TECHNISCHE UNIVERSITÄT CHEMNITZ

Institut für Physik
Physikalisches Kolloquium

Mittwoch, 03.05.2023, um 11:15 Uhr

Ort: Reichenhainer Str. 90;
Zentrales Hörsaal- und Seminargebäude, Raum C10.013

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GAEDE-PREISTRÄGER 2023

Towards chemical and optical band structure engineering in molecular-based heterostructures

Optical excitations with femtosecond light pulses offer the intriguing opportunity to control charge and spin carrier functionalities in materials on ever-shorter timescales, ultimately on the duration of the optical excitation itself. In most cases, however, the optically-induced dynamics evolves on significantly longer timescales that are dominated by secondary energy and angular-momentum conversion processes within the materials. Faster optical manipulation can only be achieved in binary materials where the charge and spin order can directly be affected by optical-induced spin and charge transfer processes between the materials' sub systems [1].

In this presentation, I will introduce molecular material-based heterostructures as a highly intriguing platform to chemically and optically tailor the spin-dependent band structure and the corresponding spin- and charge carrier functionalities by charge transfer processes.

First, I will discuss selected examples for which the chemically flexibility of molecular materials allows us to chemically functionalize the spin-dependent band structure of spin-textured surfaces [2] and to design the energy level alignment in molecular systems.

As first crucial steps towards the optical band structure engineering, I will demonstrate that optical excitation of charge transfer states in molecular materials can alter the local band structure within the molecular film on ultrafast timescales [3,4].

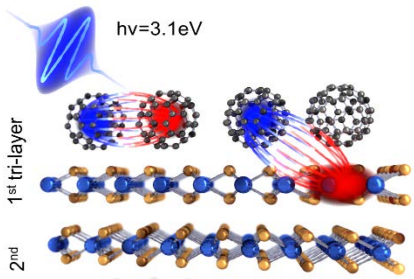

Fig.1 Illustration of the C_{60}/WSe_2 hetero-structure as well as the interfacial charge transfer after the optical excitation of the C_{60} layer

This approach can be transferred to heterostructures between molecular and 2D semiconductors where it allows us to transiently uncover the otherwise hidden spin polarization of the prototypical layered semiconductor WSe_2. These findings will open new avenues for optical controlling and functionalizing spin phenomena in molecular-based heterostructures on ultrafast timescales.

References

[1] M. Hofherr et al. *Sci. Adv.* 6 eaay8717 (2020)
[2] B. Stadtmüller et al. *Phys. Rev. Lett.* 117, 096805 (2016)
[3] B. Stadtmüller et al. *Nat. Commun.* 10, 1470 (2019)
[4] S. Emmerich et al. J. *Electron. Spectros. Relat. Phenomena* 252, 147110 (2021)

Alle Zuhörer sind ab 11:00 Uhr zum Kaffee vor dem Hörsaal eingeladen.

Informationen zum Vortrag erteilt:
Prof. Dr. Dr. h.c. Dietrich R. T. Zahn, Tel. 0371 531 33036

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