Institute for Materials Science

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“On-surface synthesis and characterization of carbon nanostructures”

Thursday, November 12
13:00 – 14:00

Seminar Room 115, Hallwachsstr. 3 (HAL)

The covalent coupling of molecular precursors catalyzed by metal surfaces opened the rapidly evolving field of on-surface chemical synthesis. Tailored precursors allow the bottom-up synthesis of novel, technologically highly relevant materials such as atomically precise graphene nanoribbons (GNRs). Such GNRs can be covalently joined into larger units, creating junctions and heterojunctions. The electronic properties of the formed structures strongly depend on the exact atomic configuration and can be altered by subtle variations of the edge configuration of the incorporated GNRs. Non-contact atomic force microscopy with CO-functionalized tips provides the ultimate resolution to resolve structural changes and bond formations associated with the synthesis and cross-coupling of GNRs. Simultaneously acquired frequency-shift and current maps are combined with tight binding (TB) simulations to gain a comprehensive characterization, where non-planarity of the junctions obstructs the direct assignment.

In the second part of my talk, I will discuss the potential of on-surface reactions on an atomically thin insulator – a well-defined monolayer of hexagonal boron nitride (h-BN) on metal. The required dehalogenation of the polyphenylene precursor I₆-CHP strongly correlates with its position on the corrugated h-BN on Rh(111). Contrary to the immediate and complete dehalogenation on metals, the h-BN imposes a distinct abstraction sequence, which can be followed by scanning tunneling microscopy and density functional theory. The subsequent aryl-aryl coupling of the CHP remnant after dehalogenation allows the formation of extended oligomers. These insights to the catalytic properties of h-BN provide a better understanding of the limitations for the bottom-up fabrication of graphene on h-BN.
Thomas Dienel is a solid state physicist working in the field of on-surface synthesis of molecular nanostructures, in situ growth of two-dimensional materials, and non-contact atomic force microscopy. Since 2011 he is research scientist at the nanotech@surfaces Laboratory, at Empa - the Swiss Federal Laboratories for Materials Science and Technology in Dübendorf, Switzerland. He studied physics at Technische Universität Dresden, Germany, where he completed his diploma and doctorate studies in the Institut für Photophysik (IAPP) on the optical properties of organic adsorbates on insulating substrates under the supervision of Dr. Torsten Fritz and Prof. Karl Leo. Subsequently, he worked on thermoelectric properties of rolled-up nanostructures at the Leibniz-Institute for Solid State and Materials Research Dresden, Germany, and light harvesting properties of luminescent solar concentrators at Optical Additives GmbH and the University of Zurich, Switzerland.