UniSysCat - Colloquium

Assist. Prof. Dr. Charlotte Vogt

Technion - Israel Institute of Technology

Start Time: Wednesday, March 1, 2023 05:15 pm

End Time: Wednesday, March 1, 2023 06:30 pm

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and via Zoom

Operando Electrochemical FT-IR and quick-XAS Spectroscopy of Electrocatalytic Reactions for the Energy Transition

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Water electrolysis and carbon dioxide electroreduction are examples of electrochemical technologies with great promise to aid in the energy transition, for example for the seasonal storage of renewable electricity the abatement of anthropogenic climate change through alternative carbon utilization. Such reactions are often even more difficult to characterize “at work” than traditional thermo- or heterogeneous catalysis, as they bring at least one additional complicating variable; the electrolyte which is often liquid phase. Utilizing a combination of potential-modulated excitation experimentation, reactor and internal reflective element design, and operando high time resolution FT-IR and operando sub-second time resolution X-ray absorption spectroscopy, we investigated the catalytic reaction mechanisms and structure-performance relationships of electrocatalytic oxidation and reduction reactions (e.g., ammonia, and urea oxidation, and CO_2 reduction) over several different metals. We thereby are able to introduce mechanical concepts of strain able to accurately describe and predict activity and stability in electrooxidation over Ni-based catalysts. We are also able to distinguish the effect of different anionic and cationic electrolyte species to the reaction mechanism. Finally, we show that the use of modulated excitation spectroscopy is an excellent tool to overcome some of the common issues dealt with in operando electrocatalysis, like weak reaction intermediate signals clouded by electrolyte rearrangement, by elucidating several details of mechanisms not yet described in literature. The developed experimental and data analysis tools help us to understand not just the reactions in our study, but likely are promising for broad use in the operando study of electrocatalysts.

Prof. Dr. Matthias Drieß

Organizer