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Einladung
zum
Physikalischen Kolloquium
Montag, 14.12.2015
16:15 Uhr in N24/H13

Professor Dr. Jannik C. Meyer
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Wien, Austria

Exploring 2D materials via high-resolution electron and scanned probe microscopies

The microscopic characterization of two-dimensional materials, and low-dimensional matter in general, poses unique challenges but also opens unique new avenues that are different from those of 3-D bulk structures or the surfaces of 3D crystals. In this talk, I will discuss some of these aspects in connection

with high-resolution electron microscopic studies as well as scanning probe investigations. The study of nano-carbons and other low-atomic number materials remains a particular challenge for high resolution transmission electron microscopy (HRTEM) or scanning transmission electron microscopy (STEM) owing to their intrinsically low contrast and high susceptibility to radiation damage. However, the recent developments in aberration-corrected electron optics open a route to atomically resolved studies of these materials at reduced electron energies, below the knock-on threshold of carbon atoms in graphene [1]. I will present insights to this class of materials from electron microscopic studies with single-light-atom precision. At the same time, the electron microscope can be used to structure and modify graphene with highest resolution and with a direct feedback [2]. We analyzed the mechanisms behind beam-driven structural changes and demonstrate how a controlled modification, beyond the ejection of atoms, can be achieved. As a complementary tool of atomic-level analysis, scanning probe microscopy and in particular scanning tunneling microscopy (STM) is frequently used for studying graphene and related materials. While most studies focus on "supported" graphene and other 2D materials, I will discuss STM studies with freely suspended graphene membranes. I will show initial results from a dual-probe STM setup where a free-standing graphene membrane is probed simultaneously from opposing sides [3], so that at the closest point, the two probes are separated only by the thickness of the membrane. In this way we could measure the deformations induced by one STM probe on a free-standing membrane with an independent second probe, reveal different regimes of stability of few-layer graphene, and show how the STM probes can be used as tools to shape the membrane in a controlled manner.

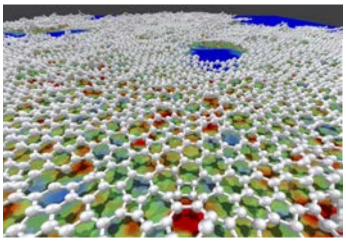
References:

[1] J. C. Meyer et al., Nano Lett. **8**, 3582 (2008); J. C. Meyer et al., Nano Lett. **9**, 2683 (2009); C. Gomez-Navarro, J. C. Meyer et al., Nano Lett. **10**, 1144 (2010); J. C. Meyer et al., Nature materials **10**, 209 (2011); J. C. Meyer et al., Phys. Rev. Lett. **108**, p. 196102 (2012); J. Kotakoski et al., Nano Lett. **9**, 5944 (2015).

[2] J. Meyer et al., Appl. Phys. Lett. 92, 123110 (2008); J. Kotakoski et al., Phys. Rev. Lett. 106, 105505 (2011); J. Kotakoski, C. Mangler, J. C. Meyer., Nat. Comm. **5**, 3991 (2014); F. Eder et al., Sci. Rep. **4**, 4060 (2014).

[3] F. Eder et al., Nano Letters **13**, 1934 (2013); S. Hummel et al,. unpublished (2015).

[4] We acknowledge funding from the European Research Council (ERC) Project No. 336453-PICOMAT and the Austrian Science Fund (FWF) through Grant No. P25721-N20, M1481-N20, and I1283-N20



The atomic structure of two-dimensional amorphous carbon. The projected atomic position are directly obtained from experimental images. Color in the background shows the local atomic density, from blue in areas of low density, via green to red in regions where atoms are closest together (F. Eder et al., Sci. Rep. 4, 4060, 2014).

Ab 16.00 Kaffee, Tee und Kekse vor dem Hörsaal H13

Organisation: Prof. Dr. F. Jelezko, Tel. 23750

Host: Prof. Dr. U. Kaiser, Tel. 22950, off.: 22951