TECHNISCHE UNIVERSITÄT
IN DER KULTURHAUPTSTADT EUROPAS
CHEMNITZ

Institut für Physik
Physikalisches Kolloquium

Donnerstag, 18.01.2024, 15:30 Uhr

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

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Exciting World of Quantum Dots: A Chemist's Perspective

- Vortrag zum Nobelpreis Chemie 2023 -

The 2023 Nobel Prize in Chemistry awarded to Mungi Bawendi, Louis Brus, and Alexei Ekimov for "the discovery and synthesis of quantum dots"[1,2] brought a renewed surge of interest to these wonderful objects lying on the border between solid state and molecules. Quantum dots (QDs) are semiconductor nanocrystals small enough for the photogenerated charge carriers to experience spatial exciton confinement resulting in spectacular size-dependent phenomena both in QD photophysics and QD photochemistry. Size dependence of the energy of the charge carriers photogenerated in semiconductor QDs influences strongly the dynamics of the photochemical reactions on the QD surface.[3] The growth of the energy (and redox-potential) of the electrons/holes with decreasing QD size results in acceleration of photoinduced reduction/oxidation reactions and, in some cases, imparts the QDs with the photocatalytic activity not possible for the bulk counterparts. The thermodynamic barriers for many photoinduced processes can also be eliminated due to a unique effect of photoinduced charging typical for many semiconductor QDs.

In the above context, the talk provides an overview of ca. 20-year collaborative work on photophysics and photochemistry of semiconductor QDs performed by a German-Ukrainian team with Semiconductor Physics in TU Chemnitz as a principal research center.[4] Our investigations evolved from diverse size effects in cadmium chalcogenide (CdX) QDs produced by "green" colloidal chemistry to the phenomena of ultimate spatial exciton confinement in "magic-size" CdX clusters to Cd-free multinary chalcopyrite QDs.[5] The latter compounds, such as $AgInS_2$ and $CuInS_2$, reveal unique tolerance to substitutuons and non-stoichiometry resulting in unprecedentedly large compositional variability which is supplemented by vivid manifestation of size-dependent spectral properties. Such chalcopyrite QDs as well as quaternary kesterite QDs constitute a new "terra incognita" for the future accelerated discovery of new functional nanomaterials using robot-assisted high-throughput experimentation.[6]

References
[1] D. Sarma and P. Kamat, ACS Energy Lett. 2023, 8, 5149.
[2] L. Manna, Nano Lett., 2023, 23, 9673.
[3] O. Stroyuk, Solar Light Harvesting with Nanocrystalline Semiconductors, Springer, 2017.
[4] O. Stroyuk et al., The Chem. Rec., 2023, 10.1002/tcr.202300241.
[5] O. Stroyuk et al., Chem. Soc. Rev., 2018, 5354.
[6] O. Stroyuk et al., J. Phys. Chem. C, 2021, 12195; Part. Part. Sys. Charact. , 2021, 21001689.

Alle Zuhörer sind ab 15:15 Uhr zum Kaffee vor dem Hörsaal eingeladen.

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

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