

TECHNOLOGY FACT SHEET

IMPROVEMENT THROUGH PROTECTION: ENABLING MORE POWERFUL LITHIUM BATTERIES

(Xu)

Introduction

This invention signals a major break-through in Li-metal and Li-ion battery technology. Researchers at the U.S. Army Research Laboratory-Sensors and Electron Devices Directorate (ARL-SEDD) in Adelphi, Maryland designed, synthesized and performed successful trials on novel solvents and additives for non-aqueous electrolytes. The resultant system affords greater protection of cell electrodes, which in turn enables increased energy storage capacity, higher discharge voltage and more stable performance. It expands the range of lithium cell chemistry and creates an improved class of energy-storage device currently unavailable on the market today.



Concept

ARL researchers envision this new technology being applied in multiple fields of use, wherever electrochemical devices rely on a wide stability window of electrolytes. One example would be batteries for electric vehicles (EVs). EVs are becoming more and more attractive with the advancement of new cells with higher power and superior energy density (i.e. greater acceleration, range and cargo loads with less battery weight). In response, developers have widened their offerings of vehicle classes, which now include light trucks and neighborhood electric vehicles in addition to passenger automobiles such as the one shown above (**Source: Department of Energy**). The ARL invention would be particularly attractive in this arena by creating more powerful batteries with a greatly diminished loss of capacity after many, many charge/discharge cycles when compared to existing battery systems.

Invention Overview

- ❖ *Protects electrodes allowing higher energy capacity and running voltage*
- ❖ *Method is simple to practice and adaptable for mass production*
- ❖ *Multiple fields of use, including ultracapacitors, electroplating and electrowinning*
- ❖ *TRL 4 – Fully functioning prototypes using coin cell format*
- ❖ *Laboratory test data available*
- ❖ *Provisional patent application filed 13 May 2010*

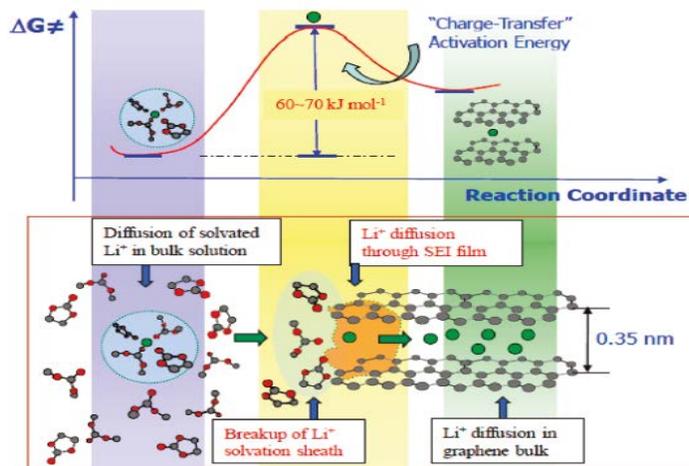
Doing Business with ARL

- ❖ *ARL-SEDD is a leader in partnering with domestic firms*
- ❖ *Successfully developed and implemented innovative tools to ease the technology transfer process*
- ❖ *Tools includes Patent License Agreements (PLAs); Cooperative Research and Development Agreements (CRADAs); Test Services Agreement (TSA); and others*
- ❖ *Visit www.arl.army.mil for more information*

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Features/Capabilities/Intellectual Property

State-of art Li ion batteries operate at high voltages (up to 4 volts), which is made possible by the passivation film formed on the surfaces of both the anode and cathode. While providing protection, these files also present resistance to the kinetics of the cell chemistry, rendering less-than-optimal power density and output as well as reduced capability at low operating temperatures.



The ARL invention solves this problem by altering the chemical composition of the passivating film through the use of purposefully designed novel solvents and additives. Tests show the electrode passivating film in electrochemical cells utilizing the technology is dense and protective yet conductive. This translates to a battery with higher energy capacity and discharge capability when compared with ordinary Li-ion cells, as shown in the graph above. Other features/ capabilities/ intellectual property offered by this invention include the following:

- Materials used are commonly found in the industry
- Uncomplicated solvent/additive manufacturing process
- Scalable for use in large and small format batteries
- IP includes novel composition of matter and assembled product (machine)

Potential Markets/Applications

The novel solvents and additives described in this invention can be applied in any device employing materials of large electrochemical potential:

- Ultracapacitors – As their energy density continues to improve, the vehicle industry is exploring ultracapacitors as a replacement for chemical batteries, which should expand this international \$275 million business
- Electroplating Cells – Higher operating potentials mean more elements would be available for plating; current plating operations would also see improved process efficiency

Key Advantages & Benefits

- ❖ Enables significantly higher operating voltage and number of charge /discharge cycles
- ❖ Reduced electrode wear means more stable operation
- ❖ Uses commonly-available materials of construction
- ❖ Cost is low
- ❖ Wide variety of potential applications
- ❖ Precursor to a number of subsequent inventions
- ❖ Inventor available to work with commercialization partner

Contact Information

This technology was developed by ARL-SEDD. It is now available for licensing and CRADA opportunities.

For further information please contact:

Mike Rausa, ARL-ORTA,
410-278-5028, mrausa@arl.army.mil.

Julio Suarez, SAIC,
717-420-7557, julio.suarez@saic.com