

**MRS Spring 2015 Press Release  
For Release:**



**April 28, 2015**

**PATHION announces breakthroughs in safe high-energy lithium ion batteries**

*Enhancements to solid-state advanced electrolytes deliver on supercapacitor-plus-battery combinations and performance levels up to four times greater than current technologies - all with high degrees of safety*

**San Francisco, Calif.** - At the Spring 2015 Materials Research Conference in San Francisco, PATHION presented new advancements in solid-state electrolytes that perform up to four times better than existing lithium ion technologies - and with a high degree of safety. "The lithium ion battery industry has recently been plagued with bad press due to highly publicized fires in the automotive sector and on airplanes," said PATHION Chairman and CEO, Mike Liddle. "Our researchers have presented new derivatives of our LiRAP™ solid-state electrolyte that not only deliver safe, non-flammable batteries, but also provide a path to more than 1,000 Watt-hours/kilogram (Wh/kg) of energy density."

The presentations describe derivatives built upon LiRAP (Lithium-Rich Anti-Perovskite), a solid electrolyte. PATHION has an exclusive worldwide license for LiRAP from Los Alamos National Laboratories. Supported by an ARPA-E grant, LiRAP has proven to be a safe alternative compared to the liquid electrolytes used in most of today's lithium ion batteries. "PATHION's focus has been on the development of advanced materials over the last five years. These new electrolyte formulations have come from our research, and represent some of the most important breakthroughs in safe high energy density batteries in recent memory. PATHION is delighted to have added to its IP portfolio," said Liddle.

The first presentation describes the role of LiRAP in a solid-state lithium sulphur electrolyte. Solid-state electrolytes, unlike liquid-state, have (1) extremely low expansion, (2) no out-gassing, and (3) the elimination of dendrite growth between anode and cathode. One or more of these three phenomena causes explosion or fire in lithium ion batteries. Our lithium sulphur electrolyte employs a doped/optimized glass electrolyte - a solid material. We have also synthesized a highly efficient sulfur cathode. In combination, this cathode and electrolyte combination has resulted in a significant improvement in charge efficiency with a longer cycle life. Such a lithium sulfur battery can achieve specific energy levels up to 800 Wh/kg, while the best lithium-ion cells today deliver only about 250 Wh/kg. In addition, our new lithium sulphur-based battery can operate as either a battery or a supercapacitor - a major breakthrough in itself whose applications will be very exciting.

In our second presentation, we describe sodium ion battery cells. Recent work demonstrates extraordinary performance. We address safety issues directly by again substituting a liquid electrolyte with a solid - PATHION'S LiGlass™. On a performance basis, LiGlass exhibits ultrafast ionic conductivities at room temperature and up to 200°C - which can lead to energy densities that comfortably exceed 1,000 Wh/kg. These characteristics will enable the creation of a very wide range of new applications. LiGlass has been replicated in the labs at the University of Texas.

PATHION technology executive Andy Murchison led these efforts with the support of Helena Braga and Jorge Ferreira of the University of Porto, who were operating under a work-for-hire agreement with PATHION. The breakthroughs - our lithium sulphur electrolyte and LiGlass - continue to be in a developmental state. PATHION looks forward to providing updates.

#### About PATHION Inc.

PATHION, a privately held corporation ("PATHION"), is headquartered in Los Gatos, California. A vertically integrated energetic applied materials and advanced power device company, PATHION develops and commercializes materials, batteries, and energy systems solutions utilizing its proprietary processes and technologies. PATHION has acquired rights to key advanced materials from Los Alamos National Laboratory under a cooperative research and development agreement. Under the terms of the license agreement, the company enjoys joint ownership of the underlying research on LiRAP™ and the exclusive right for its commercial development, manufacture, use and sale. The company has been recognized by the US Department of Energy (DOE) for its fire-resistant lithium, and has received a grant from Advanced Research Projects Agency-Energy (ARPA-E) in conjunction with Los Alamos National Labs. PATHION is uniquely positioned to provide critical technology for a broad array of batteries and systems that fundamentally change their performance and total cost of ownership.

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