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Model-assisted Analysis and Design of Electrochemical Processes

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Abstract: Electrochemical technologies offer efficient and dynamic storage of electrical energy in batteries or via electrolysis in hydrogen. In addition, power-to-chemicals technologies, such as electrochemical CO2 conversion or production of expensive fine chemicals, promise a deep energy transition of the chemical industry. Almost all new electrochemical technologies, but also established ones, suffer from performance losses due to a lack of quantitative insight into processes in the cells. Modelling tools at higher levels are already well established and predictive, when it comes to heat and mass transfer, as these phenomena are widespread in (chemical) engineering. They struggle, however, to reproduce or predict the electrochemical behaviour of electrodes.

This talk covers established and upcoming electrochemical energy and power-to-chemical technologies, their application and state of development. The complexity and challenges of the technologies at electrode level are complemented by strategies how to formulate and parameterise suitable models. The models are then used to give insight into the many unmeasurable processes or states, and for virtual design of better catalysts, electrodes, cells or operating conditions.

ABOUT THE SPEAKER

Ulrike Krewer is a Full Professor and Head of the Institute for Applied Materials Electrochemical Technologies at Karlsruhe Institute of Technology (KIT), Germany. She received a PhD in Process Engineering from University/Max Planck Institute Magdeburg. After researching in Samsung (Korea) and an Assistant Professorship, she became Full Professor for Energy and Process Systems Engineering at TU Braunschweig in 2012, and moved to her current position KIT in 2020. With more than 20 years of research expertise in electrochemical energy technologies, she and her team contribute(d) to advancing established technologies, such as Li-ion batteries and PEM electrolysis, as well as exploratory ones such as Li/Na-metal batteries and CO2 electrolysis. Model-based and dynamic analysis of processes at electrodes allows her to reveal performance limiting steps and the (degradation) state of cells and electrodes, and to propose improvements.