

SolarGrid Energy Solutions

Bismuth Liquid Flow Battery



Overview

What is a liquid metal battery (LMB)?

The liquid metal battery (LMB) is an attractive chemistry for grid-scale energy-storage applications. The full-liquid feature significantly reduces the interface resistance between electrode and electrolyte, endowing LMB with attractive kinetics and transport properties. Achieving a high energy density still remains a big challenge.

Could a liquid metal battery be used for grid-scale energy storage?

A team at University of Kentucky have patented a liquid metal battery using tin and bismuth electrodes, with molten zinc chloride, for grid-scale energy storage.

Is bismuth a cathode?

Bismuth (Bi) has shown promise as a cathode material, owing to its moderate melting point (271.5 °C) and high electronegativity.

What is a Bi-Sn battery?

The Bi-Sn electrodes achieve superior kinetics. The Li||Bi-Sn cells show exceptional electrochemical performances. Liquid metal battery (LMB) is emerging as a promising solution for grid-scale energy storage, offering advantages such as low cost, long lifespan, safety, ease of configuration and scalability.

What are the advantages of bismuth-tin (Bi-Sn) alloy cathode?

Notably, the bismuth-tin (Bi-Sn) alloy cathode exhibits a significantly high lithium (Li) ion diffusion coefficient, reducing polarization voltage and increasing the reaction stoichiometric ratio of Li. The Li||Bi-Sn cell achieves a high energy efficiency of 91.39 %, with enhanced material utilization of 93.91 % at 100 mA cm⁻².

What is tin & bismuth?

In this new variant, patented by the University of Kentucky, tin and bismuth are combined with a molten zinc salt, to make a much safer system than previous technologies based on sodium, magnesium or lithium, and the ability to operate at the much lower temperature of 300°C.

Bismuth Liquid Flow Battery



Bismuth-based materials for rechargeable aqueous batteries

Nov 15, 2021 · In this review, several synthetic methods for Bi and its derivatives will be introduced, followed by a summary of the application of Bi-based materials in aqueous ...

Understanding the iodine electrochemical behaviors in ...

Feb 1, 2025 · Iodine is widely used in aqueous zinc batteries (ZBs) due to its abundant resources, low cost, and active redox reactions. In addition to the active material in zinc-iodine batteries, ...



Liquid tin bismuth battery for grid-scale energy ...

Jan 9, 2018 · A team at University of Kentucky have patented a liquid metal battery using tin and bismuth electrodes, with molten zinc chloride, for grid ...

N, O Co-doped carbon felt for high-performance all-vanadium redox

flow

Mar 9, 2017 · Based on these findings, it would be interesting to investigate the electrochemical behaviour of oxygen and nitrogen co-doped graphite felt in redox flow batteries. Herein, we, for ...

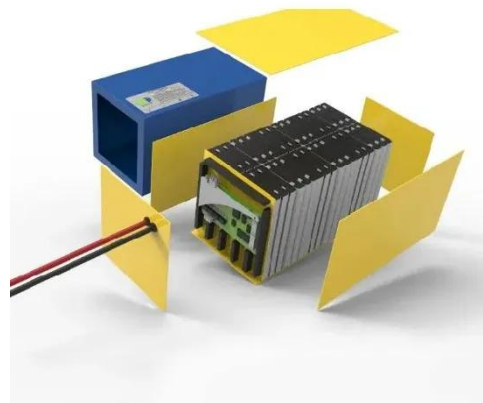


Iron-Chromium Flow Battery

Jan 6, 2023 · The Fe-Cr flow battery (ICFB), which is regarded as the first generation of real FB, employs widely available and cost-effective chromium and iron chlorides (CrCl_3 / CrCl_2 and ...

The Effect of Bismuth on the Performance of a Single-Cell ...

May 31, 2024 · This study examines the need for bismuth as a catalyst for the Cr^{2+} / Cr^{3+} redox couple in an iron-chrome redox flow battery (ICRFB) using 1) open-circuit voltage (OCV) ...



A novel strategy toward high energy density: Liquid-solid ...

Feb 15, 2025 · The theoretical basis of liquid-solid two-phase chemical reaction (LTCR) for improving the energy density of flow batteries was first described

based ...



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May 11, 2020 · Redox flow batteries (RFBs) are promising large-scale energy storage t ??? : ???, ??, ???, ?????, ?????? ...



Capacity extended bismuth-antimony cathode for high-performance liquid

Mar 31, 2018 · The cost of electrode materials in the Li-Sb-Bi cell is 68 \$ kWh⁻¹. Li-Bi based liquid metal batteries (LMBs) have attracted interest due to their potential for solving grid scale ...

Sodium-bismuth-lead low temperature liquid ...

Jun 15, 2015 · A low temperature liquid metal battery based on an ionic liquid electrolyte (20 mole% Na [TFSI] in [TEA])

[TFSI]) was constructed and ...



Evaluating uniformity and strategies of bismuth catalysts

Bismuth (Bi) catalysts enhance the $\text{Cr}^{3+}/\text{Cr}^{2+}$ redox reaction and suppress hydrogen evolution in iron-chromium redox flow batteries. However, in practical battery stacks, limited electrolyte ...

A high-performance flow-field structured iron-chromium redox flow battery

Aug 30, 2016 · Unlike conventional iron-chromium redox flow batteries (ICRFBs) with a flow-through cell structure, in this work a high-performance ICRFB featuring a flow-field cell ...



Simulation of potential and species distribution in a $\text{Li}_{1-x}\text{Bi}_x$ liquid

Jan 1, 2023 · liquid metal battery effects, focusing on the electrochemical

properties of the cell and the mass transport in electrolyte and cathode. Interface reactions in the electrical double layer ...



Surface chemistry of liquid bismuth under oxygen and water ...

Feb 15, 2021 · Conclusions. In this study the interaction oxygen and water vapor with the interface of liquid bismuth at 550 K was examined using ambient pressure XPS. Results reveal that ...



GEL Battery



Lithium Battery



Container storage system



Power Battery

Mass transport induced asymmetry in charge/discharge behavior of liquid

Aug 1, 2019 · 1. Introduction Mass transport in most modern battery systems is typically dominated by diffusion and migration in micrometer-scale liquid layers and solids, while ...

Lead-modified graphite felt electrode with improved

Oct 1, 2022 · Lead-modified graphite felt electrode with improved $V O_2 + / V O_2$ + electrochemical activity for vanadium

redox flow battery



ESS



[PDF] A High Energy Density Bromine-Based Flow Battery ...

Feb 18, 2022 · Semantic Scholar
extracted view of "A High Energy Density Bromine-Based Flow Battery with Two-Electron Transfer" by Yue Xu et al.

Convection-Diffusion Model of Lithium-Bismuth Liquid Metal Batteries

Here we present a two-dimensional physics-based model for Lithium-Bismuth liquid metal batteries. The model takes into account dynamical changes in the battery, including surface ...



Charge-Discharge Behavior of Bismuth in a ...

May 25, 2017 · In the present study, we have prepared a fluoride-conducting liquid electrolyte by dissolving an

organic fluoride in a room-temperature ionic ...



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Dec 20, 2024 · ??,????????????????????
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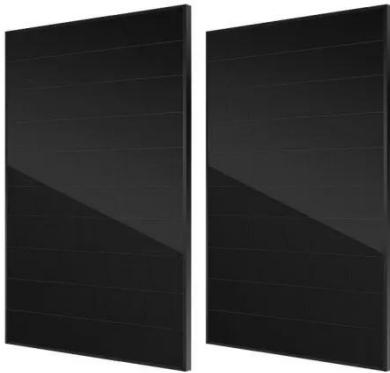
Improving the performance of negative electrode for vanadium redox flow

May 21, 2019 · The inherent disadvantages of untreated carbon felt (pristine-CF) still restrict the vanadium redox flow battery (VRFB) from further improving in electrochemical performances. ...

Carbon felt coated with tungsten-bismuth-based oxides as ...

May 6, 2025 · Abstract All-vanadium redox flow batteries (VRFBs) are one of

the future strategic energy storage technologies for large-scale applications. For developing the VRFB negative ...



A silver-bismuth bimetallic functionalized negative electrode ...

May 22, 2025 · The sluggish redox kinetics of chromium ions at the negative electrode have hindered the development of iron-chromium redox flow batteries. A silver-bismuth bimetallic ...

Lithium transport and intermetallic generation in Li-Bi liquid ...

Feb 10, 2022 · Liquid metal batteries (LMBs) are a potential electrochemical energy storage technology. However, solid intermetallics could be generated during operation, which hinders ...



Electrodes for All-Vanadium Redox Flow Batteries

All-vanadium redox flow battery (VFB) is deemed as one of the most promising energy storage technologies with

attracting advantages of long cycle, superior safety, rapid response and ...



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Capacity extended bismuth-antimony cathode for high-performance liquid metal battery, Journal of Power Sources, 2018, 381, 38-45 Xiaohui Ning, Satyajit Phadke, Brice Chung, Huayi Yin, ...



114KWh ESS



Multiple-dimensioned defect engineering for ...

Feb 29, 2024 · An ultra-homogeneous modification was used for multiple-dimensioned defect engineering of graphite felt electrodes for a vanadium ...



BiVO₄-Decorated Graphite Felt as Highly ...

Mar 6, 2023 · Recently, discovering high-performance electrocatalytic materials for vanadium redox flow batteries (VRFBs) has been one of the most crucial

...



Achieving superior electrode kinetics in bismuth-based liquid

Mar 9, 2025 · Liquid metal battery (LMB) is emerging as a promising solution for grid-scale energy storage, offering advantages such as low cost, long lifespan, safety, ease of configuration and ...

Reaction Kinetics and Mass Transfer

...

Apr 18, 2025 · Zinc-bromine flow batteries (ZBFBs) hold great promise for grid-scale energy storage owing to their high theoretical energy density and cost

...



Promoting Pore-Level Mass Transport/Reaction ...

Jul 28, 2021 · Abstract Elaborate nanoarchitected solid/liquid interface design of felt electrodes is arguably the



most effective pathway to promote the pore ...

Flow field design and optimization based on the mass ...

Aug 30, 2016 · For example, Zawodzinski and Mench et al. [18] reported a 'zero-gap' flow battery prototype design, which uses a serpentine flow channel along with the electrode as the flow ...



APPLICATION SCENARIOS



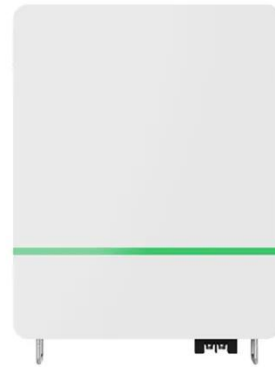
Electrode materials for vanadium redox flow batteries: ...

Jan 1, 2022 · The design and future development of vanadium redox flow battery were prospected. Vanadium redox flow battery (VRFB) is considered to be one of the most ...

Evaluating uniformity and strategies of bismuth catalysts

Jul 26, 2025 · Bismuth (Bi) catalysts enhance the $\text{Cr}^{3+}/\text{Cr}^{2+}$ redox reaction and suppress hydrogen evolution in iron-chromium redox flow batteries. However,

in practical battery stacks, ...

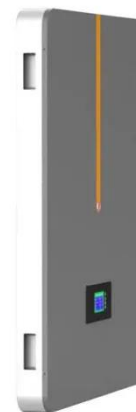


A high-performance carbon nanoparticle-decorated graphite ...

Aug 15, 2016 · Increasing the performance of vanadium redox flow batteries (VRFBs), especially the energy efficiency and power density, is critically important to reduce the system cost to a ...

High-Performance Antimony-Bismuth-Tin ...

Nov 26, 2018 · Abstract The liquid metal battery (LMB) is an attractive chemistry for grid-scale energy-storage applications. The full-liquid feature significantly ...



Review of the Development of First-Generation ...

Nov 1, 2021 · Let it flow: This is the first Review of the iron-chromium redox flow battery (ICRFB) system that is



considered the first proposed true RFB.
The ...

High Performance Liquid Metal Battery with Environmental Friendly

May 5, 2016 · For the first time, the Sb-Sn alloys are reported as environmental friendly positive electrodes for high performance liquid metal batteries (LMBs). Meanwhile, the dominate role of ...



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