Advanced Electrochemical Approaches for Nanomaterial Characterization and Renewable Energy Technologies

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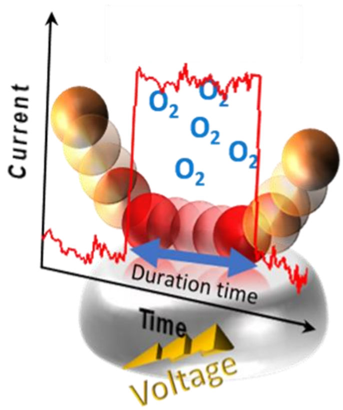
Over the past two decades, electrochemistry has undergone a remarkable renaissance in the perception of many scientists. From a supposedly exhaustively studied discipline, it transformed into modern and versatile toolbox for basic physicochemical studies, smart bio- and nanoparticle sensors, environmentally friendly synthesis approaches, and renewable energy technologies.

This transformation has been driven primarily by the goal of sustainable conversion and storage of energy from renewable energy sources and non-fossil fuels, as almost all technologies discussed for this purpose are based on electrochemical processes: Batteries, supercapacitors, photovoltaic cells, water electrolyzers, fuel cells, etc. Since electrochemical reactions always occur at an electrode, the transport of reactants and products to and from the electrode play a significant role in addition to reaction kinetics, which complicates quantitative understanding. Nanomaterials are often used to achieve large surface areas and high reaction rates. Their reactivity and transformations are insufficiently described by traditional electrochemical concepts.[1] This inhibits the characterization - and thus the targeted further development - of nanocatalysts, as well as active materials and requires the development of novel electrochemical methods. Such new electrochemical methods for the determination of intrinsic nanomaterial properties and reactivities will be discussed in the talk (Figure 1). Additionally, perspectives to exploit confinement effects and combine electrochemical methods with spectroscopic tools will be highlighted.



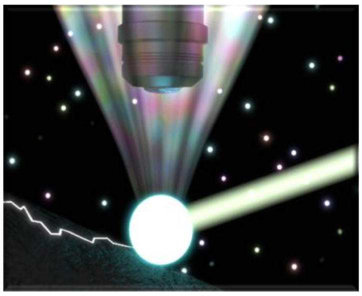


Figure 1. Schematic drawings of single particle electrocatalysis[2] (left), and spectroelectrochemical dark-field microscopy[3]; two examples of advanced electrochemical tools.

References

[1]] . Linnemann, K. Kanokkanchana, K. Tschulik, *ACS Catal.*, **2021**, 11, 5318.

[2] A. El Arrassi, Z. Liu, M. V. Evers, N. Blanc, G. Bendt, S. Saddeler, D. Tetzlaff, D. Pohl, C. Damm, S. Schulz, K. Tschulik, *JACS,* **2019**, 23, 141.

[3[K. Wonner, M. V. Evers, K. Tschulik, JACS, **2018**, 140, 12658.