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Weaker Solvation Structure Electrolytes for Severe Temperature Lithium-ion Battery Operations

A weak-solvation ether electrolyte delivers fast charge and stability at –40 °C for EVs, space, and subsea.

Researchers at Purdue University have developed an electrolyte to significantly increase the performance of lithium-ion batteries in severe low temperature environments. In conventional lithium-ion batteries, cold temperatures increase internal resistance, significantly prolonging charging time and decreasing discharge capacity. By using cyclopentyl methyl ether as the electrolyte's solvent, the weaker solvation structure enables faster charge time and greater cycle life stability at temperatures down to â€“40 deg C. While this technology is broadly applicable to the design all Li-ion batteries that seek to operate in low temperatures, it is particularly applicable to spaceflight, subsea operations, and electric vehicles

Advantages:

- Improved performance at temperatures down to â€“40 deg C

- Improved charging time

- Greater cycle life stability

- Environmentally safe, commercially available solvent

Applications:

- Extreme low temperature batteries

- Energy storage systems

- Electric vehicles

- Spacecraft

- Subsea operations

Technology ID

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Category

Energy & Power Systems/Energy Storage

Semiconductors/Fabrication & Process Technologies

Chemicals & Advanced Materials/Materials Processing & Manufacturing Technologies

Further information

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Technology Validation: This technology has been validated through the fabrication and testing of multiple test cells at varied solvent concentrations. At a 0.1 C rate, the battery retained 100% of capacity at â€“20 deg C for 50 cycles. At â€“40 deg C, the battery retained a capacity of roughly 73% of its 0 deg C capacity. For comparison, the traditional battery that was tested stopped functioning at â€“ 20 deg C.

Related Publications: Hari Vignesh Ramasamy, Soohwan Kim, Ethan J. Adams, Harsha Rao, and Vilas G. Pol. A novel cyclopentyl methyl ether electrolyte solvent with a unique solvation structure for subzero (â˜’40 Â°C) lithium-ion batteries. Chem. Commun., 2022, 58, 5124-5127.

TRL: 3

Intellectual Property:

Provisional-Patent, 2022-02-26, United States

PCT-Patent, 2023-02-24, WO

NATL-Patent, 2024-08-22, United States

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