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ABSTRACT

Tailoring the Properties of Ion-Conducting Nanostructures using Surface Engineering

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Ion-conducting ceramic oxides key components for a variety of electrochemical energy storage devices. While ceria and zirconia-based materials are used as electrolyte or electrode material for oxygen storage devices or solid oxide fuel cells, LiCoO2-based ceramics are still the state-of-the art electrode material for lithium-ion batteries. In both cases, the electrodes are made of oxide nanostructures with a high surface area to ensure efficient exchange of oxygen or lithium ions with the surrounding atmosphere or electrolyte, respectively. Although the high surface area proves highly beneficial for various electrochemical device structures, a major drawback of the porous nanostructure is a reduced thermal and chemical stability of the mixed conducting oxides.
One promising approach to tackle the stability issue is the deposition of a homogeneous coating with a thickness of only a few nanometer on the surface of the nanostructured oxides. The talk will give some examples of how such surface coatings can improve the chemical stability of Li(Ni,Co,Mn)O2-based cathodes for lithium-ion batteries [1,2] and solid state batteries [3]. In addition, it will be discussed that surface modifications allow the preparation of artificial mixed ionic-electronic conductors, whose electrical properties can be tuned by varying the structural properties of the coating layer [4]. This offers a promising design principle for next-generation electrochemical devices.

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