16th World Congress on Computational Mechanics and 4th Pan American Congress on Computational Mechanics

July 21-26, 2024, Vancouver Convention Centre, Vancouver, British Columbia, Canada

MODELING AND SIMULATION OF THE ELECTRO-CHEMO-THERMO-MECHANICAL INTERACTIONS IN ENERGY TRANSITION AND ENERGY STORAGE SYSTEMS

Ralf Jänicke[1] and Fredrik Larsson[2] and Kenneth Runesson[2] and Kerstin Weinberg[3] and Philipp Junker[4] and Tim Ricken[5] and Thomas Wallmersperger[6]*

[1]*Technische Universität Braunschweig*
[2]*Chalmers University of Technology*
[3]*University of Siegen*
[4]*Leibniz Universität Hannover*
[5]*University of Stuttgart*
[6]*Technische Universität Dresden*

MINISYMPOSIUM

The rapid growth of renewable energy sources and the increasing demand for high-performance energy storage systems have ushered in a new era of interdisciplinary research and development. To address the complex challenges associated with energy transition and storage, a holistic approach is required. This mini-symposium aims to bring together experts from various fields to explore innovative strategies and computational techniques for understanding and optimizing these intricate systems.

In recent years, layered energy transition and energy storage systems, such as solid-state batteries, structural batteries, water electrolyzers, or fuel cells, have gained significant attention. These systems involve complex interactions between multiple physical and chemical processes, including electro-chemical reactions, heat transfer, mechanical deformation, mass transport, damage and fatigue. Accurate modeling and simulation of these coupled phenomena are crucial for improving the efficiency, safety, and durability of energy conversion and storage devices.

This mini-symposium will provide a platform for researchers to discuss novel methodologies and present their latest findings in modeling and simulation of such electro-chemo-thermo-mechanical interactions. Topics of interest include, but are not limited to,

- material modeling,
- advanced numerical techniques,
- multi-scale modeling, and
- optimization (design and/or control)

for the relevant multi-physics problems that occur during assembly, service, aging and failure of systems for energy transition and storage.

References:
[1] Carlstedt, D., Runesson, K., Larsson, F., Jänicke, R., & Asp, L. E. (2023). Variationally consistent modeling of a sensor-actuator based on shape-morphing from electro-chemical–mechanical interactions. *Journal of the Mechanics and Physics of Solids*, *179*, 105371.
[2] Kink, J., Ise, M., Bensmann, B., & Hanke-Rauschenbach, R. (2023). Modeling Mechanical Behavior of Membranes in Proton Exchange Membrane Water Electrolyzers. *Journal of The Electrochemical Society*, *170*(5), 054507.
[3] Werner, M., Pandolfi, A., & Weinberg, K. (2021). A multi-field model for charging and discharging of lithium-ion battery electrodes. *Continuum Mechanics and Thermodynamics*, *33*, 661-685.