

US Patent No. 8,877,388

SD# 11322

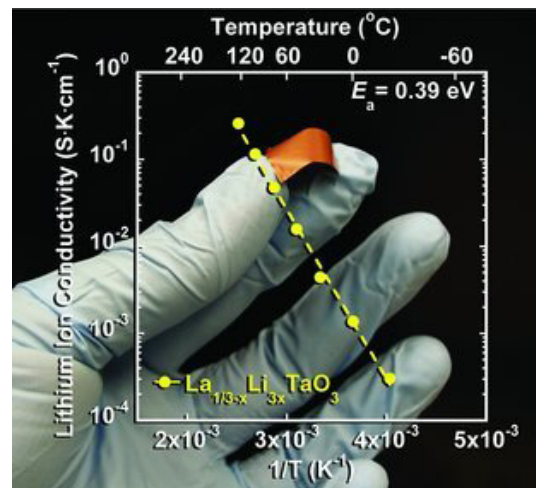
Technology Readiness Level: 4

Key Elements Demonstrated in Laboratory Environment

A higher power, solid-state thin film battery for breakthrough conductance and performance for on-package power in mass market electric vehicles (EVs) and electronics

Enhancing battery safety and durability, reducing form factor, and increasing range remains a priority for furthering the widespread enablement of electric vehicles (EVs). Solid-state batteries have garnered growing interest for their potential in these areas, yet technical limitations negatively impacting battery efficiency have hindered its commercial viability.

Sandia researchers have developed a higher-power, thin film lithium-ion battery as a more durable and energy dense solution for EVs and electronics. By leveraging a lithium-stable, higher conductivity electrolyte – lanthanum lithium tantalate ($\text{Li}_5\text{La}_3\text{Ta}_2\text{O}_{12}$) – and inexpensive metal foil substrates, this technology enables a solid-state lithium battery with high power in a very low form factor. Researchers have demonstrated 15 to 1000x improved conductance, enhanced power density, and wider temperature range over industry standard LiPON thin films. The new materials and battery geometries overcome limitations such as stress-induced film fracturing to deliver compact, robust, and higher energy density batteries that could revolutionize the EV market with improved driving range, battery life, and reduced cost per kilowatt hour. A thin and flexible battery substrate also presents advantages for reel-to-reel manufacturing, flexible electronics, and applications requiring low profiles.



Shown: Arrhenius plot for the lithium-ion conductivity of $\text{La}_{0.281}\text{Li}_{0.155}\text{TaO}_3$. An activation energy of 0.39 eV was measured for the LLTO film, enabling 15x higher conductivity than LiPON at room temperature.

TECHNICAL BENEFITS

- Inherently leak-proof, low-profile, and mechanically robust
- 15 to 1000x improvement in conductance over LiPON thin films
- Maintains performance in varied temperatures
- Solid state solution for on-chip or on-package power
- Embedded, microbattery, or cell battery format
- Lower cost

INDUSTRIES & APPLICATIONS

- Automotive
- Flow battery energy storage
- Remote sensors
- Extreme environments

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