Max Planck Institute for Solid State Research
Quantum Microscopy and Dynamics

"The Molecular Nanoprobe – Ballistic Transport with Atomic Precision"

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Seminar Room 4D2
2:00 pm

Low-loss charge carrier transport is of great interest for the realization of efficient and small electronic components. Improvements would minimize heat generation and reduce energy con- sumption at the same time. However, individual scattering processes that determine the loss in charge carrier transport occur on length scales from nanometers to micrometers. To study these in detail, measurement methods with high temporal or spatial resolution are required. For the latter, few established experiments exist, often based on scanning tunneling microscopy, which are however subject to various limitations.

In order to get real space access to charge carrier transport at distances of the mean free path and thus in the ballistic regime, we developed and established the molecular nanoprobe (MONA) technique [1,2]. Hereby, we use a single molecule as a detector for charge carriers, which are injected into the substrate under investigation by the STM tip a few nanometers away from the molecule. The high spatial resolution of MONA combined with the small size of the molecular detector allows atomic control of transport paths down to the single nanometer level. In several publications, we have proven the capabilities of this novel technique, ranging from the influence of artificial [1,2] and natural occurring atomic structures [3] to the propagation of spin-polarized charge carriers in a Rashba-split surface state [5, 6].

[1] J. Kügel et al., Nano Lett. 17, 5106 (2017)
[2] M. Leisegang et al., Nano Lett. 18, 2165 (2018)
[3] M. Leisegang et al., Phys. Rev. Lett. 126, 144601 (2021)
[4] M. Leisegang et al., J. Phys. Chem. C 127, 592 (2023)
[5] P. Härtl et al., Nano Lett. 23, 11608 (2023)

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