Energy Storage EC-13

Program Title: Lithium and Sodium Metal Solid State Batteries for Advanced Energy Storage Applications

	U.S. Entities	Israeli Entities
Leaders	University of Maryland, College Park	Bar-Ilan Research and Development Company
Consortium Members	Saft America	Tel Aviv University
	Forge Nano	Materials Zone
	Ion Storage Systems	3DBattery

Commercialization of Lithium ion batteries (LIB) enabled a new era of portable devices (for consumer, military, commercial, and other sectors), medical batteries, electric vehicles, and grid energy storage. Nevertheless, the ever-increasing demands of modern society for advanced energy storage challenges the scientific and engineering communities to realize further advancements in batteries to improve energy and power densities, extend lifetime, improve safety, and lower cost. Current state of the art LIBs has three major components: a graphite anode, an organic electrolyte, and a metal oxide cathode material. The use of organic electrolytes is beneficial due to their high ionic conductivity, ease of processing, and good wetting capabilities with the electrode materials. However, they have limitations related to safety (due to electrolyte flammability), longevity (due to electrolyte degradation), and battery energy density (due to the solvent's limited electrochemical stability). In recent years there is increased interest in developing solid electrolytes (SEs) to create all solid-state LIB (SSLIB). A shift to solid electrolytes could *simultaneously* address all three challenges associated with liquid electrolytes: improving safety because SEs are not volatile, improving longevity because solid electrolyte interfaces can be engineered and are "static" rather than dynamic as in liquids, and improving energy density (by >30%, a transformative increase) because solid electrolytes may help enable a shift to using metallic rather than intercalation anodes. These potential benefits have been stymied for many years by the limited ionic conductivity of the SEs at room temperature, along with difficulty in contacting the SE and active materials (cathode/cathode) and high processing costs.

The U.S.-Israel Energy Center's Consortium on Lithium and Sodium Metal Solid State Batteries for Advanced Energy Storage Applications will directly address the challenges posed by enabling metal anode solid state batteries with a top-notch team of academic and industrial partners in the US (University of Maryland, Saft, and Forge Nano) and Israel (Bar-Ilan University, Tel Aviv University, Materials Zone, and 3D Battery). This effort will span from world-class fundamental scientific research, to specific innovations in materials and cell designs, to the development of pre-commercial full cells for testing under duty cycles and environmental conditions reflecting field use. The goal is to build pre-commercial full solid-state prototype cells with a metal anode that can achieve >425 Wh/kg and >1150 Wh/L at the level of the stack repeat unit. With the guidance and contributions of the industrial partners, the consortium will develop prototype cells for first markets in unmanned aerial and underwater vehicles, specialty aerospace, solider power, and biomedical, with potential further development of the cells for electric vehicle or stationary storage.

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