chemisch physikalische gesellschaft

Gegründet im Jahre 1869 von H. Hlasiwetz, J. Loschmidt, J. Petzval und J. Stefan

EINLADUNG

zum Vortrag von

Ass.Prof. Dr. Richard Wilhelm

Technische Universität Wien, Institute of Applied Physics

Femtosecond charge dynamics at surfaces induced by highly charged ion impact and probed by the emission of electrons

am Dienstag, 14. März 2023, um 17:30 Uhr

Ort: Lise-Meitner-Hörsaal, Fakultät für Physik, Universität Wien,
1090 Wien, Strudlhofgasse 4 / Boltzmanngasse 5, 1. Stock

Barrierefreier Zugang: Boltzmanngasse 5, Lift, 1. Stock rechts über den Gang zum Hintereingang des Hörsaals

Abstract

Ion beam technologies are used in a plethora of applications in surface science, semiconductor technology, and material science in general. In these applications it is the momentum of the ion, which is typically exploited to tailor material properties. The changing charge of the ion is either neglected or mostly seen as an obstacle when using scattered ions for material analysis. It can, however, be utilized to drive material modification on surfaces with high efficiency [1].

Charge exchange of ions at surfaces is a complex phenomenon which involves charge transport between the ion and the solid material as well as electronic excitations, both on the atomic scale and femtosecond time scale [2]. As direct timing resolution on that scale with ions is currently not available in an experiment, the ion charge exchange with solids remains elusive.

To probe the material response to ions in elevated charge states and to understand the electronic processes involved, we use slow heavy ions prepared in high charge states in our experiment. We further use freestanding two-dimensional materials which allow us to apply atomically-resolved transmission electron microscopy to study material damage by single ion impacts, perform charge state analysis of the ions after material transmission, and detect secondary electrons in coincidence with the transmitted ion [3]. In the case of ion transmission through atomically flat materials, the interaction time is naturally limited to the femtosecond timescale and consequently we can link the experimental observables to processes active within this short amount of time.

In the presentation I will discuss recent experimental work on ion charge exchange dynamics and will show how the emission of electrons can be used as a probe for the nanoscale surface charge dynamics triggered by the incoming ion.

[1] Schwestka, J. et al. Atomic-Scale Carving of Nanopores into a van der Waals Heterostructure with Slow Highly Charged Ions. *ACS Nano* **14**, 10536–10543 (2020).

[2] Wilhelm, R. A. The charge exchange of slow highly charged ions at surfaces unraveled with freestanding 2D materials. *Surface Science Reports* **77**, 100577 (2022).

[3] Niggas, A. et al. Ion-Induced Surface Charge Dynamics in Freestanding Monolayers of Graphene and MoS2 Probed by the Emission of Electrons. *Physical Review Letters* **129**, 086802 (2022).