Material Research DirectionBattery

Are Materials & Surface Sciences a driving force in modern-day lithium-ion batteries?
Materials and surface sciences have been the driving forcein the development of modern-day lithium-ion batteries. This Comment explores this journey while contemplating future challenges,such as interface engineering,sustainability and the importance of obtaining high-quality extensive datasets for enhancing data-driven research.

What is the purpose of the battery research chapter?
The chapter focuses on the economical use and reuse of battery materials. The core of the chapter is devoted to battery materials and the full cycle from battery research through production,with discussions about starting materials,production effects,and the fate of materials after their utilization.

How important is experimental characterization of battery materials and interfaces?
[42]Experimental characterization of materials and interfaces at large-scale research facilities,such as synchrotron and neutron scattering facilities,plays a critical rolein ensuring sufficient acquisition of high-fidelity data describing battery materials and interfaces. [5]

What is a chemistry-neutral roadmap for battery research?
This roadmap presents the transformational research ideas proposed by "BATTERY 2030+," the European large-scale research initiative for future battery chemistries. A "chemistry-neutral" roadmap to advance battery research, particularly at low technology readiness levels, is outlined, with a time horizon of more than ten years.

What is inverse design of battery materials & interfaces?
Inverse design of battery materials and interfaces effectively inverts the traditional discovery processby allowing the desired performance goals to define the composition and structure of the battery materials and/or interfaces that best meet the targets without a priori defining the starting materials.

What is battery research?
Battery research occurs throughout the value chain of battery development. It can be oriented toward battery cells,based on competences in chemistry,physics,materials science,modelling,characterization,etc. It can also be oriented toward systems where the battery cells are integrated into packs,to be used in different applications.

Advancements in electrode materials and characterization tools for rechargeable lithium-ion batteries for electric vehicles and large-scale smart grids where weighty research works are dedicated to identifying materials that bid higher energy density, longer cycle life, lower cost, and improved safety compared to those of conventional LIBs ...

We develop a comprehensive data network to accelerate battery material research, integrating multiscale data from three databases and 330,000+ papers using natural language processing and expert curation.

Energy Materials Industrial Research Initiative (EMIRI) and European Automotive Research Partners Association (EARPA) organised a special workshop for their member organisations in September 2019. All the collected input was used to produce the second, more comprehensive draft published in November 2019 and discussed at the BATTERY 2030+ workshop on 20 ...

Metal-ion batteries (MIBs), including alkali metal-ion (Li +, Na +, and K +), multi-valent metal-ion (Zn 2+, Mg 2+, and Al 3+), metal-air, and metal-sulfur batteries, play an indispensable role in electrochemical energy storage.However, the performance of MIBs is significantly influenced by numerous variables, resulting in multi-dimensional and long-term ...

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In recent years, active research has taken place on the materials and electrolyte design for non-flexible electrochromic Zn-ion batteries. For instance, Liang et al. reported on the tungsten (W) activated titanium dioxide (TiO 2) nanocrystals, for application in electrochromic Zn-ion batteries [96].

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BATTERY 2030+ advocates the development of a battery Materials Acceleration Platform (MAP) to reinvent the way we perform battery materials research today. We will achieve this by creating an autonomous, "self-driving" laboratory for the accelerated discovery and optimization of battery materials, interfaces, and cells. This can be done by ...

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As with most materials, the bulk of the research is based on lithium. The insertion voltage for TiO 2 is higher than that of graphite, ca. 1.5 V vs. Li + /Li compared to 0.2 V vs Li + /Li for graphite [143]. While this does lower the voltage of the battery, it can avoid the formation of SEI layers, which usually form at lower voltages [144, 145]. The main advantage of the titanate ...

In this review article, we discuss the current state-of-the-art of battery materials from a perspective that focuses on the renewable energy market pull. We provide an overview ...

The aim of this viewpoint is to present in a nutshell a summary of practical considerations in research for new battery materials and concepts targeting nonspecialists in the field. Indeed, cross-fertilization from other research domains is, as always in science, precious, but a number of aspects need to be taken into account when entering ...

The European research community is ready to support a truly European research effort dedicated to advancing our knowledge of battery materials by the creation of a European battery materials acceleration platform, combining the complementary strengths of each partner with the strongly collaborative existing environment.

This review discusses case studies of theory-guided experimental design in battery materials research, where the interplay between theory and experiment led to advanced material predictions and/or improved fundamental understanding. We focus on specific examples in state-of-the-art lithium-ion, lithium-metal, sodium-metal, and all-solid-state ...

In this chapter, we will discuss the battery materials selection and design principles in order to develop new battery systems. We will introduce the basic materials science and chemistry of ...

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