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# New lithium battery with simple production and high safety developed

**Prof. Dr. Francesco Ciucci's team at the University of Bayreuth developed solid-state lithium-metal batteries with high energy density and stability. Using a novel nitrate-based additive, they resolved incompatibility issues in battery electrolytes, underscoring the importance of molecular design in creating effective additives for quasi-solid-state electrolytes.**

For the first time, Prof. Dr. Francesco Ciucci, Chair of Electrode Design for Electrochemical Energy Systems at the University of Bayreuth, in collaboration with his research partners from China, succeeded in resolving the incompatibility between lithium nitrate and 1, 3dioxolane (DOL) for use in quasi-solid, battery electrolytes. They achieved this by integrating a novel nitrate-based additive. This advancement holds significant implications for solid-state batteries. It enables the development of solid-state lithium metal batteries that are not only highly safe and durable but also easy to produce. Furthermore, this process maintains the existing manufacturing methods used for conventional liquid batteries.

"At the same time, the batteries' solid-state nature ensures a high level of safety, while their manufacturing remains straightforward," states Prof. Ciucci. "We demonstrated the approach's universality by creating various types of lithium-metal batteries. Notably, the manufactured pouch Li-S cell exhibits superior performance compared to previously documented pouch Li-S cells."

In a study published in the journal 'Energy & Environmental Science', Prof. Ciucci's research team introduced a new additive, triethylene glycol dinitrate, specifically designed to the enable the polymerization of DOL. The research team showed that, concomitant with the polymerization, the formation of a nitrogen-rich solid electrolyte interphase layer suppresses dentrimental parasitic reactions and also increases the batteries efficiency.
Based on the study findings, several battery cells were developed. Among them, a lab-scale, button-type cells could stably charged and discharged more than 2000 times. Excitingly, A 1.7 Ah Li-S pouch cell with high energy density of 304 Wh kg-1 and stable cycling was also fabricated. Prof. Ciucci confirms: "This study underscores the importance of molecular structure design in creating effective additives for quasi-solid-state electrolytes. It represents a significant advancement in the practical feasibility of employing poly-DOL-based quasi-solid-state electrolytes in lithium metal batteries."

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