Lithium battery homogenization experience

How do we homogenize a battery?
In our approach the homogenization is performed on two scales (i) from the particulate electrodes to homogenized electrode materials using an extended Newman model and (ii) from individual cell layer materials to a homogenized battery material with anisotropic electrical and thermal transport properties.

What is a cathode homogenization strategy?
This cathode homogenization strategy contrasts to the conventional cathode heterogeneous design, potentially improving the viability of all-solid-state lithium batteries for commercial applications.

Why do lithium batteries fail?
Very large mechanical stressesand huge volume changes emerge during intercalation and extraction of Lithium in battery electrodes. Mechanical failure is responsible for poor cyclic behavior and quick fading of electrical performance,especially in energy storage materials for the next generation of Li-ion batteries.

What is a multi scale multi domain model for lithium ion battery cells?
A multi scale multi domain model for large sized lithium-ion battery cells. Homogenization of electrode and distinct material layers. Consideration of inhomogeneous temperature and locally fluctuating cell conditions. Parametrization and simulation of a 120 Ah LIB large format cell. Comparison of four different cooling concepts.

What is computational homogenization?
The computational homogenization is essentially based on the solution of two nested boundary value problems,one for each scale. A first order theory,which hinges on the principles of local action and of scales separation (Geers et al.,2003),is adopted for both mechanical and electrochemical homogenization procedures.

What happens during charging/discharging cycles in Li-ion battery electrodes?
A two-scale modeling of several electrochemical and mechanical processes that take place during charging/discharging cycles in Li-ion battery electrodes has been dealt with the present note. The performance of batteries relies on the interaction between micro and nano-scale phenomena, in particular within the electrodes.

A key aspect in design of lithium ion batteries is to improve the battery"s capacity. Having a thinner separator between anode and cathode layers boosts the energy density. However, this can affect the battery"s safety by increasing chances of separator failure during battery production or under abnormal conditions. One of the biggest concerns ...

Researchers at the Qingdao Institute of Bioenergy and Bioprocess Technology (QIBEBT), Chinese Academy of Sciences (CAS), in collaboration with international partners, have introduced a new cathode homogenization strategy for all-solid-state lithium batteries (ASLBs).

Our multi scale multi domain model (MSMD) for large sized lithium-ion battery cells applies separate solution domains for (i) the cell level, (ii) the electrode level and (iii) the particle level. We introduce novel homogenization approaches on two scales: (1) from the particulate electrodes to homogenized electrode materials using an extended ...

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These electrochemically inactive additives are not fully compatible with layered oxide cathodes that undergo large volume change, significantly reducing battery energy density and cycle life. Here we propose a cathode homogenization strategy by cold pressing a zero-strain cathode material with efficient mixed conduction throughout the (dis)cha

The capacity of lithium ion batteries can be improved through the use of functionally graded electrodes. Here, we present a computational framework for optimizing the ...

Researchers Pioneer New Approach to Enhance All-Solid-State Lithium Batteries. Researchers at the Qingdao Institute of Bioenergy and Bioprocess Technology (QIBEBT) of the Chinese Academy of Sciences, along with collaborators from leading international institutions, have introduced an innovative cathode homogenization strategy for all-solid-state lithium ...

All-solid-state lithium batteries typically employ heterogeneous composite cathodes where conductive additives are introduced to improve mixed conduction. These electrochemically inactive ...

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This paper proposes a Topology Optimization (TO) method for the design of microstructures within All-Solid-State Batteries (ASSBs), using the homogenization method. ASSBs have attracted significant attention because of their possibilities to surpass the problems of conventional liquid lithium-ion batteries regarding safety, energy density, and longevity. To ...

The capacity of lithium ion batteries can be improved through the use of functionally graded electrodes. Here, we present a computational framework for optimizing the layout of electrodes using a ... Expand

The new generation of Lithium-ion batteries (LIBs) is widely used because of their high energy storage and power capacity, low self-discharge, and long service life [1, 2] mercially available Lithium-ion battery cells are primarily offered in three different forms: cylindrical, prismatic, and pouch cells [3, 4].Cylindrical and prismatic cells have a similar basic ...

Researchers at the Qingdao Institute of Bioenergy and Bioprocess Technology (QIBEBT), Chinese Academy of Sciences (CAS), in collaboration with international partners, have introduced a new cathode ...

Researchers from the Chinese Academy of Sciences Qingdao Institute of Bioenergy and Bioprocess Technology have unveiled a novel cathode homogenization approach for All-Solid-State Lithium Batteries (ASLBs). This novel strategy greatly increased the cycle life and energy density of ASLBs and marked a significant breakthrough in energy storage ...

Throughout battery charge-discharge cycles, both battery parameters [129] and the elastic modulus [130] experience linear changes, influencing wave velocity and subsequently impacting wave propagation time within the battery [128]. However, the battery interior is typically not perfectly isotropic, limiting the effectiveness of the composite homogenization model. This ...