O 51: Poster Session IV: Poster to Mini-Symposium: Free-standing functional molecular 2D materials II

Time: Tuesday 13:30–15:30 Location: P

O 51.1 Tue 13:30 P

Proton and Li-Ion Permeation through Graphene with Eight-Atom-Rings Defects — •Eoin Griffin — Department of Physics and Astronomy & National Graphene Institute, The University of Manchester, Manchester

Defect-free graphene is impermeable to gases and liquids but highly permeable to thermal protons. Atomic-scale defects such as vacancies, grain boundaries and Stone-Wales defects are predicted to enhance graphene's proton permeability and may even allow small ions through, whereas larger species such as gas molecules should remain blocked. These expectations have so far remained untested in experiment. Here we show that atomically thin carbon films with a high density of atomic-scale defects continue blocking all molecular transport, but their proton permeability becomes ~1,000 times higher than that of defect-free graphene. Lithium ions can also permeate through such disordered graphene. The enhanced proton and ion permeability is attributed to a high density of 8-carbon-atom rings. The latter pose approximately twice lower energy barriers for incoming protons compared to the 6-atom rings of graphene and a relatively low barrier of ~0.6 eV for Li ions. Our findings suggest that disordered graphene could be of interest as membranes and protective barriers in various Li-ion and hydrogen technologies.

O 51.2 Tue 13:30 P

From self-assembled monolayers to highly functional substrates for cryo-transmission electron microscopy (cryoTEM) — •Andreas Terfort — University of Frankfurt, Department of Chemistry, Institute of Inorganic and Analytical Chemistry, Max-von-Laue-Str. 7, 60438 Frankfurt, Germany

Major problems for the cryo-transmission electron microscopy (cryoTEM) of proteins are the stabilization of the nm-thick water film and the preservation of the particles within the field of observation without denaturation. Here we report three approaches to produce TEM grids suitable for the task.

1) Covering the supporting carbon films with a hydrophilic film to suppresses adhesion of proteins. This could be extended by introduction of carbon nanotubes, covered by the same kind of molecular film to aid charge dissipation during observation.

2) The cross linking of a polyglycerol-SAM resulted in ultrathin hydrogel membranes, which help the distribution of the unaltered proteins. Self-perforation of the membranes during the deposition process opened windows for an unaltered observation by the electron beam.

3) The modification of the hydrogel membrane with selective binding sites, by formation on-top of carbon nano-membranes, which in turn are obtained by cross-linking of aromatic monolayers by electron-beam irradiation. The bi-layer system is then modified covalent attachment of a selective binding site, which allows for the selective extraction of the analyte from e.g. protein mixtures.

O 51.3 Tue 13:30 P

The impact of domain walls on broken symmetry states in suspended dually-gated bilayer graphene — •Fabian Rudolf Geisenhof[1], Felix Winterer[1], and R. Thomas Weitz[1,2,3,4] — [1]Physics of Nanosystems, Department of Physics, Ludwig-Maximilians-Universität München, Amalienstrasse 54, Munich 80799, Germany — [2]Center for Nanoscience (CeNS), Schellingstr. 4, Munich 80799, Germany — [3]Munich Center for Quantum Science and Technology (MCQST), Schellingstrasse 4, Munich 80799, Germany — [4]1st Physical Institute, Faculty of Physics, University of Göttingen, Friedrich-Hund-Platz 1, Göttingen 37077, Germany

Bilayer graphene exhibits a rich variety of broken symmetry states due to its various internal degrees of freedom and non-vanishing density of states at the charge neutrality point. Most important for their emergence is the cleanliness of the graphene, however, also the existence of structural and electronic domain walls in bilayer graphene can heavily affect the quantum transport. Here, we present an extensive study on several dual-gated freestanding bilayer graphene devices, giving evidence that domains within a device change its transport properties significantly. Besides suppressing the insulating spontaneous ground state, domain walls alter the electric field dependence of quantum Hall states.

O 51.4 Tue 13:30 P

Crystalline and amorphous graphene from aromatic precursors — •Katayoun Gharagozloo-Hubmann[1], Tibor Lehnert[2], Niclas Sven Mueller[1], Patryk Kusch[1], Ute Kaiser[2], and Stephanie Reich[1] — [1]Department of physics, Freie Universität Berlin, Arnimallee 14, 14195 Berlin, Germany — [2]Ulm University, Central Facility of Electron Microscopy, Electron Microscopy Group of Materials Science, Albert Einstein Allee 11, Germany

We study the growth of graphene from (poly)aromatic precursors that react on a substrate while preserving their sp2 structure. These precursors require lower growth temperatures, produce specific types of defects and are self-limited to a monolayer. The growth temperature ($T<500°C$) for p-Terphenyl is far below the typical growth temperature ($T>900°C$) from the gaseous precursors. Spherical and chromatic aberration-corrected high-resolution transmission electron microscopy and Raman investigations verify the grown structures: Amorphous and crystalline domains are grown from p-Terphenyl molecules. Correlative near field microscopy and spectroscopy (tip enhanced Raman spectroscopy) confirm the co-exist of both domains. Confocal micro-Raman spectra depict the structure observed by high-resolution TEM as well. Larger precursor molecules Di(naphthylen)anthracene led to the growth of polycrystalline graphene. We present a synthesis route, which delivers monolayered 2-D-carbonmaterial with different degree of order. Amorphous, polycrystalline and also crystalline graphene can be produced by modifying the synthesis condition.