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Modeling the Effect of Microstructure in Recheargeable Lithium-Ion Batteries

The effective power and energy density delivered by a rechargeable lithium-ion battery is determined by the electrochemical and kinetic properties of its constituent materials and underlying microstructure. Furthermore, while the thermodynamic state of a volume element of active material is determined entirely by the local particle-particle electrochemical interactions, current (one-dimensional) battery designs fail to fully take advantage of the driving forces that control the intercalation and de-intercalation processes. As a result, batteries with alternate electrode architectures are being proposed and have the potential to outperform classical designs. In the presentation, the well-known rocking chair lithium-ion battery architecture is taken as a point of reference to explore variations of emerging battery concepts, combined chemistries, crystallographic anisotropies, and particle size distributions. In particular, advantages and disadvantages of three-dimensional (3D) battery architectures are shown. The analysis demonstrates that 3D batteries have a significant decrease on ohmic losses and localized joule heating, while simultaneously delivering higher power densities and specific energies closer to the theoretical ideal. Additionally, the analyzed 3D devices greatly diminish the possibility of salt precipitation during discharge due to removal of microstructure limitations in the classic design. The details of the electrochemical and stress fields are resolved in an effort to maximize the performance of the device. Advantages and limitations of conventional rocking-chair configurations, and novel cutting-edge battery designs, such as hybrid, self-assembled, and patterned columnar structures are discussed.

Die Vorträge finden, wenn nicht anders angegeben, jeweils um **16:15**
im Gebäude der Materialwissenschaften, Lichtwiese, Petersenstr. 23, **Raum 77** statt