal a weakness of UHV growth for producing high quality ZLG samples, namely a generally disorder structure and depressions within the terraces. This type of defects disappears at higher temperatures. After ZLG growth and verification, Sn is deposited. We focus specifically on the influence of sample temperature (120-1000 K) during deposition. These are analyzed using AFM and KPFM. [1] Ghosal et al, Phys. Rev. B 111, 235426, 2025 [2] Harling et al, Carbon 244, 120711, 2025

O 73.5 Wed 18:00 P2

Ca-intercalation of epitaxial monolayer graphene — Luqman Mahdi Syed[1,2], Niclas Tilgner[1,2], •Philip Schädlich[1,2], and Thomas Seyller[1,2] — [1]Institut für Physik, Technische Universität Chemnitz — [2]Research Center for Materials, Architectures and Integration of Nanomembranes (MAIN), Technische Universität Chemnitz

Realizing proximity-induced correlation effects, such as superconductivity, in graphene is a major challenge in the field of research on two-dimensional (2D) materials. Among the graphite intercalation compounds (GICs), the Ca-GICs exhibit the highest critical temperature with T_c=11.5 K, where the electron doping from the Ca atoms may be a crucial factor. Hence, expanding this superconducting phase into the 2D limit of epitaxial monolayer graphene (EMLG) on SiC(0001) requires precise control over the arrangement of the intercalated Ca atoms. However, several structural models have been proposed for Ca-intercalated EMLG, and in particular, the vertical position - i.e., the gallery - in which Ca resides remains unresolved (S. Ichinokura et al. 2016 ACS Nano 10 2761, J.C. Kotsakidis et al. 2020 Chem. Mater. 32 (15) 6464). Here, we investigate Ca-intercalation into EMLG grown by polymer-assisted sublimation growth. Using x-ray and angle-resolved photoemission spectroscopy, we monitor the intercalation process and quantify the doping level. Our results indicate the saturation of the SiC interface by Ca. We observe the low-energy bands of the resulting intercalated bilayer graphene, and more interstingly regarding the superconducting state, a highly doped graphene π-band, which may point towards the presence of calcium in the upper gallery.

O 73.6 Wed 18:00 P2

Porphyrin derivatives on Graphene/Cu(111) — •Asma Khizar, Christophe Nacci, and Leonhard Grill — Department of Physical Chemistry, University of Graz, Heinrichstrasse 28, 8010 Graz, Austria

Molecules as well as their assemblies and reactions have been widely investigated on single-crystal metal samples, which represent a highly defined flat support for efficient diffusion and high-resolution imaging by scanning probe microscopy (STM). However, the interaction between the metal and the molecule can alter the intrinsic properties of the molecules, making a decoupling layer essential to understand the pristine molecular properties. Graphene, with its two-dimensional structure and weak interaction with adsorbates, serves as an excellent decoupling layer for molecules. On epitaxial graphene, the reduced molecule-metal interaction allows molecules to retain their intrinsic electronic features while still sensing the underlying metal, which influences adsorption energy and selective interactions. In this study, we use Cu(111) as a substrate for graphene growth, due to its cleanliness and minimal lattice mismatch. Our focus is on chemical reactions of porphyrin derivatives on the graphene layer, thus at a distance from the copper catalyst. Various stimuli are used to controllably dissociate side groups from the molecules and induce covalent coupling to get better insight into the chemical reactions.