TROY TECHNICAL

NEXT-GENERATION ENERGY STORAGE WEEKLY REPORT

October 31 - November 6, 2026 | Issue 2026-W44

Cell-level evidence, manufacturing yield, safety and bankable supply

16	10
ANALYZED ARTICLES	PRIORITY THEMES

Issued 2026-11-06 | English edition | fixed approved cover artwork



Next-Generation Energy Storage: the boundary moved from isolated claims to qualification evidence

16 English articles were reviewed independently from the Japanese edition. Ten themes are retained for management decisions.

SIGNAL 01 | ACTIVE MATERIALS

LMR Cathodes: Posco and Korea University Reduce Voltage Loss

Posco Holdings and Korea University have developed a manufacturing method that reduces voltage loss in lithium-manganese-rich (LMR) cathodes by approximately 30 percent.

SIGNAL 02 | CELL DESIGN

Liquid Air Energy Storage: China's 60 MW/600 MWh Facility Specs

China has connected the world's largest liquid-air energy storage (LAES) facility to the grid in Qinghai province, featuring a 60 MW output and 600 MWh capacity.

SIGNAL 03 | MANUFACTURING

Sodium-Sulfur Batteries: Aluminum Catalyst for 2,500+ Cycles

Researchers at the Chinese Academy of Sciences have developed an aluminum single-atom catalyst that enables sodium-sulfur (Na-S) batteries to maintain capacity over 2,500 cycles.

SIGNAL 04 | SYSTEM VALIDATION

MnO2 Slurry Electrolytes: 409% Capacity Boost for Mn-Flow Batteries

Researchers at Shanghai University have developed a semi-solid MnO2 slurry electrolyte that increases the specific capacity of manganese-based redox flow batteries to 156.2 Ah L-1.

DECISION

Focus this week's management attention on cell-level evidence, manufacturing yield, safety and bankable supply. Move only when the linked evidence can be reproduced under your own operating conditions.

THREE MANAGEMENT MOVES

1. Buyers: compare technologies under the same duty cycle, safety envelope and total system cost.
2. Suppliers: connect materials claims to electrode processing, yield, validation and secured capacity.
3. Executives: track cycle life, fast charge, safety abuse, yield, cost, sourcing and warranty.

EVIDENCE DISCIPLINE

FACT states what the collected English source reports. BUSINESS READ and ACTION are editorial interpretations. UNKNOWN lists information that the source file does not establish. A linked article is not treated as independent confirmation of every claim.

Five numbers or evidence anchors that require conditions

60 MW
A12

SOURCE-BOUND CONDITION
China has connected the world's largest liquid-air energy storage (LAES) facility to the grid in Qinghai province, featuring a 60 MW output and 600 MWh capacity.

500 cycles
A14

SOURCE-BOUND CONDITION
Researchers at the Chinese Academy of Sciences have developed an aluminum single-atom catalyst that enables sodium-sulfur (Na-S) batteries to maintain capacity over 2,500 cycles.

30 times
A06

SOURCE-BOUND CONDITION
This approach enables operation at current densities 30 times higher than previous semi-solid MnO_2 systems, offering a cost-effective path for large-scale energy storage.

106.4%
A07

SOURCE-BOUND CONDITION
In specific cycling pathways, discharge capacity rose to 106.4% of its initial value after 200 cycles.

9MW
A15

SOURCE-BOUND CONDITION
CATL has introduced the 9MWh TENER+ and the sodium-ion based TENER Sodium energy storage systems at All Energy Australia 2026.

HOW TO USE THESE NUMBERS
Each value is shown with the condition stated in the collected English article. Do not compare values across different test methods, device sizes, operating temperatures or commercial stages without normalizing those conditions.

Where the value chain moved

Each stage combines one leading theme and one supporting theme. The report treats handoffs as evidence transfers, not decorative arrows.

1

Active materials

P01/P06

Posco Holdings and Korea University have developed a manufacturing method that reduces voltage loss in lithium-manganese-rich.

2

Cell design

P02/P07

China has connected the world's largest liquid-air energy storage (LAES) facility to the grid in Qinghai province, featuring.

3

Manufacturing

P03/P08

Researchers at the Chinese Academy of Sciences have developed an aluminum single-atom catalyst that enables sodium-sulfur.

4

System validation

P04/P09

Researchers at Shanghai University have developed a semi-solid MnO2 slurry electrolyte that increases the specific capacity.

5

Deployment & recycling

P05/P10

Researchers from Pohang University of Science and Technology discovered that controlling oxygen loss in lithium- and.

EVIDENCE REQUIRED AT EACH HANDOFF

Active materials to Cell design	Transfer test conditions, acceptance criteria, failure data, owner and decision date. Recheck cycle life, fast charge, safety abuse, yield, cost, sourcing and warranty.
Cell design to Manufacturing	Transfer test conditions, acceptance criteria, failure data, owner and decision date. Recheck cycle life, fast charge, safety abuse, yield, cost, sourcing and warranty.
Manufacturing to System validation	Transfer test conditions, acceptance criteria, failure data, owner and decision date. Recheck cycle life, fast charge, safety abuse, yield, cost, sourcing and warranty.
System validation to Deployment & recycling	Transfer test conditions, acceptance criteria, failure data, owner and decision date. Recheck cycle life, fast charge, safety abuse, yield, cost, sourcing and warranty.

COMMON CONTROL POINT

No theme moves to a commercial commitment until a named owner has reproduced the relevant evidence and documented cycle life, fast charge, safety abuse, yield, cost, sourcing and warranty.

Priority map: maturity and next decision locus



P01	LMR Cathodes: Posco and Korea University Reduce Voltage Loss Business / rules | cue: capacity
P02	Liquid Air Energy Storage: China's 60 MW/600 MWh Facility Specs Business / rules | cue: capacity
P03	Sodium-Sulfur Batteries: Aluminum Catalyst for 2,500+ Cycles Business / rules | cue: fid
P04	MnO2 Slurry Electrolytes: 409% Capacity Boost for Mn-Flow Batteries Business / rules | cue: Capacity
P05	Lithium-Manganese-Rich Oxides: Controlled Oxygen Loss for EV Batteries Business / rules | cue: capacity
P06	Li+/Mg2+ Selective Membranes: Subnanometer Pore Control for Brines Business / rules | cue: regulated
P07	CATL ESS Lineup: TENER+ and TENER Sodium Specs for 2026 System / adoption | cue: partners
P08	PDES Electrolyte: Chonnam National University's SMB Stability Specs Business / rules | cue: capacity
P09	IQM and Volkswagen: QC-AFQMC Battery Material Simulation Speedup Tech / process | cue: no system/business cue
P10	Zinc Anode Electrocrystallization: Work Function and (100) Orientation Tech / process | cue: no system/business cue

REPRODUCIBLE POSITIONING RULE

Horizontal position uses five discrete stages: Research, Prototype, Joint evaluation, Product adoption and Scale. The vertical bands classify the next decision locus: Tech / process, System / adoption, or Business / rules (including supply systems). Article-title cues take precedence; the overview is used only when the title is silent. These are categories, not impact ranks. Bubble diameter reflects the editorial score.

FACT is source-bound. BUSINESS READ, ACTION and UNKNOWN are explicit editorial layers.

P01 LMR Cathodes: Posco and Korea University Reduce Voltage Loss

A08 | Active materials | Product adoption

2026-11-05

FACT

Posco Holdings and Korea University have developed a manufacturing method that reduces voltage loss in lithium-manganese-rich (LMR) cathodes by approximately 30 percent. By optimizing heat-treatment temperatures during early production, the team improved structural stability without altering chemical compositions. This approach provides a practical path toward the commercialization of high-capacity batteries for EVs and energy storage systems.

WHY IT MATTERS

The decision relevance is cell-level evidence, manufacturing yield, safety and bankable supply. The signal should be tested at the application and operating-system level, not accepted from a headline alone.

BUSINESS READ

For operating companies, compare the reported change with current qualification, sourcing and product-roadmap assumptions. For suppliers, connect materials claims to electrode processing, yield, validation and secured capacity.

ACTION

Within 30 days, compare technologies under the same duty cycle, safety envelope and total system cost; record the evidence and owner against P01.

UNKNOWN

Still unproven or incompletely stated: cycle life, fast charge, safety abuse, yield, cost, sourcing and warranty.

EDITORIAL SCORE 20/25 | MATURITY 4/5 | DECISION LOCUS: BUSINESS / RULES

P02 Liquid Air Energy Storage: China's 60 MW/600 MWh Facility Specs

A12 | Cell design | Product adoption

2026-11-06

FACT

China has connected the world's largest liquid-air energy storage (LAES) facility to the grid in Qinghai province, featuring a 60 MW output and 600 MWh capacity. Developed by CGDG and CAS, the plant demonstrates a 100% localized cryogenic supply chain for long-duration energy storage. This project enables the shifting of surplus renewable energy to peak demand periods without requiring specific geological formations.

WHY IT MATTERS

The decision relevance is cell-level evidence, manufacturing yield, safety and bankable supply. The signal should be tested at the application and operating-system level, not accepted from a headline alone.

BUSINESS READ

For operating companies, compare the reported change with current qualification, sourcing and product-roadmap assumptions. For suppliers, connect materials claims to electrode processing, yield, validation and secured capacity.

ACTION

Within 30 days, compare technologies under the same duty cycle, safety envelope and total system cost; record the evidence and owner against P02.

UNKNOWN

Still unproven or incompletely stated: cycle life, fast charge, safety abuse, yield, cost, sourcing and warranty.

EDITORIAL SCORE 20/25 | MATURITY 4/5 | DECISION LOCUS: BUSINESS / RULES

FACT is source-bound. BUSINESS READ, ACTION and UNKNOWN are explicit editorial layers.

P03 Sodium-Sulfur Batteries: Aluminum Catalyst for 2,500+ Cycles

A14 | Manufacturing | Product adoption

2026-11-03

FACT

Researchers at the Chinese Academy of Sciences have developed an aluminum single-atom catalyst that enables sodium-sulfur (Na-S) batteries to maintain capacity over 2,500 cycles. By breaking atomic symmetry to suppress polysulfide shuttling, the team achieved a capacity of 1,196 mAh g-1 after 100 cycles. This provides a low-cost, scalable alternative to lithium for large-scale energy storage.

WHY IT MATTERS

The decision relevance is cell-level evidence, manufacturing yield, safety and bankable supply. The signal should be tested at the application and operating-system level, not accepted from a headline alone.

BUSINESS READ

For operating companies, compare the reported change with current qualification, sourcing and product-roadmap assumptions. For suppliers, connect materials claims to electrode processing, yield, validation and secured capacity.

ACTION

Within 30 days, compare technologies under the same duty cycle, safety envelope and total system cost; record the evidence and owner against P03.

UNKNOWN

Still unproven or incompletely stated: cycle life, fast charge, safety abuse, yield, cost, sourcing and warranty.

EDITORIAL SCORE 20/25 | MATURITY 4/5 | DECISION LOCUS: BUSINESS / RULES

P04 MnO2 Slurry Electrolytes: 409% Capacity Boost for Mn-Flow Batteries

A06 | System validation | Product adoption

2026-11-05

FACT

Researchers at Shanghai University have developed a semi-solid MnO2 slurry electrolyte that increases the specific capacity of manganese-based redox flow batteries to 156.2 Ah L-1. This approach enables operation at current densities 30 times higher than previous semi-solid MnO2 systems, offering a cost-effective path for large-scale energy storage.

WHY IT MATTERS

The decision relevance is cell-level evidence, manufacturing yield, safety and bankable supply. The signal should be tested at the application and operating-system level, not accepted from a headline alone.

BUSINESS READ

For operating companies, compare the reported change with current qualification, sourcing and product-roadmap assumptions. For suppliers, connect materials claims to electrode processing, yield, validation and secured capacity.

ACTION

Within 30 days, compare technologies under the same duty cycle, safety envelope and total system cost; record the evidence and owner against P04.

UNKNOWN

Still unproven or incompletely stated: cycle life, fast charge, safety abuse, yield, cost, sourcing and warranty.

EDITORIAL SCORE 20/25 | MATURITY 4/5 | DECISION LOCUS: BUSINESS / RULES

FACT is source-bound. BUSINESS READ, ACTION and UNKNOWN are explicit editorial layers.

P05 Lithium-Manganese-Rich Oxides: Controlled Oxygen Loss for EV Batteries

A07 | Deployment & recycling | Product adoption

2026-11-02

FACT

Researchers from Pohang University of Science and Technology discovered that controlling oxygen loss in lithium- and manganese-rich layered oxides can reshape internal structures to improve lithium ion movement. In specific cycling pathways, discharge capacity rose to 106.4% of its initial value after 200 cycles. This finding suggests that battery aging can be steered to enhance the performance of low-cost cathode materials.

WHY IT MATTERS

The decision relevance is cell-level evidence, manufacturing yield, safety and bankable supply. The signal should be tested at the application and operating-system level, not accepted from a headline alone.

BUSINESS READ

For operating companies, compare the reported change with current qualification, sourcing and product-roadmap assumptions. For suppliers, connect materials claims to electrode processing, yield, validation and secured capacity.

ACTION

Within 30 days, compare technologies under the same duty cycle, safety envelope and total system cost; record the evidence and owner against P05.

UNKNOWN

Still unproven or incompletely stated: cycle life, fast charge, safety abuse, yield, cost, sourcing and warranty.

EDITORIAL SCORE 20/25 | MATURITY 4/5 | DECISION LOCUS: BUSINESS / RULES

P06 Li+/Mg2+ Selective Membranes: Subnanometer Pore Control for Brines

A04 | Active materials | Pilot

2026-10-31

FACT

Researchers have developed a crosslinking-regulated membrane achieving a Li+/Mg2+ separation factor of up to 6454 under electrodialysis conditions. The technology maintains high selectivity in untreated natural salt-lake brines, offering a scalable solution for lithium recovery.

WHY IT MATTERS

The decision relevance is cell-level evidence, manufacturing yield, safety and bankable supply. The signal should be tested at the application and operating-system level, not accepted from a headline alone.

BUSINESS READ

For operating companies, compare the reported change with current qualification, sourcing and product-roadmap assumptions. For suppliers, connect materials claims to electrode processing, yield, validation and secured capacity.

ACTION

Within 30 days, compare technologies under the same duty cycle, safety envelope and total system cost; record the evidence and owner against P06.

UNKNOWN

Still unproven or incompletely stated: cycle life, fast charge, safety abuse, yield, cost, sourcing and warranty.

EDITORIAL SCORE 20/25 | MATURITY 2/5 | DECISION LOCUS: BUSINESS / RULES

FACT is source-bound. BUSINESS READ, ACTION and UNKNOWN are explicit editorial layers.

P07 CATL ESS Lineup: TENER+ and TENER Sodium Specs for 2026

A15 | Cell design | Research

2026-11-02

FACT

CATL has introduced the 9MWh TENER+ and the sodium-ion based TENER Sodium energy storage systems at All Energy Australia 2026. These systems target high-temperature environments and grid stability, supported by three new MoUs with partners including Hitachi Energy.

WHY IT MATTERS

The decision relevance is cell-level evidence, manufacturing yield, safety and bankable supply. The signal should be tested at the application and operating-system level, not accepted from a headline alone.

BUSINESS READ

For operating companies, compare the reported change with current qualification, sourcing and product-roadmap assumptions. For suppliers, connect materials claims to electrode processing, yield, validation and secured capacity.

ACTION

Within 30 days, compare technologies under the same duty cycle, safety envelope and total system cost; record the evidence and owner against P07.

UNKNOWN

Still unproven or incompletely stated: cycle life, fast charge, safety abuse, yield, cost, sourcing and warranty.

EDITORIAL SCORE 20/25 | MATURITY 1/5 | DECISION LOCUS: SYSTEM / ADOPTION

P08 PDES Electrolyte: Chonnam National University's SMB Stability Specs

A16 | Manufacturing | Product adoption

2026-11-02

FACT

Researchers at Chonnam National University have developed a polymerisable deep eutectic solvent (PDES) electrolyte that enhances the safety and durability of sodium metal batteries (SMBs). The electrolyte achieved 90.4% capacity retention after 1,000 cycles at 2 C, offering a non-flammable, leak-resistant alternative to traditional lithium-ion technology.

WHY IT MATTERS

The decision relevance is cell-level evidence, manufacturing yield, safety and bankable supply. The signal should be tested at the application and operating-system level, not accepted from a headline alone.

BUSINESS READ

For operating companies, compare the reported change with current qualification, sourcing and product-roadmap assumptions. For suppliers, connect materials claims to electrode processing, yield, validation and secured capacity.

ACTION

Within 30 days, compare technologies under the same duty cycle, safety envelope and total system cost; record the evidence and owner against P08.

UNKNOWN

Still unproven or incompletely stated: cycle life, fast charge, safety abuse, yield, cost, sourcing and warranty.

EDITORIAL SCORE 20/25 | MATURITY 4/5 | DECISION LOCUS: BUSINESS / RULES

FACT is source-bound. BUSINESS READ, ACTION and UNKNOWN are explicit editorial layers.

P09 IQM and Volkswagen: QC-AFQMC Battery Material Simulation Speedup

A13 | System validation | Research

2026-11-06

FACT

IQM and Volkswagen Group Innovation achieved up to a 124-times speedup in computational time for simulating battery materials using an improved Quantum-Classical Auxiliary-Field Quantum Monte Carlo (QC-AFQMC) method. The approach utilizes superconducting quantum hardware to address the limitations of classical modeling for strongly correlated electron interactions. This hybrid method demonstrates a viable path for tackling complex materials problems, specifically within lithium-air battery cycles.

WHY IT MATTERS

The decision relevance is cell-level evidence, manufacturing yield, safety and bankable supply. The signal should be tested at the application and operating-system level, not accepted from a headline alone.

BUSINESS READ

For operating companies, compare the reported change with current qualification, sourcing and product-roadmap assumptions. For suppliers, connect materials claims to electrode processing, yield, validation and secured capacity.

ACTION

Within 30 days, compare technologies under the same duty cycle, safety envelope and total system cost; record the evidence and owner against P09.

UNKNOWN

Still unproven or incompletely stated: cycle life, fast charge, safety abuse, yield, cost, sourcing and warranty.

EDITORIAL SCORE 19/25 | MATURITY 1/5 | DECISION LOCUS: TECH / PROCESS

P10 Zinc Anode Electrocrystallization: Work Function and (100) Orientation

A05 | Deployment & recycling | Pilot

2026-11-04

FACT

Researchers have identified the variation of work function upon facet-dependent additive adsorption as the governing factor for zinc electrocrystallization orientation, achieving a prediction accuracy of 93.1%. The study further demonstrates that a preferred (100) orientation provides superior cyclability under high current density and deep cycling conditions. This challenges the existing consensus that the (002) orientation is optimal for practical zinc anodes.

WHY IT MATTERS

The decision relevance is cell-level evidence, manufacturing yield, safety and bankable supply. The signal should be tested at the application and operating-system level, not accepted from a headline alone.

BUSINESS READ

For operating companies, compare the reported change with current qualification, sourcing and product-roadmap assumptions. For suppliers, connect materials claims to electrode processing, yield, validation and secured capacity.

ACTION

Within 30 days, compare technologies under the same duty cycle, safety envelope and total system cost; record the evidence and owner against P10.

UNKNOWN

Still unproven or incompletely stated: cycle life, fast charge, safety abuse, yield, cost, sourcing and warranty.

EDITORIAL SCORE 19/25 | MATURITY 2/5 | DECISION LOCUS: TECH / PROCESS

Playbook and 0-5 year roadmap

STAKEHOLDER	NOW | 0-30 DAYS	NEXT | 1-12 MONTHS	LATER | 1-5 YEARS
Operating companies	compare technologies under the same duty cycle, safety envelope and total system cost	Run production-like qualification with explicit acceptance and stop criteria.	Build a portfolio and architecture that can absorb technology and supplier changes.
Materials, equipment and technology suppliers	connect materials claims to electrode processing, yield, validation and secured capacity	Create shared reliability, process-window and failure-analysis data with customers.	Standardize interfaces, traceability, lifecycle support and recovery services.
Trading, investment and legal teams	Map cycle life, fast charge, safety abuse, yield, cost, sourcing and warranty.	Contract for capacity, quality, change notice, liability, alternatives and exit.	Diversify regional, technical and customer concentration risk.

ROADMAP

NOW | 0-30 DAYS
Evidence ledger
Owner: Strategy + quality
Deliverable: claim, source, condition, owner

NOW | 0-30 DAYS
Risk screen
Owner: Procurement + legal
Deliverable: unknowns, alternatives, stop

NEXT | 1-12 MONTHS
Joint qualification
Owner: R&D + supplier
Deliverable: process window and failure data

NEXT | 1-12 MONTHS
Commercial gate
Owner: Business + finance
Deliverable: unit economics and capacity

LATER | 1-5 YEARS
Platform strategy
Owner: Executive team
Deliverable: portfolio and interface roadmap

LATER | 1-5 YEARS
Service layer
Owner: Operations + channel
Deliverable: monitoring, maintenance and recovery

GO / NO-GO GATES

GATE	OWNER	REQUIRED EVIDENCE	NO-GO CONDITION
G1 Evidence	**Quality**	Source, test conditions and reproducibility	No traceable evidence
G2 Integration	**R&D**	Interface, process window and failure analysis	Cannot meet system conditions
G3 Commercial	**Business**	Capacity, total cost, contract and alternatives	Economics or supply cannot be supported
G4 Lifecycle	**Operations**	Monitoring, maintenance, change notice and exit	No accountable operating plan

ANALYZED ARTICLES | ITEMS 01-08

Every title and URL is displayed in full. URLs wrap without shortening and remain clickable. A verified-reference label means the translated HTML did not retain its original source URL.

ID	FULL ARTICLE TITLE	FULL SOURCE / VERIFIED REFERENCE URL - CLICKABLE
A01	Anode-Free Sodium Batteries: 1,400-Cycle Stability via DOX	https://www.nature.com/articles/s41560-026-02154-y
A02	Photocatalytic Battery Recycling: Sunlight-Driven Metal Recovery	https://doi.org/10.1038/s41467-026-78307-0
A03	Lithium-ion Battery Degradation: Electrolyte-Interfacial Kinetics	https://doi.org/10.1038/s41467-026-79025-3
A04	Li+/Mg2+ Selective Membranes: Subnanometer Pore Control for Brines	https://doi.org/10.1038/s41467-026-79061-z
A05	Zinc Anode Electrocrystallization: Work Function and (100) Orientation	https://doi.org/10.1038/s41557-026-02291-7
A06	MnO2 Slurry Electrolytes: 409% Capacity Boost for Mn-Flow Batteries	https://www.miragenews.com/mno-slurry-electrolytes-boost-manganese-flow-1772361/
A07	Lithium-Manganese-Rich Oxides: Controlled Oxygen Loss for EV Batteries	https://knowridge.com/2026/11/controlled-oxygen-loss-could-help-electric-car-batteries-last-longer/
A08	LMR Cathodes: Posco and Korea University Reduce Voltage Loss	https://www.koreaherald.com/article/10927214

ANALYZED ARTICLES | ITEMS 09-16

Every title and URL is displayed in full. URLs wrap without shortening and remain clickable. A verified-reference label means the translated HTML did not retain its original source URL.

ID	FULL ARTICLE TITLE	FULL SOURCE / VERIFIED REFERENCE URL - CLICKABLE
A09	Lithium Metal Batteries: Atomic-Level SEI Formation Analysis 2026	https://eetimes.itmedia.co.jp/ee/articles/2611/02/news023.html
A10	Fraunhofer ISE: PFAS-Free Dry Coating for Sodium-Ion Batteries	https://taiyangnews.info/technology/fraunhofer-ise-develops-pfas-free-battery-electrode-process
A11	Sodium-ion Batteries: Graphene-shell Anode for Fast Charging	https://www.notebookcheck.net/Sodium-ion-battery-allows-fast-charging-and-longer-lifespan-with-graphene-shell.1441211.0.html
A12	Liquid Air Energy Storage: China's 60 MW/600 MWh Facility Specs	https://www.pv-magazine.com/2026/11/06/worlds-largest-liquid-air-storage-facility-comes-online-in-china/
A13	IQM and Volkswagen: QC-AFQMC Battery Material Simulation Speedup	https://quantumzeitgeist.com/quantum-classical-methods-iqm-volkswagen-battery/
A14	Sodium-Sulfur Batteries: Aluminum Catalyst for 2,500+ Cycles	https://interestingengineering.com/energy/aluminum-catalyst-helps-sodium-sulfur-battery
A15	CATL ESS Lineup: TENER+ and TENER Sodium Specs for 2026	https://www.todayenergy.kr/news/articleView.html?idxno=304983
A16	PDES Electrolyte: Chonnam National University's SMB Stability Specs	https://www.bestmag.co.uk/novel-electrolyte-boosts-sodium-battery-chemistry/

NextGenEnergyStorage — Selected Articles

Date: 2026-11-08

Articles: 16

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#04 Li+/Mg2+ Selective Membranes: Subnanometer Pore Control for Brines

#05 Zinc Anode Electrocrystallization: Work Function and (100) Orientation

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#07 Lithium-Manganese-Rich Oxides: Controlled Oxygen Loss for EV Batteries

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#12 Liquid Air Energy Storage: China's 60 MW/600 MWh Facility Specs

#13 IQM and Volkswagen: QC-AFQMC Battery Material Simulation Speedup

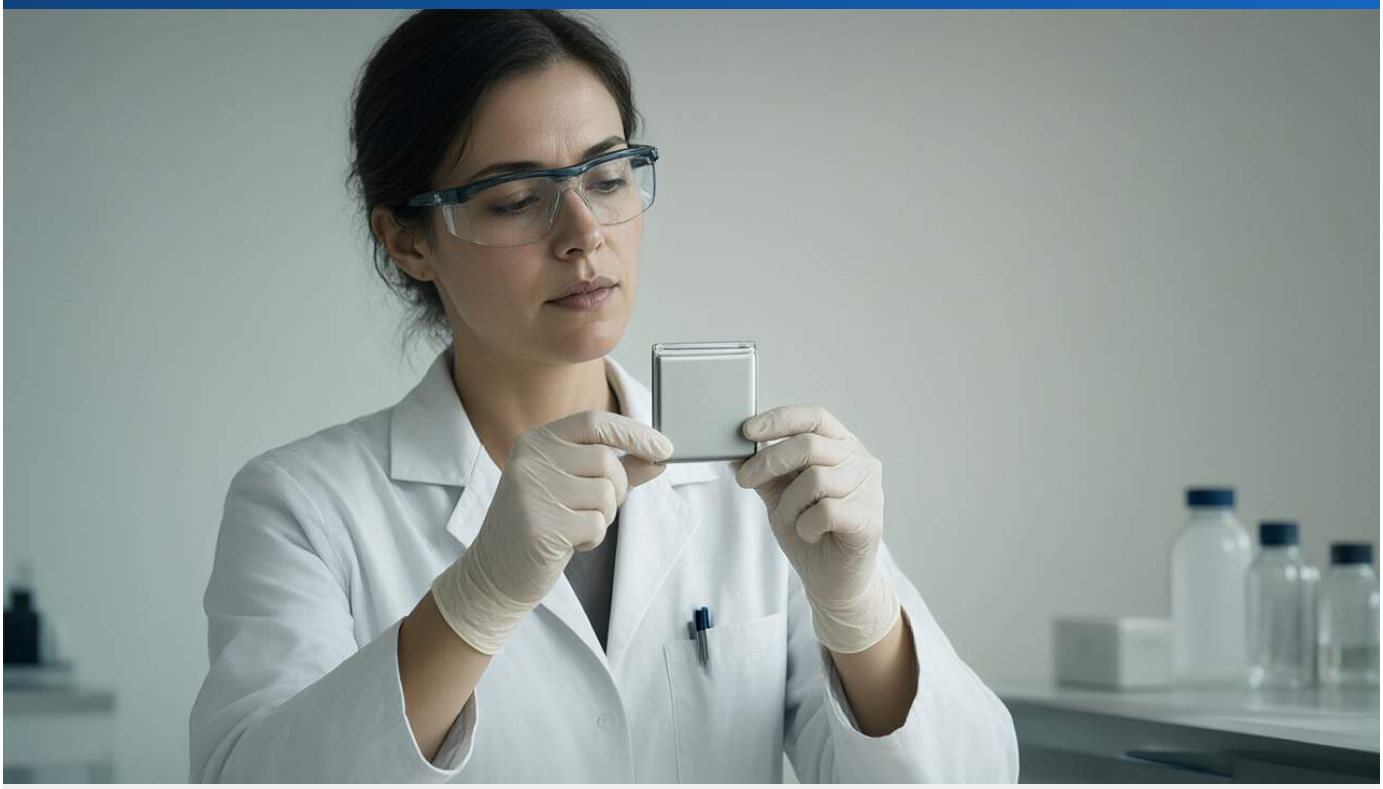
#14 Sodium–Sulfur Batteries: Aluminum Catalyst for 2,500+ Cycles

#15 CATL ESS Lineup: TENER+ and TENER Sodium Specs for 2026

#16 PDES Electrolyte: Chonnam National University's SMB Stability Specs

#01 Anode-Free Sodium Batteries: 1,400-Cycle Stability via DOX

Published November 02, 2026 Nature Energy



OVERVIEW

A molecular electrolyte design using 1,3-dioxane (DOX) enables anode-free sodium batteries (AFSBs) to retain ~80% capacity after 1,400 cycles at 1 C. This strategy mitigates irreversible sodium loss by promoting reversible deposition and forming a robust solid–electrolyte interphase. The result is a high-energy-density storage solution capable of operating at -40 °C with 88% capacity.

IN DEPTH

Key Findings

Researchers have developed a molecular-level electrolyte design that significantly extends the lifetime of anode-free sodium batteries (AFSBs). Using 300-mAh-level AFSB pouch cells with a cathode loading of ~20 mg cm^{-2}, the system retains ~80% capacity after 1,400 cycles at 1 C. Additionally, the cells demonstrate high round-trip energy efficiency of up to ~98% and maintain 88% capacity when operating at -40 °C.

Technical Details

The performance gains are driven by the integration of the cyclic ether 1,3-dioxane (DOX) into the electrolyte. The mechanism operates on two levels:

- **Sodium Deposition:** The weak coordination of DOX with Na+ facilitates Na+ desolvation, which promotes highly reversible sodium deposition.
- **Interphase Formation:** Controlled oligomerization of DOX creates a thin and robust solid–electrolyte interphase (SEI). This layer suppresses continuous electrolyte decomposition and stabilizes the plating and stripping of sodium.

These optimizations allow the cells to operate at rates up to 3 C while maintaining stability.

Background & Context

Anode-free sodium batteries are viewed as a promising route toward low-cost, high-energy-density energy storage. However, their practical application has been historically limited by the irreversible loss of sodium during cycling. This study addresses this limitation by focusing on the molecular design of the electrolyte to manage the interface between the electrolyte and the sodium deposition site.

Significance & Outlook

By simultaneously promoting reversible deposition and suppressing decomposition, this strategy provides a viable path for increasing the durability of AFSBs. The ability to maintain high capacity at extreme low temperatures (-40 °C) and achieve high energy efficiency suggests that molecular electrolyte engineering can overcome the primary barriers to the commercial viability of anode-free sodium-based storage systems.

Source: https://www.nature.com/articles/s41560-026-02154-y

Collected: November 07, 2026 | Automated Research System (AI)

#02 Photocatalytic Battery Recycling: Sunlight-Driven Metal Recovery

Published November 06, 2026 Nature Communications South Korea



OVERVIEW

Researchers have developed a sunlight-driven photocatalytic leaching framework for recovering critical metals from diverse commercial lithium-ion battery cathodes. By combining mild organic acids with a reusable photocatalyst, the system reduces energy inputs and greenhouse gas emissions compared to conventional recycling methods.

IN DEPTH

Key Findings

The reported photocatalytic leaching framework enables the robust recovery of critical metals from various commercial cathode materials. Techno-economic and life cycle analyses indicate that this method offers clear advantages over conventional recycling processes, specifically through lower energy requirements and a reduction in greenhouse gas emissions.

Technical Details

The process utilizes a combination of mild organic acids and a reusable photocatalyst to facilitate a twofold leaching mechanism driven by sunlight. The technical operation involves the following steps:

- In situ generation of hydrogen peroxide across the solar spectrum.
- Activation of the generated hydrogen peroxide by UV components to enhance metal extraction.
- Elimination of the need for external oxidizing agents.

The system demonstrates consistent performance over multiple operation cycles, which supports its potential for scalability and process robustness.

Background & Context

The rapid deployment of secondary batteries has increased pressures on waste management and resource security. Current battery recycling technologies are limited by their intensive reliance on chemicals and energy. To address these limitations, there is a need for sustainable waste management systems that improve economic and environmental feasibility while remaining versatile across different cathode chemistries.

Significance & Outlook

This work establishes a versatile and environmentally benign approach to battery recycling. By providing a profitable and scalable pathway for metal recovery, the framework contributes to the development of a sustainable circular economy for lithium-ion batteries.

Source: https://doi.org/10.1038/s41467-026-78307-0

Collected: November 07, 2026 | Automated Research System (AI)

#03 Lithium-ion Battery Degradation: Electrolyte-Interfacial Kinetics

Published November 05, 2026 Nature Communications UK



OVERVIEW

Electrolyte composition significantly shapes degradation trajectories and lifetime variability in lithium-ion batteries through interfacial kinetics. Research demonstrates that incorporating electrolyte-sensitive interfacial transport parameters into physics-based models is essential for reliable lifetime prediction.

IN DEPTH

Key Findings

Electrolyte-sensitive interfacial degradation is a critical dimension for the reliable prediction of lithium-ion battery lifetimes. The study found that varying the solvent ratio leads to distinct lifetime trajectories across comparable cells, a divergence associated with parasitic reactions, spatially heterogeneous surface degradation, and electrolyte-sensitive interphase growth.

Technical Details

Researchers utilized customized multi-layer pouch cells to examine degradation under accelerated conditions. The experimental framework varied the following parameters:

- Ethylene carbonate:dimethyl carbonate ratio
- Lithium hexafluorophosphate concentration
- Electrolyte amount

To analyze these effects, the team employed electrochemical diagnostics, gas analysis, and post-mortem interfacial characterization. These findings were then integrated into a physics-based degradation model incorporating electrolyte-dependent thermodynamic and transport properties.

The results indicated that a transport-only model implementation failed to reproduce the observed separation in capacity-retention trajectories. However, introducing a minimal electrolyte-sensitive refinement via an effective interphase transport parameter improved the agreement in cases rich in ethylene carbonate.

Background & Context

Current continuum degradation models typically represent the electrolyte through bulk transport. This approach fails to capture the specific role of the electrolyte in interfacial degradation, which remains a major obstacle to the sustainable deployment of lithium-ion batteries. This gap in modeling contributes to increased material demand, premature battery retirement, and uncertainty in lifecycle assessments.

Significance & Outlook

By identifying the necessity of electrolyte-dependent interfacial kinetics in modeling, this research provides a pathway toward more accurate lifetime predictions. Moving beyond bulk transport representations allows for a deeper understanding of how specific electrolyte formulations influence the physical and chemical kinetics at the interface, ultimately impacting the overall durability of the battery system.

Source: https://doi.org/10.1038/s41467-026-79025-3

Collected: November 07, 2026 | Automated Research System (AI)

#04 Li+/Mg2+ Selective Membranes: Subnanometer Pore Control for Brines

Published October 31, 2026 Nature Communications China



OVERVIEW

Researchers have developed a crosslinking-regulated membrane achieving a Li+/Mg2+ separation factor of up to 6454 under electrodialysis conditions. The technology maintains high selectivity in untreated natural salt-lake brines, offering a scalable solution for lithium recovery.

IN DEPTH

Key Findings

The developed membrane achieved a Li+/Mg2+ separation factor of up to 6454 when tested at an Mg/Li mass ratio of 140 under electrodialysis conditions. In tests using untreated natural salt-lake brine with an Mg/Li mass ratio of 87 and various competing ions, the membrane maintained a separation factor above 1200. To demonstrate practical viability, the researchers fabricated a 25 cm × 35 cm membrane and confirmed stable performance over 15 days of repeated operation.

Technical Details

The core of the technology lies in the regulation of the crosslinking degree during the membrane formation process. This approach allows for precise subnanometer pore size control within the narrow window required to differentiate between Li+ and Mg2+ ions. The membrane was tested under electrodialysis conditions to evaluate its selectivity and stability.

Background & Context

Membrane-based separation is a competitive technology for extracting lithium from salt-lake brines. However, industrial implementation has been hindered by the low Li+/Mg2+ selectivity of conventional membranes. This research addresses the need for membranes that can operate effectively despite high magnesium concentrations and the presence of other competing ions found in natural brine sources.

Significance & Outlook

The ability to produce larger-scale membranes (25 cm × 35 cm) and maintain stability over two weeks suggests a path toward industrial application. This design strategy for precisely regulating subnanometer pores may be applicable to a wide range of other sustainable separation processes requiring high ion selectivity.

Source: https://doi.org/10.1038/s41467-026-79061-z

#05 Zinc Anode Electrocrystallization: Work Function and (100) Orientation

Published November 04, 2026 Nature Chemistry



OVERVIEW

Researchers have identified the variation of work function upon facet-dependent additive adsorption as the governing factor for zinc electrocrystallization orientation, achieving a prediction accuracy of 93.1%. The study further demonstrates that a preferred (100) orientation provides superior cyclability under high current density and deep cycling conditions. This challenges the existing consensus that the (002) orientation is optimal for practical zinc anodes.

IN DEPTH

Key Findings

The primary discovery is that the variation of the work function, resulting from facet-dependent molecular adsorption of additives, determines the crystallographic orientation of zinc electrocrystallization. Through an investigation of 29 additives using experimental and computational methods, the researchers achieved a prediction accuracy of 93.1% for the resulting orientation. Additionally, the study reveals that zinc anodes featuring a preferred (100) orientation exhibit outstanding cyclability, contradicting the previous industry consensus that the (002) orientation is the most favorable for practical applications.

Technical Details

The research focused on the atomic-scale physical variations of different zinc facets upon the adsorption of additives. The findings indicate that the work function is the critical governing factor in this process. The performance of the (100) orientation was validated under harsh electrochemical conditions, specifically:

- High current densities reaching up to 20 mA cm−2.
- Deep cycling with a depth of discharge exceeding 85%.

Background & Context

Conventional wisdom in the field attributed the additive-mediated orientation of zinc electrocrystallization primarily to the selective facet adsorption of additives. However, this view has been increasingly challenged by various counterexamples in recent literature. This study seeks to resolve these contradictions by shifting the focus from simple adsorption to the resulting physical changes in the work function of the zinc facets.

Significance & Outlook

This research establishes a fundamental criterion for the screening of additives to achieve favorably oriented zinc electrocrystallization. By demonstrating that the (100) orientation outperforms the (002) orientation under extreme conditions, the study provides a new direction for the development of high-performance zinc metal anodes with improved stability and longevity.

Source: https://doi.org/10.1038/s41557-026-02291-7

Collected: November 07, 2026 | Automated Research System (AI)

#06 MnO_2 Slurry Electrolytes: 409% Capacity Boost for Mn-Flow Batteries

Published November 05, 2026 Mirage News China



OVERVIEW

Researchers at Shanghai University have developed a semi-solid MnO_2 slurry electrolyte that increases the specific capacity of manganese-based redox flow batteries to 156.2 Ah L^{-1}. This approach enables operation at current densities 30 times higher than previous semi-solid MnO_2 systems, offering a cost-effective path for large-scale energy storage.

IN DEPTH

Key Findings

A new semi-solid slurry strategy has achieved a 409% increase in specific capacity compared to $MnSO_4$-based electrolyte benchmarks. Using a 4 M MnO_2 slurry, the researchers reached a soluble manganese species concentration of 3.76 M and a specific capacity of 156.2 Ah L^{-1}. Notably, the system maintains high performance at a current density of 30 mA cm^{-2}, where it retains a specific capacity above 151 Ah L^{-1} and an energy efficiency exceeding 71%.

Technical Details

The system overcomes the common-ion effect in conventional sulfuric acid electrolytes, which typically limits $MnSO_4$ solubility. By introducing solid MnO_2 particles, the battery accesses more active material as the solid MnO_2 is electrochemically converted into soluble Mn^{2+} during discharge. The slurry operates without additional conductive carbon additives while maintaining low viscosity.

The study identified a shift in the electrochemical reaction mechanism:

- Initial cycles rely on a slower solid-phase MnO_2/Mn^{2+} reaction.
- Subsequent charging creates a more disordered MnO_2 with a larger specific surface area.
- This new structure favors a reverse disproportionation reaction with Mn^{2+}, shifting the dominant process to a faster solution-phase Mn^{3+}/Mn^{2+} reaction.

This transition improves reaction kinetics and discharge voltage, allowing for higher current densities.

Background & Context

Manganese-based redox flow batteries are attractive for large-scale storage due to the abundance and low cost of manganese. However, conventional systems are limited by solubility, and previous semi-solid attempts suffered from slow reaction kinetics that restricted operating current densities.

Significance & Outlook

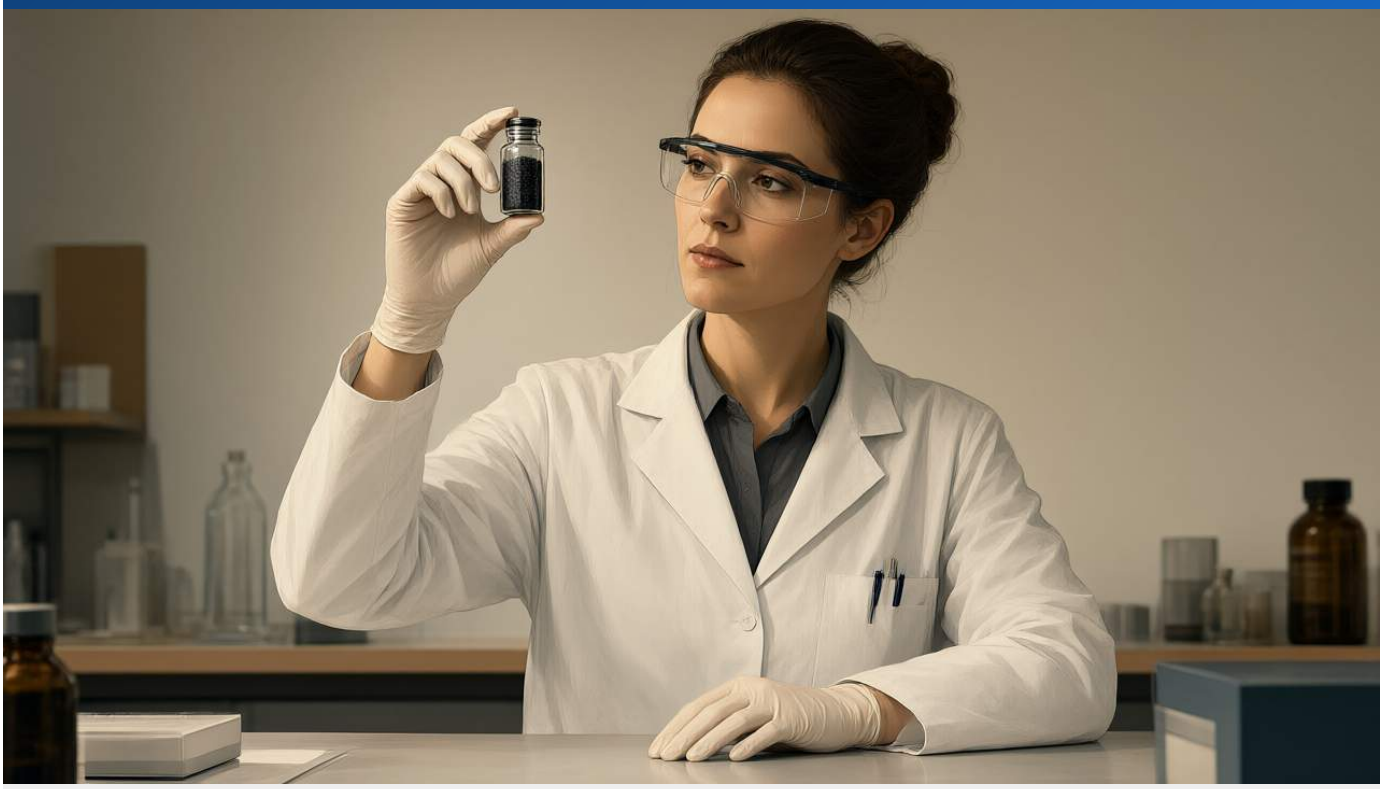
With an estimated electrolyte energy cost of US$33 kWh^{-1}, this method provides a significant economic advantage. While a 1 M MnO_2 slurry demonstrated 99% Coulombic efficiency and 76% energy efficiency over 100 cycles at 30 mA cm^{-2}, capacity retention remains a challenge at higher concentrations due to manganese crossover and particle accumulation. Future optimization of membranes and electrolytes is required to improve cycling stability for renewable energy storage applications.

Source: https://www.miragenews.com/mno-slurry-electrolytes-boost-manganese-flow-1772361/

Collected: November 07, 2026 | Automated Research System (AI)

#07 Lithium-Manganese-Rich Oxides: Controlled Oxygen Loss for EV Batteries

Published November 02, 2026 Knowridge Science Report South Korea



OVERVIEW

Researchers from Pohang University of Science and Technology discovered that controlling oxygen loss in lithium- and manganese-rich layered oxides can reshape internal structures to improve lithium ion movement. In specific cycling pathways, discharge capacity rose to 106.4% of its initial value after 200 cycles. This finding suggests that battery aging can be steered to enhance the performance of low-cost cathode materials.

IN DEPTH

Key Findings

A research team led by Pohang University of Science and Technology has demonstrated that managed oxygen loss in cathode materials can be used to improve battery performance rather than simply acting as a sign of deterioration. By controlling the conditions under which oxygen leaves the material, the researchers were able to create additional routes for lithium movement. In one specific test condition, the discharge capacity increased to 106.4% of its initial value after 200 cycles.

Technical Details

The study focused on lithium- and manganese-rich layered oxides. These materials typically feature an orderly layered arrangement of lithium and metal atoms stabilized by oxygen. During use, oxygen can escape, creating empty sites that allow other atoms to rearrange. The researchers used a combination of computer calculations and detailed material measurements to determine how charging conditions influence this process.

The team found that the interaction between oxygen loss and the depth of charging determines the resulting structure. Depending on these variables, the material either preserves its layers or transitions through stages that produce a more disordered structure. While disorder is usually associated with degradation, this specific structural change can open new pathways for the movement of lithium ions.

Background & Context

Lithium- and manganese-rich layered oxides are candidates for cathodes because they offer high storage capacity and reduce the industry's reliance on expensive nickel and cobalt. However, these materials often struggle with long-term durability, as repeated charging typically reduces operating voltage and the amount of charge delivered.

Significance & Outlook

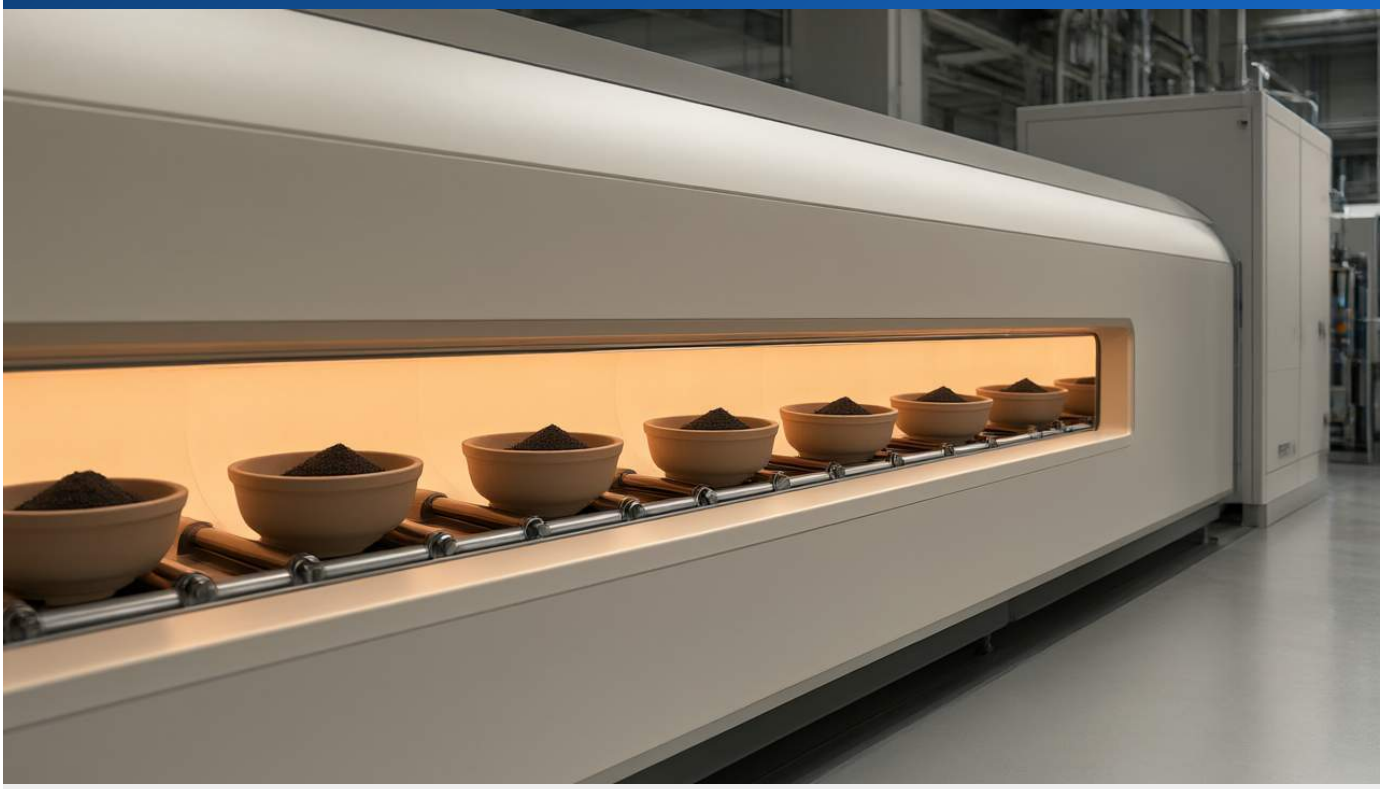
This research indicates that charging voltage and temperature are critical levers for controlling structural pathways. Rather than treating structural changes as unavoidable damage, engineers may be able to steer the aging process to extract more performance from the material. Future development must now integrate these findings with requirements for energy output, voltage, and durability to determine performance under commercial driving conditions.

Source: https://knowridge.com/2026/11/controlled-oxygen-loss-could-help-electric-car-batteries-last-longer/

Collected: November 07, 2026 | Automated Research System (AI)

#08 LMR Cathodes: Posco and Korea University Reduce Voltage Loss

Published November 05, 2026 The Korea Herald South Korea



OVERVIEW

Posco Holdings and Korea University have developed a manufacturing method that reduces voltage loss in lithium-manganese-rich (LMR) cathodes by approximately 30 percent. By optimizing heat-treatment temperatures during early production, the team improved structural stability without altering chemical compositions. This approach provides a practical path toward the commercialization of high-capacity batteries for EVs and energy storage systems.

IN DEPTH

Key Findings

Researchers have successfully reduced voltage decline in next-generation lithium-ion battery cathodes by adjusting the temperature during the initial stages of production. After 500 charge-discharge cycles, cathodes produced using a lower-temperature treatment exhibited a voltage decline of 250 millivolts, compared to 358 millivolts in those treated at higher temperatures.

Technical Details

The study, led by Professor Park Hyeok-jun of Korea University and Posco Holdings' N.EX.T Hub research institute, focused on the internal structure of lithium-manganese-rich (LMR) cathodes. The team discovered that the temperature used during the early stages of cathode production is the critical factor in determining long-term performance. Key technical observations include:

- **Lower-temperature treatment:** Promotes a more uniform distribution of metals inside the cathode, stabilizing the structure.
- **Higher-temperature treatment:** Causes metals to separate into uneven clusters, creating structural weaknesses that accelerate performance degradation.

Crucially, these improvements were achieved by optimizing existing production processes without introducing new materials or changing the chemical composition of the precursors.

Background & Context

LMR cathodes are considered a promising alternative for electric vehicles and energy storage systems because they can store more energy than conventional materials by utilizing chemical reactions involving both oxygen and metals. However, widespread commercial adoption has been hindered by structural instability and gradual voltage loss during repeated cycling.

Significance & Outlook

The findings suggest that manufacturers can enhance the durability of high-capacity cathodes by simply optimizing heat-treatment parameters. This offers a practical route toward commercial production for the EV and energy storage sectors. The research was supported by Posco Holdings and the National Research Foundation of Korea and was published in the journal *ACS Energy Letters* on Oct. 19, where it was featured on the supplementary cover.

Source: https://www.koreaherald.com/article/10927214

Collected: November 07, 2026 | Automated Research System (AI)

#09 Lithium Metal Batteries: Atomic-Level SEI Formation Analysis 2026

Published November 02, 2026 EE Times Japan Japan



OVERVIEW

Researchers from the University of Tokyo and ENSTA Paris have visualized the formation process of the solid electrolyte interface (SEI) in lithium metal batteries using machine learning simulations. This method enables atomic-level tracking of electrolyte decomposition and is applicable to various electrode materials and electrolyte interfaces.

IN DEPTH

Key Findings

A research group comprising the University of Tokyo and ENSTA Paris has successfully visualized the formation process of the protective film, known as the solid electrolyte interface (SEI), in lithium metal batteries. The team demonstrated that the composition and spatial structure of the SEI vary significantly depending on the electrolyte composition, specifically identifying that in LiFSI/EC high-concentration electrolytes, Li2O distributes near the lithium metal surface with LiF positioned on the outer layer.

Technical Details

The researchers developed a method to track the decomposition of electrolytes and the subsequent formation of the SEI at an atomic level. The technical approach includes:

- **Machine Learning Force Fields:** By utilizing machine learning force fields trained on first-principles calculations, the team performed large-scale simulations of the lithium metal/electrolyte interface involving approximately 4000 atoms.
- **Automated Reaction Analysis:** The group developed an automated analysis technique to detect the generation and cleavage of bonds between atoms during simulation, allowing for the extraction of numerous reaction paths and products.

The results of these simulations were found to be consistent with experimental observation results.

Background & Context

Lithium metal batteries are targeted for use in electric vehicles and renewable energy storage due to their higher energy density compared to standard lithium-ion batteries. However, lithium metal is highly reactive; upon contact with electrolytes, the electrolyte decomposes to form the SEI. Because the SEI's composition and structure directly influence battery safety, lifespan, and charge-discharge efficiency, understanding its detailed formation mechanism is critical, though it has remained largely unexplained until now.

Significance & Outlook

This simulation framework allows for the visualization of SEI formation processes that are difficult to observe through physical experiments. Furthermore, the research group states that this analysis method is not limited to lithium metal and can be applied to analyze reactions occurring at the interfaces of various other electrode materials and electrolytes.

Source: https://eetimes.itmedia.co.jp/ee/articles/2611/02/news023.html

Collected: November 07, 2026 | Automated Research System (AI)

#10 Fraunhofer ISE: PFAS-Free Dry Coating for Sodium-Ion Batteries

Published November 05, 2026 TaiyangNews Germany



OVERVIEW

Fraunhofer ISE and IKA have developed a solvent-free and PFAS-free dry-coating process for sodium-ion battery electrodes. The method reduces capital expenditure by at least 15% and operating costs by 10% to 20% compared to conventional wet coating. This advancement significantly lowers energy consumption and CO2 emissions while removing hazardous chemicals from the production chain.

IN DEPTH

Key Findings

Fraunhofer ISE, in collaboration with equipment manufacturer IKA, has developed a dry-coating process for sodium-ion battery electrodes that eliminates both solvents and per- and polyfluoroalkyl substances (PFAS). The process is estimated to reduce capital expenditure (CapEx) per production line by at least 15% and operating expenditure (OpEx) by 10% to 20% relative to conventional wet-coating lines. Furthermore, the elimination of drying, calendaring, and bonding agent application steps could reduce energy consumption and associated CO2 emissions by approximately 50%.

Technical Details

Developed under the LAENDLE research project, the process utilizes continuous kneading to prepare electrode materials without the need for PFAS-based binders. Researchers identified two classes of PFAS-free polymer binders suitable for this dry-coating application. The team produced freestanding electrode films with thicknesses ranging from 80 to 180 µm, which can be attached directly to a metal current-collector foil. Notably, the process removes the requirement for an additional bonding agent on the metal foil, simplifying the manufacturing sequence. Fraunhofer ISE states that this process can be integrated into existing dry-coating production lines without altering subsequent manufacturing steps.

Background & Context

Conventional battery electrode manufacturing typically relies on a wet-coating process, where materials are mixed with solvents, applied to metal foil, and dried. While some existing dry-coating methods exist to reduce energy use, many still depend on PFAS-based chemicals to bind electrode materials. The LAENDLE project seeks to eliminate these environmental and financial burdens.

Significance & Outlook

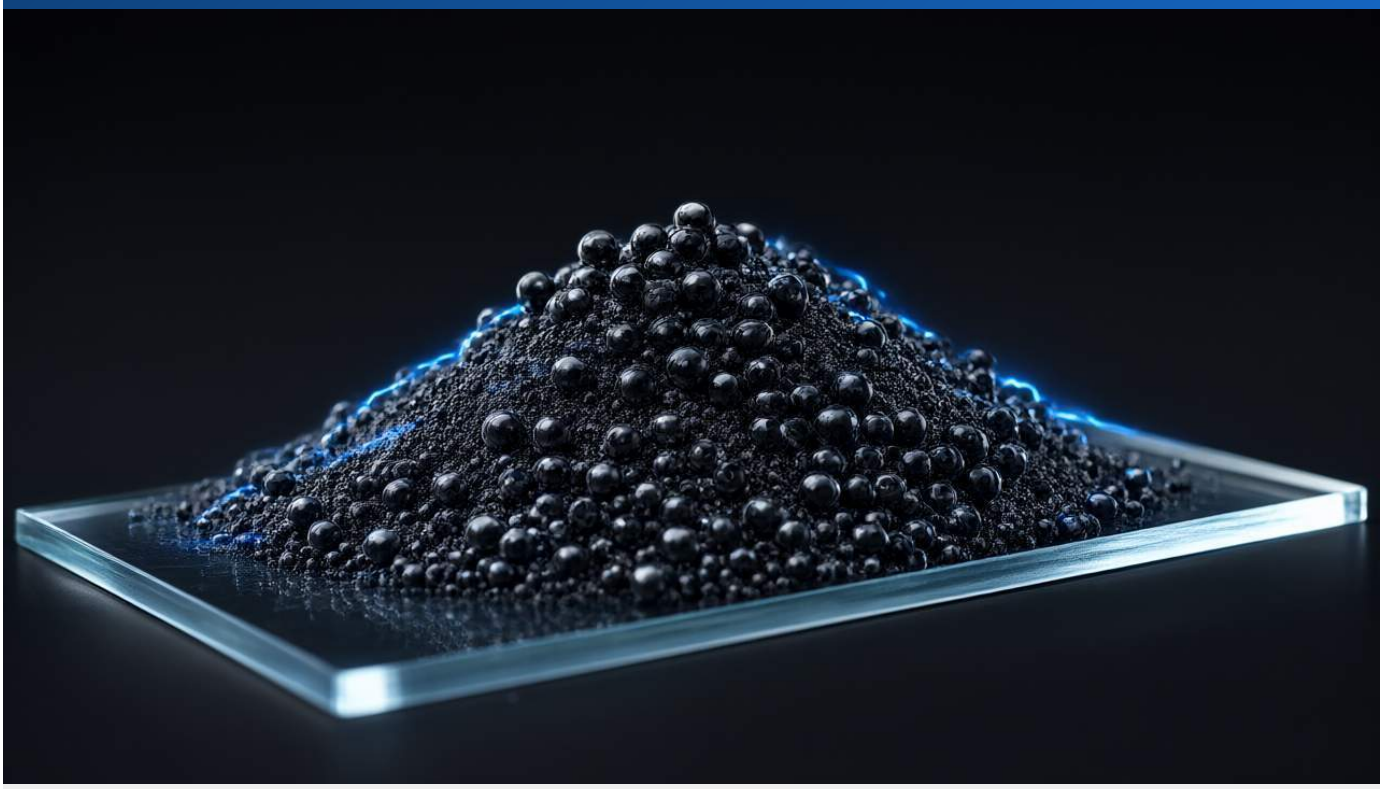
Project manager Dr. Oliver Fitz notes that reducing equipment requirements and simplifying the coating process may make battery electrode manufacturing more accessible to small and medium-sized enterprises. The project, funded by the Baden-Württemberg Ministry of Economic Affairs, Labor, and Tourism, is scheduled to continue until June 2027. Future phases will focus on scaling the technology to pouch-cell production and reducing binder amounts to levels found in commercial battery manufacturing.

Source: https://taiyangnews.info/technology/fraunhofer-ise-develops-pfas-free-battery-electrode-process

Collected: November 07, 2026 | Automated Research System (AI)

#11 Sodium-ion Batteries: Graphene-shell Anode for Fast Charging

Published November 03, 2026 Notebookcheck USA



OVERVIEW

Researchers in China have developed a titanium dioxide nanosheet anode wrapped in a 0.4 nm graphene-like carbon shell to eliminate the tradeoff between charging speed and lifespan. The anode maintained 131 mAh/g over 10,000 cycles at a 10C charging rate, significantly outperforming bare nanosheets. This innovation could accelerate the adoption of sodium-ion batteries in electric vehicles and grid storage by matching LFP performance.

IN DEPTH

Key Findings

The research team successfully developed an anode that enables ultrafast charging without compromising cycle life. At a 10C charging rate (six minutes), the graphene-shell anode delivered 131 mAh/g and remained stable for 10,000 cycles. Even at a 100C rate, which allows a full charge in approximately half a minute, the anode provided 121 mAh/g. In contrast, bare nanosheets collapsed after only 400 cycles.

Technical Details

The anode consists of titanium dioxide nanosheets, approximately 10 nm across, assembled into hollow double-shelled spheres. Each sheet is coated in a graphene-like carbon shell 0.4 nm thick. This structural wrapping increased conductivity from 1.86×10^{-8} S/cm for bare materials to 3.55×10^{-4} S/cm.

The graphene shell addresses two primary failure points:

- **Surface Reactivity:** Bare nanosheets have a high surface area (261 m^2/g vs. 76 m^2/g for ordinary nanoparticles), leading to high sodium loss. The armored version improved initial efficiency from 55.6% to 80.1%.
- **Structural Integrity:** The shell prevents the fragile nanosheets from cracking during the swelling and shrinking caused by fast ion movement and limits direct contact with the electrolyte, forming a thinner, more inorganic sodium phosphate film.

Regarding mass loading, electrodes up to 10.5 mg/cm^2 delivered 2.13 mAh/cm^2 at slow rates and 0.567 mAh/cm^2 at high current. A full cell using a sodium vanadium phosphate cathode was also tested, maintaining stability over 170 cycles at 2 A/g.

Background and Significance

Sodium-ion batteries offer advantages in raw material cost, safety, and low-temperature performance, but typically face a conundrum where fast charging reduces lifespan. While commercial hard carbon fades quickly above 1 A/g, this graphene-wrapped anode maintains delivery.

Although the anode operates at a higher average voltage than hard carbon—reducing total cell energy—the results suggest a path toward parity with LFP batteries. Such durability in fast-charging anodes would strengthen the case for companies like CATL and HiNa to deploy sodium-ion technology in vehicles and grid storage.

Source: https://www.notebookcheck.net/Sodium-ion-battery-allows-fast-charging-and-longer-lifespan-with-graphene-shell.1441211.0.html

Collected: November 07, 2026 | Automated Research System (AI)

#12 Liquid Air Energy Storage: China's 60 MW/600 MWh Facility Specs

Published November 06, 2026 pv magazine China



OVERVIEW

China has connected the world's largest liquid-air energy storage (LAES) facility to the grid in Qinghai province, featuring a 60 MW output and 600 MWh capacity. Developed by CGDG and CAS, the plant demonstrates a 100% localized cryogenic supply chain for long-duration energy storage. This project enables the shifting of surplus renewable energy to peak demand periods without requiring specific geological formations.

IN DEPTH

Key Findings

A 60 MW/600 MWh liquid air energy storage (LAES) demonstration project in Golmud, Haixi Mongolian and Tibetan Autonomous Prefecture, began generating electricity on October 30. Developed by the state-owned China Green Development Investment Group (CGDG) in cooperation with the Technical Institute of Physics and Chemistry of the Chinese Academy of Sciences (CAS), the facility is the world's largest grid-connected LAES plant by both rated power and energy capacity.

Technical Details

The system utilizes ambient air as the working fluid, eliminating the need for electrochemical batteries or underground caverns. The process operates in three primary stages:

- **Charging:** Surplus electricity powers a three-stage centrifugal compressor to pressurize purified air to approximately 7 MPa. Heat from this process is recovered and stored as hot water at temperatures up to 195 C. The air is then cooled and liquefied at approximately -194 C for storage in insulated cryogenic tanks.
- **Discharging:** Liquid air is pressurized, reheated, and vaporized. The resulting expanding gas drives turbines connected to generators.
- **Recovery:** Cold energy recovered during vaporization is stored for use in subsequent charging cycles.

The facility is designed for 10 hours of continuous electricity delivery. It can accommodate approximately 600 MWh of surplus renewable electricity daily, supplying an estimated 180 GWh to the grid annually.

Background & Context

Construction began in July 2023 as part of China’s national new-type energy storage demonstration program. The project achieved a 100% localization rate, with all major equipment—including liquid expanders, cryogenic heat exchangers, and large centrifugal compressors—manufactured domestically. Engineering was handled by Hualu Engineering & Technology, with construction participation from China National Chemical Engineering Third Construction.

Significance & Outlook

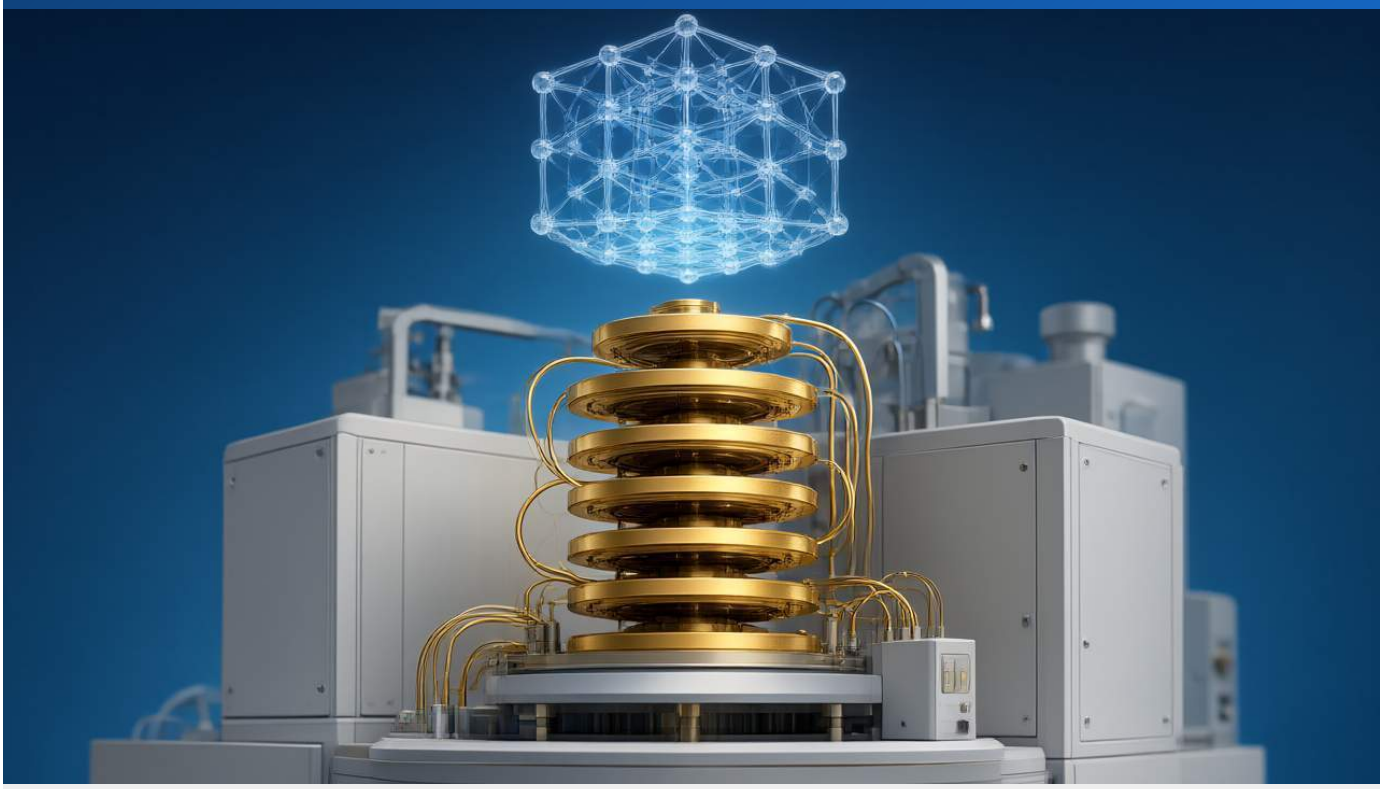
Located in the renewable-rich Qaidam Basin, the facility provides inertial support to the power grid and offers greater site flexibility than compressed-air storage due to its use of insulated tanks. This project represents one of several long-duration storage technologies China is pursuing alongside lithium-ion, including vanadium redox flow, sodium-ion, and thermal storage.

Source: https://www.pv-magazine.com/2026/11/06/worlds-largest-liquid-air-storage-facility-comes-online-in-china/

Collected: November 07, 2026 | Automated Research System (AI)

#13 IQM and Volkswagen: QC-AFQMC Battery Material Simulation Speedup

Published November 06, 2026 Quantum Zeitgeist



OVERVIEW

IQM and Volkswagen Group Innovation achieved up to a 124-times speedup in computational time for simulating battery materials using an improved Quantum-Classical Auxiliary-Field Quantum Monte Carlo (QC-AFQMC) method. The approach utilizes superconducting quantum hardware to address the limitations of classical modeling for strongly correlated electron interactions. This hybrid method demonstrates a viable path for tackling complex materials problems, specifically within lithium-air battery cycles.

IN DEPTH

Key Findings

IQM and Volkswagen Group Innovation have demonstrated a computational speedup of up to 124 times in the simulation of battery materials. This was achieved by implementing improvements to the Quantum-Classical Auxiliary-Field Quantum Monte Carlo (QC-AFQMC) method, which reduces the costs associated with classical post-processing.

Technical Details

The collaboration utilized IQM's Emerald superconducting quantum hardware to validate ground-state energy calculations. The team used error-mitigated data from the Emerald processor to confirm results against full configuration-interaction references and established phaseless-AFQMC for stretched hydrogen chains. Following this validation, the researchers scaled the method to a 40-qubit study focusing on a lithium superoxide dimer rearrangement, a process critical to lithium-air battery cycles.

Background and Context

The project was designed to address specific limitations of classical computational methods when modeling strongly correlated electron interactions in complex chemical systems. Volkswagen Group Innovation provided the industrially relevant materials challenges, ensuring the algorithm development remained focused on practical application. The hybrid approach combines the materials expertise of Volkswagen with the quantum hardware capabilities of IQM.

Significance and Outlook

While the team reports that substantial runtime challenges still persist, the successful scaling to 40 qubits indicates that quantum-classical hybrid approaches are a viable path for solving complex materials science problems. By moving QC-AFQMC beyond prior performance levels, the research highlights the potential for quantum hardware to accelerate the discovery and optimization of battery materials, potentially changing the future of energy storage research.

Source: https://quantumzeitgeist.com/quantum-classical-methods-iqm-volkswagen-battery/

Collected: November 07, 2026 | Automated Research System (AI)

#14 Sodium–Sulfur Batteries: Aluminum Catalyst for 2,500+ Cycles

Published November 03, 2026 Interesting Engineering USA



OVERVIEW

Researchers at the Chinese Academy of Sciences have developed an aluminum single-atom catalyst that enables sodium–sulfur (Na–S) batteries to maintain capacity over 2,500 cycles. By breaking atomic symmetry to suppress polysulfide shuttling, the team achieved a capacity of 1,196 mAh g^{-1} after 100 cycles. This provides a low-cost, scalable alternative to lithium for large-scale energy storage.

IN DEPTH

Key Findings

The new aluminum-based cathode demonstrates exceptional long-term durability and energy output. In laboratory testing, the battery delivered a high storage capacity of 1,196 mAh g^{-1} after 100 cycles. Most notably, the system maintained stable performance over 2,500 continuous charge-discharge cycles, with a capacity drop of only 0.017% per cycle. These results allow an inexpensive main-group metal to outperform more costly transition metal and rare-earth catalysts.

Technical Details

The performance breakthrough was achieved by re-engineering the atomic architecture of aluminum to overcome the limitations of traditional main-group metal catalysts. The research team, led by Profs. Wang Hui and Zheng Fangcai at the High Magnetic Field Laboratory in Hefei, focused on breaking atomic symmetry:

- **Structural Modification:** The team replaced one oxygen atom in the typical Al–O4 coordination (where aluminum is surrounded by four oxygen atoms) with a nitrogen atom.
- **Asymmetric Coordination:** This created an Al–O3N asymmetric structure, altering the local electron distribution around the central aluminum atom.
- **Chemical Interaction:** The resulting strong localized electric charge promoted intense p-p orbital hybridization between aluminum sites and sulfur species.
- **Polysulfide Suppression:** This mechanism effectively trapped volatile sodium polysulfide intermediates, preventing them from shuttling and dissolving from the cathode.

Background & Context

While sodium is abundant and cheap for large-scale storage, Na–S batteries typically degrade quickly. Previous attempts to increase longevity focused on precious heavy metals such as platinum, cobalt, or nickel. While aluminum is non-toxic and inexpensive, it was previously considered a "lazy" catalyst that lacked the necessary catalytic punch to manage polysulfide shuttling.

Significance & Outlook

The study, published in *Angewandte Chemie*, demonstrates that adjusting the local atomic environment of abundant elements can create highly efficient catalysts. For grid operators seeking safer and cheaper alternatives to lithium for renewable power storage, this aluminum-based approach offers a scalable path toward long-lasting sodium–sulfur battery technology.

Source: https://interestingengineering.com/energy/aluminum-catalyst-helps-sodium-sulfur-battery

Collected: November 07, 2026 | Automated Research System (AI)

#15 CATL ESS Lineup: TENER+ and TENER Sodium Specs for 2026

Published November 02, 2026 투데이에너지 (TodayEnergy） South Korea



OVERVIEW

CATL has introduced the 9MWh TENER+ and the sodium-ion based TENER Sodium energy storage systems at All Energy Australia 2026. These systems target high-temperature environments and grid stability, supported by three new MoUs with partners including Hitachi Energy.

IN DEPTH

Key Findings

CATL has expanded its energy storage system (ESS) portfolio with the global debut of TENER+ and the introduction of TENER Sodium. To strengthen its presence in the Australian market, the company signed three Memorandums of Understanding (MoUs) with key organizations, including Hitachi Energy, focusing on utility-scale battery projects and grid connection enhancements.

Technical Details

The TENER+ is a 9MWh ultra-large capacity ESS designed for projects with site constraints. It reduces the required number of containers by up to 40% and the total site area by 12% compared to previous systems. Engineered for a 25-year lifespan, it features a top-exhaust design to prevent "heat island" effects, allowing the unit to operate at rated output during extreme summer temperatures. It also includes intelligent thermal management and protection for humid coastal environments.

The TENER Sodium is the first mass-produced and field-verified sodium-ion battery ESS. Key specifications include:

- **Capacity:** Over 30MWh via a modular cabinet architecture.
- **Thermal Tolerance:** Operational up to 55°C.
- **Performance:** Over 10,000 cycles and 95% round-trip efficiency at 45°C.
- **Supply Chain:** Utilizes sodium as an alternative to lithium due to its abundance and distribution.

Background & Context

The Australian power grid requires "grid-forming" ESS capabilities to maintain voltage and frequency stability as coal-fired power plants close and renewable energy penetration increases. CATL currently holds a significant footprint in the region with over 17GWh of installed capacity and serves as the technical partner for the 400MW/1860MWh Baranduda Power Energy Reserve project by Birdwood Energy.

Significance & Outlook

According to SNE Research, CATL has ranked first in global energy storage battery shipments for five consecutive years, holding a 30.4% market share as of 2025. The deployment of TENER+ and TENER Sodium provides technical flexibility for asset owners and developers facing extreme climatic conditions and supply chain volatility.

Source: https://www.todayenergy.kr/news/articleView.html?idxno=304983

Collected: November 07, 2026 | Automated Research System (AI)

#16 PDES Electrolyte: Chonnam National University's SMB Stability Specs

Published November 02, 2026 BEST Magazine South Korea



OVERVIEW

Researchers at Chonnam National University have developed a polymerisable deep eutectic solvent (PDES) electrolyte that enhances the safety and durability of sodium metal batteries (SMBs). The electrolyte achieved 90.4% capacity retention after 1,000 cycles at 2 C, offering a non-flammable, leak-resistant alternative to traditional lithium-ion technology.

IN DEPTH

Key Findings

The developed PDES electrolyte enables sodium metal batteries to maintain high stability and performance. In full-cell testing, the battery demonstrated an initial discharge capacity of 110.2 mAh g-1 at 0.1 C with nearly 99% coulombic efficiency. Notably, the system retained 90.4% of its capacity after 1,000 cycles at 2 C.

Technical Details

The PDES electrolyte is composed of sodium perchlorate (NaClO4), N-isopropylacrylamide (NIPAM), and succinonitrile (SN). These components create a deep eutectic solvent characterized by chemical and thermal stability. To eliminate leakage risks associated with liquid electrolytes, the team employed in-situ polymerisation to convert the mixture into a solid electrolyte matrix.

Technical advantages of the PDES design include:

- High ionic conductivity and a high sodium-ion transference number.
- A wide electrochemical stability window.
- Strong flame-retardant properties and mechanical robustness.
- Reduction of side reactions and irregular sodium growth at the electrode-electrolyte interface.

The mechanical strength was further validated using a pouch-cell battery that continued to power an LED even when the cell was folded and cut.

Background & Context

Sodium metal batteries are viewed as a low-cost alternative to lithium-ion batteries due to the abundance of sodium. However, widespread adoption has been hindered by the high reactivity of sodium metal, the formation of dendrites, and the volatility of traditional organic liquid electrolytes, which are often toxic and flammable.

Significance & Outlook

Professor Chan-Jin Park and the research team believe this electrolyte design provides a path toward safer and more sustainable rechargeable batteries. Potential applications for this technology include grid-level renewable energy storage, backup power systems, and low-cost rechargeable battery systems. The study's findings were published in the journal Energy Storage Materials.

Source: https://www.bestmag.co.uk/novel-electrolyte-boosts-sodium-battery-chemistry/

Collected: November 07, 2026 | Automated Research System (AI)