Public Presentation at the Faculty of Physics

Date: Wednesday, 20 February 2019

Place: Ernst-Mach lecture hall, 2nd floor, Boltzmanngasse 5, 1090 Wien

Time: from 9 a.m.

	Time Slot	Name	Topic	Supervisor
	9:00-9:10	--	Introduction by Thomas Pichler	
1	9:10-9:25	Heena Inani	Atomic scale in situ electron microscopy of multidimensional heteronanostructures	Jani Kotakoski
2	9:25-9:40	Judith Kasper	Airborne measurements of the complex refractive index of atmospheric aerosol layers	Bernadett Weinzierl
3	9:40-9:55	Marilena Teri	Light-absorbing aerosol layers in the Eastern Mediterranean: characterization and assessment of their impact on the temperature structure and aerosol lifetime	Bernadett Weinzierl
4	9:55-10:10	David Erkinger	Calabi-Yau moduli spaces and special regions therein	Johanna Knapp
	10:10-10:40	**Dominik Stolzenburg**	**Clouds formed by the smell of trees: The whole troposphere can act as a phase transition reactor for organics**	
	10:40-11:10	COFFEE BREAK		
5	11:10-11:25	Karolina Matejak Cvenic	Constructing a diagnostic instrument for wave optics	Martin Hopf
6	11:25-11:40	Stefan Riemelmoser	Pseudization of the Coulomb kernel in many body solid state calculations	Georg Kresse
7	11:40-11:55	Stefan Noisternig	Characterization of structural order in amorphus materials	Christian Rentenberger
8	11:55-12:10	Alexander Müllner	Investigating the Nanostructure and Mechanical Properties of Hair due to Colour Treatment	Herwig Peterlik
	12:10-12:40	**Mukesh Tripathi**	**Modifying low-dimensional materials using energetic charged particles**	
	12:40-13:40	LUNCH BREAK		
9	13:40-13:55	Manuel Engel	Electron-phonon interactions using the projector augmented wave method	Georg Kresse
10	13:55-14:10	Sergio Arguedas Cuendis	Setting new limits to the axion-photon coupling using novel RF resonant cavity geometry in the CAST experiment	Eberhard Widmann
11	14:10-14:25	Georg Zagler	Nucleation, Growth and Transformation of Two-Dimensional Materials at the Atomic Scale	Jani Kotakoski
12	14:25-14:40	Nicolaus Kratochwil	Studies on time resolution for scintillator-based detector systems for HEP and PET applications	Eberhard Widmann

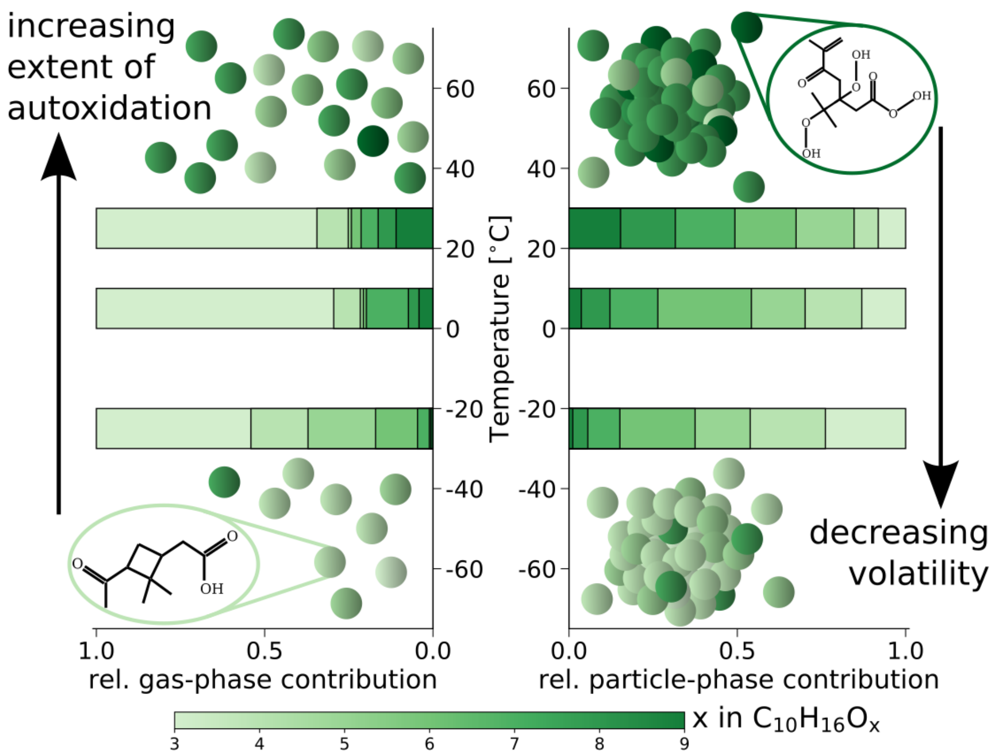
Clouds formed by the smell of trees

The whole troposphere can act as a phase transition reactor for organics

Dominik Stolzenburg – Aerosol and Environmental Physics

Nanoparticles in the atmosphere can impact the global climate by acting as seeds for cloud droplets and thereby changing cloud properties. The majority of such cloud condensation nuclei are formed by gas-to-particle conversion of atmospheric precursor trace gases. Besides sulfuric acid of mainly anthropogenic origin, oxidation products from volatile organic compounds emitted by vegetation might play a crucial role in this process. However, both the oxidation pathways and the subsequent phase transition mechanisms are highly complex and might depend on various ambient parameters like temperature.

In a recent study performed at the CERN CLOUD experiment, it was shown that oxidation products of alpha-pinene can contribute to nanoparticle formation under warm and cold ambient conditions (Stolzenburg et al. (2018), PNAS, 115 (37), 9122-9127). The decreasing extend of autoxidation at reduced temperatures is compensated by a decrease in volatility of all oxidation products. For the first time, mass closure between the measured organic gas-phase compounds and the nanoparticle growth rates could be demonstrated. Due to their significant contribution to early nanoparticle growth, organics are able to play an important role in atmospheric new particle formation throughout the whole troposphere.



Modifying low-dimensional materials using energetic charged particles

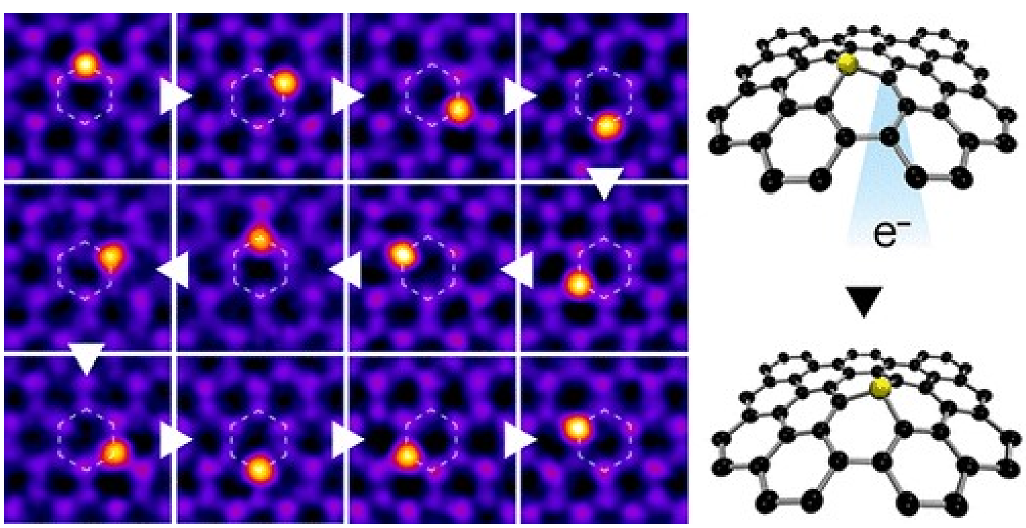
Mukesh Tripathi- Physics of Nanostructured Materials

Low-dimensional materials including graphene, and single-walled carbon nanotubes (SWCNTs) have attracted significant attention due to their unique intrinsic properties. To fully exploit their potential for novel applications, these properties need to be tailored. Defect engineering via electron and ion irradiation is one way to achieve this in a controlled way, for example by introducing heteroatoms into graphene and SWCNTs lattice to alter their electronic, mechanical and chemical properties. At the same time, advances in aberration-corrected scanning transmission electron microscopy (STEM) have not only made it possible to image atomic structures, but also to manipulate individual strongly bound impurity atoms using the Å-sized focused electron beam.

We present here two studies to illustrate these approaches: in the first one, we used low-energy ion implantation to introduce germanium, the heaviest impurity reported to date, into the graphene lattice [1]. Although sample contamination remains an issue, atomic resolution STEM imaging and quantitative image simulations reveal that Ge can either directly substitute single carbon atoms, bonding to three carbon neighbors in a buckled out-of-plane configuration, or occupy an in-plane position in a double vacancy.

In the second study, we used aberration-corrected STEM to reveal atom-conserving and non-conserving electron-beam driven dynamics of heteroatoms in graphene and single-walled CNTs. We further explored the electron-beam manipulation of silicon and phosphorus impurities in single-layer graphene [2,3]. Individual silicon impurities could be precisely moved over hundreds of lattice sites, whereas phosphorus are much more challenging to move. Manipulation of silicon was also achieved in SWCNTs.

Even with manual operation, the rate of electron-beam manipulation is already comparable to the state-of-the-art in any atomically precise technique including scanning probe microscopy, demonstrating the great potential of STEM for atomic engineering of low-dimensional materials.



[1] M. Tripathi, A. Markevich, R. Böttger, S. Facsko, E. Besley, J. Kotakoski and T. Susi, *ACS Nano* **2018** *12* (5)

[2] M. Tripathi, A. Mittelberger, N. A. Pike, C. Mangler, J. C. Meyer, M. J. Verstraete, J. Kotakoski, and T. Susi *Nano Letters* **2018** *18* (8)

[3] C. Su, M. Tripathi, Q. B. Yan, Z. Wang, L. Basile, G. Su, M. Dong, J. Kotakoski, J. Kong, J.C. Idrobo, T. Susi and J. Li, (accepted in *Science Advances*, **2019**)