10th International Conference on Molecular Electronics
November 29 - December 2, 2021

Invited Speaker

Single-layer MoS_2 on Au(111) as decoupling layer for organic molecules and magnetic adatoms

Sergey Trishin, Nils Krane, Nils Bogdanoff, Gael Reecht, Christian Lotze, Felix von Oppen, Katharina Franke

Fachbereich Physik, Freie Universität Berlin, Germany

Abstract:

Adsorption of atoms and organic molecules on metal surfaces typically leads to strong hybridization of the frontier molecular orbitals with the substrate electronic bands. This results in broad energy levels reflecting the ultrashort lifetime of excited states in tunneling experiments. A monolayer of MoS_2 is a direct-bandgap semiconductor. Here, we show that single-layer MoS_2 on Au(111) acts as an efficient decoupling layer for organic molecules and magnetic adatoms. Molecular resonances within the semiconducting band gap of MoS_2 exhibit widths of only a few meV. This exquisite energy resolution allows to study vibrational excitations and their spatial variations within the individual molecules [1,2].

Furthermore, we investigate single Fe atoms on MoS_2/Au(111). We find that the decoupling efficiency strongly varies across the moiré pattern induced by the lattice mismatch at the interface. Fe atoms located on the minima of the moiré structure show sharp inelastic spin excitations. In contrast, Fe atoms on the moiré maxima exhibit a Kondo resonance. We track the evolution of magnetic excitations by investigating Fe atoms on different adsorption sites with respect to the moiré pattern and ascribe the gradual increase of Kondo correlations to the moiré-modulated density of states [3].

References:

[1] N. Krane, C. Lotze, G. Reecht, L. Zhang, A. L. Briseno, K. J. Franke, ACS Nano 12, 11698 (2018).

[2] G. Reecht, N. Krane, C. Lotze, L. Zhang, A. L. Briseno, K. J. Franke, Phys. Rev. Lett. 124, 116804 (2020).

[3] S. Trishin, C. Lotze, N. Bogdanoff, F. von Oppen, K. F. Franke, arXiv:2105.01176 (2021).