

Solid-state lithium-air battery



Overview

Schematic of solid-state type Li-air battery design. A solid-state battery design is attractive for its safety, eliminating the chance of ignition from rupture. Current solid-state Li-air batteries use a lithium anode, a ceramic, glass, or glass-ceramic electrolyte, and a porous carbon cathode. The lithium-air battery (Li-air) is a chemistry that uses O_2 at the cathode. Originally proposed in the 1970s as a possible power source for spacecraft, Li-air batteries recaptured scientific interest late in the first decade of the 2000s due to advances in solid-state electrolytes. In general lithium ions move between the anode and the cathode across the electrolyte. Under discharge, electrons follow the external circuit to do electric work and the lithium ions migrate to the cathode. During charging, the reverse process occurs. As of 2013, many challenges confronted designers. Generally, they fall into either surface passivation or pore clogging, which are confronted below. Long-term battery operation requires chemical stability. The research towards deciphering the impacts of pore size and distribution remain ongoing, but some conclusions have been made, especially regarding sets of pores smaller than 100nm. In cells using cathodes made from Super-P, Li-air cells are of interest for electric vehicles, because of their high theoretical specific and volumetric energy density, comparable to gasoline. Electric motors provide high efficiency (95% compared to 35% for an internal combustion engine).



Article Content

Li-air batteries hitting the road

An article in Science demonstrates a Li-air battery with a solid-state electrolyte that achieves an energy density higher than for Li-ion batteries.

Rechargeable solid-state Li-air batteries: a status report

The theoretical specific energy of lithium-air battery is as high as $3436 \text{ Wh}\cdot\text{kg}^{-1}$, and the possible achieved value may reach $600\text{--}700 \text{ Wh}\cdot\text{kg}^{-1}$, which enables this energy storage system as an important propulsion power sources for electric vehicles with the driving range of 500–800 km. Currently, Li-air batteries are facing main challenges at stability, efficiency, ...

Solid-state lithium-ion battery: The key components enhance the ...

Solid state batteries (SSBs) are utilized an advantage in solving problems like the reduction in failure of battery superiority resulting from the charging and discharging cycles processing, the ability for flammability, the dissolution of the electrolyte, as well as mechanical properties, etc , .For conventional batteries, Li-ion batteries are composed of liquid ...

Ultra-fine Surface Solid-State Electrolyte for Long ...

a) Structure diagram of the all-solid-state Li-air battery consists of three components: the Li-metal anode, UFSLAGP electrolyte and air cathode with RuO_2 and CNT catalysts.

A room temperature rechargeable Li_2O -based ...

By using a composite polymer electrolyte based on $\text{Li}_{10}\text{GeP}_2\text{S}_{12}$ nanoparticles embedded in a modified polyethylene oxide polymer matrix, we found that Li_2O is the main product in a room temperature solid-state lithium ...

Working at room temperature | Science

Lithium-air (Li -air or Li-O_2) batteries offer great promise because of their low cost and high energy density . On page 499 of this issue, Kondori et al. describe a Li-air battery that leverages the advantages of both organic and ...

Advances in sulfide solid-state electrolytes for lithium batteries

The high energy density and long cycle life of Li-ion batteries, along with their related benefits, have made them a crucial technology in portable electronics, electric vehicles, renewable energy, grid energy storage, and defense applications [9, 10] 2023, China's total lithium battery output exceed 940 GWh, registering a year-on-year growth of 25 %.

A high-rate and long cycle life solid-state lithium-air battery

In this work, we create a novel solid-state lithium-air battery having a porous LATP cathode, designed using silicone-oil film coated pores that block water vapor and carbon dioxide from reaching reaction sites, but allow a high rate of oxygen transfer owing to an increase in the specific area of the films and a reduced oxygen transfer ...

Recent advances and challenges in the design of ...

As a typical example, Yu et al. designed a stable solid-state Li-air battery by in situ growing a high-ion-conductive membrane on an electron-conductive CNT, subsequently casting Li metal on the SSE. 34 As a result, this ...

Lithium-Air Batteries: Liquid or Solid?

Fig. 1: Schematic of solid-state type Lithium-air battery design. (Source: Wikimedia Commons) Energy consumption is becoming one of the most essential features of nowadays society. Hence energy storage turns out to be especially important. ... all-solid-state battery configurations (Figure 1). For the liquid cells, the key component in ...

Air Energy Launches to Bring Solid-State Lithium-Air Batteries ...

Air Energy team, from left: Larry Curtiss, Mohammad Asadi, Ben Drake While some may call it a fairytale chemistry, solid-state lithium-air battery (SS-LAB) technology is now a step closer to commercial reality with the foundation of Air Energy. The startup

What Is A Solid State Lithium Battery And How It Revolutionizes ...

Discover the future of energy storage with solid state lithium batteries (SSLBs). This article explores the revolutionary technology behind SSLBs, highlighting their enhanced safety, longer lifespan, and higher energy density compared to traditional batteries. Learn about their applications in electric vehicles, consumer electronics, and renewable energy storage, as ...

Researchers design long-lasting, solid-state lithium battery

Now, Li and his team have designed a stable, lithium-metal, solid-state battery that can be charged and discharged at least 10,000 times — far more cycles than have been previously demonstrated — at a high current density. The researchers paired the new design with a commercial high energy density cathode material.

Solid-state lithium batteries-from fundamental research to ...

In 2012, Zhao et al. proposed lithium-rich anti-perovskites (LiRAPs) with a formula of $X_{+3}B_{2-}A_{-}$ (e.g., Li_3OCl). The anion sublattice of anti-perovskites is in a body-centered-cubic (bcc) packed pattern and Li^{+} ions occupy the cubic-face center sites forming octahedral units, which has been believed to promote high ionic mobility (Fig. 2 b).). ...

Solid-State Electrolyte for Lithium-Air Batteries: A Review

1. Introduction. The first generation of lithium ion solid-state electrolytes dates back to the 1830s when Faraday discovered that heated Ag_2S and PbF_2 had anionic conduction properties, but they did not develop rapidly because of they have low ionic conductivity and high interfacial impedance at room temperature, and susceptibility to short circuit due to ...

Solar-driven all-solid-state lithium-air batteries operating at ...

We propose an innovative solar photothermal battery technology to develop all-solid-state lithium-air batteries operating at ultra-low temperatures where a plasmonic air electrode can efficiently harvest solar energy and convert it into heat, enabling efficient charge storage and transmission in electrolyte/electrode materials.

Air Energy: Transforming Energy Storage with Solid-State Lithium-Air ...

Air Energy is a participant in cohort 2 of Resurgence, a cleantech accelerator led by the University of Chicago's Polsky Center for Entrepreneurship and Innovation in partnership with the UChicago Pritzker School of Molecular Engineering. Air Energy was founded following a groundbreaking breakthrough in solid-state lithium-air battery (SS-LAB) technology.

A highly stable and flexible zeolite electrolyte solid-state Li-air battery

Solid-state lithium-air battery represents one of the most promising energy storage systems to simultaneously achieve high energy density, safety, and cost-efficiency. Conventional inorganic solid ...

Recent advances in solid-state metal-air batteries

However, the solid-state metal-air battery is still in its infancy, and many thorny problems still need to be solved, such as the large resistance of the metal/electrolyte interface and catalyst design. ... LLZO) and Li_3PS_4 solid electrolytes by monitoring the dynamic evolution of the lithium concentration distribution during lithium ...

A leap by the rise of solid-state electrolytes for Li-air batteries ...

They presented an integrated solid-state Li-air battery with a lithium-ion-exchanged zeolite, X zeolite membrane (LiXZM), as the sole solid electrolyte. LiXZM with a ...

Solid-State Electrolyte for Lithium-Air Batteries: A ...

Traditional lithium-air batteries (LABs) have been seriously affected by cycle performance and safety issues due to many problems such as the volatility and leakage of liquid organic electrolyte, the generation of ...

A high-rate and long cycle life solid-state lithium-air ...

In this work, we create a novel solid-state lithium-air battery having a porous LATP cathode, designed using silicone-oil film coated pores that block water vapor and carbon dioxide from reaching reaction sites, but allow a ...

Advances on lithium, magnesium, zinc, and iron-air batteries as ...

Overview of lithium-air battery. An innovative energy storage system that offers great energy density is the lithium-air battery, which uses lithium as the anode and airborne oxygen as the cathode [1]. Lithium ions undergo a reaction with oxygen as they travel from the anode to the cathode during discharge, releasing energy in the process [17, 18]. ...

A room temperature rechargeable Li₂O-based lithium-air ...

BATTERIES A room temperature rechargeable Li₂O-based lithium-air battery enabled by a solid electrolyte Alireza Kondori¹, Mohammadreza Esmaeilirad, Ahmad Mosen Harzandi, Rachid Amine², Mahmoud Tamadoni Saray³, Lei Yu⁴, Tongchao Liu⁵, Jianguo Wen, Nannan Shan^{2,6}, Hsien-Hau Wang², Anh T. Ngo^{2,6}, Paul C. Redfern, Christopher S. Johnson⁵, Khalil ...

Recent Progress on the Air-Stable Battery Materials ...

Solid-state lithium metal batteries have been recognized as promising energy storage devices for the near future, but their key materials, such as Li metal anodes, SSEs, and high-energy cathodes, exhibit inferior air ...

Solid-state Li-air batteries: Fundamentals, challenges, and ...

Li-air(O₂) battery, characterized by energy-rich redox chemistry of Li stripping/plating and oxygen conversion, emerges as a promising “beyond Li-ion” strategy. In view of the superior stability and inherent safety, a solid-state Li-air battery is regarded as a more practical choice compared to the liquid-state counterpart.

Solid-State lithium-ion battery electrolytes: Revolutionizing energy ...

A Na-Sn/Fe[Fe(CN)₆]₃ solid-state battery utilizing this electrolyte demonstrated a high initial discharge capacity of 91.0 mAh g⁻¹ and maintained a reversible capacity of 77.0 mAh g⁻¹. This study highlights the potential of fluorinated sulfate anti-perovskites as promising candidates for solid electrolytes in solid-state battery systems.

Enhanced performance of solid-state lithium-air batteries with ...

Lithium air batteries (LABs) highly desire stable and dense solid-state electrolytes (SSEs) instead of liquid organic electrolytes for suppressing lithium dendrite penetration, resisting attack from active oxygen species, and blocking the diffusion of CO₂, moisture as well as O₂ in air to the anode side. Herein, we report the preparation and ...

Minireview: Design of Cathode Structures for Solid-State Lithium-Air ...

Solid-state lithium-air batteries (SSLABs) hold immense promise as energy storage and conversion devices for future electric vehicle applications as a result of their ...

Solid-State Lithium-Air Batteries

Lithium-air rechargeable batteries have attracted much attention because of their fairly large specific energy density. During this quarter century, three types of lithium-air batteries—namely nonaqueous, aqueous, and solid state—have been proposed. The research efforts have been concentrated on the nonaqueous system because it is simpler compared with the aqueous ...

Perspectives and challenges of rechargeable lithium-air batteries ...

The solid-state lithium-air battery is attractive with respect to the safety issues and long-term stability. However, lithium-stable and lithium dendrite formation-free high lithium-ion-conducting solid electrolytes have yet to be developed. Therefore, a lithium-stable interlayer such as a liquid or polymer electrolyte between the lithium ...

Minireview: Design of Cathode Structures for Solid-State Lithium-Air ...

Solid-state lithium-air batteries (SSLABs) hold immense promise as energy storage and conversion devices for future electric vehicle applications as a result of their ultrahigh energy density and high safety. The air cathode is widely recognized as a crucial factor influencing the overall SSLAB performance. While significant advancements have been made in electrode ...

Researchers Report Progress On A Solid-State ...

In a press release, IIT says the battery design Asadi and his colleagues created has the potential to store one kilowatt-hour of electricity per kilogram — four times greater than current ...

Ultra-fine Surface Solid-State Electrolyte for Long Cycle Life All ...

a) Structure diagram of the all-solid-state Li-air battery consists of three components: the Li-metal anode, UFSLAGP electrolyte and air cathode with RuO₂ and CNT catalysts.

Lithium-Air EV Batteries Tapped For Net Zero Economy

The school is getting an award of \$1.5 million to continue working on its solid-state lithium-air battery. "The inexpensive battery materials in IIT's technology improves supply chain ...

Solid-State Electrolytes for Lithium-Air Batteries

Solid-state lithium-air batteries (SSLABs) have become the focus of next-generation advanced batteries due to their safety and high energy densities. Current research on SSLABs is mainly ...

New design for lithium-air battery could offer much longer driving ...

The main new component in this lithium-air battery is a solid electrolyte instead of the usual liquid variety. Batteries with solid electrolytes are not subject to the safety issue with the liquid electrolytes used in lithium-ion and other battery types, which can overheat and catch fire. ... Together the NSRCs comprise a suite of complementary ...

Solid-state battery

A solid-state battery (SSB) is an electrical battery that uses a solid electrolyte to conduct ions between the electrodes, instead of the liquid or gel polymer electrolytes found in conventional batteries. Solid-state batteries theoretically offer much higher energy density than the typical lithium-ion or lithium polymer batteries.

Do Solid State Batteries Contain Lithium: Understanding Their ...

Explore the world of solid state batteries and discover whether they contain lithium. This in-depth article uncovers the significance of lithium in these innovative energy storage solutions, highlighting their enhanced safety, energy density, and longevity. Learn about the various types of solid state batteries and their potential to transform technology and ...

A highly stable and flexible zeolite electrolyte solid-state Li-air ...

Here we present an integrated solid-state Li-air battery that contains an ultrathin, high-ion-conductive lithium-ion-exchanged zeolite X (LiX) membrane as the sole solid ...

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