Rechargeable Batteries with Increased Stability under Cold Conditions

ID# 2020-5056

Off-grid Solar in Cold Conditions

Technology Summary

Rechargeable batteries based on metal anodes are highly desirable due to their high energy density. However, the electrochemical interface is generally not favorable for metal deposition, resulting in an unstable solid-electrolyte interphase (SEI). When below freezing, the lithium ions aren't efficiently captured by the anode. Instead, many lithium ions coat the surface of the anode, a process called lithium plating, which means there's less lithium available to cause the flow of electricity and the battery's capacity drops.

The disclosed invention uses electrochemically labile molecules to regulate the electrochemical interface and guide even lithium deposition and a stable SEI. The molecule, benzenesulfonyl fluoride, was bonded to the surface of a reduced graphene oxide aerogel which is applied to the surface of the anode.

Application & Market Utility

The labile molecule guides homogeneous metal deposition and also contributes lithium fluoride to the SEI to improve Li surface passivation. High-efficiency lithium deposition was achieved at a high current density of 6.0 mA cm-2. A capacity retention of 85.3% after 400 cycle was achieved. The cell also tolerated low-temperature (-60C) operation without additional capacity fading.

Next Steps

Tests completed on Li, Na, and Zn anodes; further testing could be done on additional anode types. Seeking licensing opportunities.

TECHNOLOGY READINESS LEVEL 4-7

Seeking

Licensing |

Keywords

- Lithium anode
- zinc anode
- sodium anode
- cold resistance
- solid-electrolyte interphase (SEI)

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