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Media Contact: Lana Cox
Savannah River National Laboratory
803.725.4396
lane.cox@srnl.doe.gov

DOE Media Contact: Bill Taylor
803.952.8564
bill.taylor@srs.gov

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SRNL Innovation to Keep the Country Charged

AIKEN, S.C. (April 1, 2014) – It's a first-world problem needing a high-tech solution - how to keep portable electronic and communications devices charged for longer periods of time and for less money. The need to charge phones, tablets, and laptop computers is a constant battle. The Savannah River National Laboratory (SRNL) is helping conquer that challenge through the use of hydrogen. By combining a small fuel cell with a hydrogen storage device, power systems are being developed that provide higher energy storage capacity, longer run times, faster recharge, and potentially lower operating costs. This technology is also being developed for use in commercial vehicles and in military applications.

The performance of traditional lithium ion batteries has not improved significantly in recent years. Batteries that are currently commercially available can only provide a limited amount of energy. While advances have been made in hydrogen technologies to provide an effective alternative, work is still needed to lower the cost of hydrogen fuel and improve the durability of fuel cells. Scientists at SRNL, in partnership with Ardica Technologies, Inc., are tackling this battery issue through the use of alane, or aluminum hydride.

Instead of using traditional batteries, electronic devices would have a small fuel cell and a hydrogen storage material. This fuel system will last approximately four times longer than current Li-ion technology. The fuel cell would operate like a continuous battery and could run for an extended period of time, providing electricity as long as you provide fuel. The fuel would come from the hydrogen storage material (alane) and oxygen from the air. The fuel cartridges are small, and could be swapped in an instant and recycled. For certain applications, the fuel cell system could provide a 200% reduction in weight for a 24 hour mission, 300% reduction in weight for a 48 hour mission, and 400% weight reduction for 72 hours of use.

“When combined with a fuel cell, chemical hydrides operate much like a battery that is used and recycled and not directly recharged,” explained SRNL researcher Dr. Ragaiy Zidan. “These materials have some of the highest hydrogen storage densities and show great potential for many near-term applications, but still require lower cost and more



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efficient regeneration and recycling methods to make them practical. That is where SRNL and Ardica Technologies are focusing their efforts.”

“Aluminum hydride can store twice the hydrogen in the same volume as liquid hydrogen, and can do so at a very high capacity. Alane also shows very favorable discharge conditions, making it ideal. About the only down side for alane is its availability and high cost to produce,” he said.

Alane can store five to ten times more hydrogen than what similar materials can store. It can also store hydrogen more compactly than compressed gas. Dr. Zidan, SRNL and Ardica, Inc. have been working closely for several years to apply this new technology in an effort to make alane and alane reprocessing less expensive. Lab-scale results to date have been very successful and efforts are now underway to scale-up the process. Once successful, this will open the door for a new line of portable devices that may only need to be charged once a week instead of once a day.

Funding for this project comes from the Department of Energy’s Office of Energy Efficiency and Renewable Energy. “As part of the cooperative agreement, SRNL is developing two promising methods to reduce the cost of alane production to make it competitive with other hydrogen storage methods. The first innovation is a dry mechanical alane synthesis method that minimizes the need for solvents. We believe this method has the ability to bring the cost of alane production down significantly and perhaps even sooner than the electrochemical method,” said Zidan. “The second innovation, the electrochemical method has the potential to lower the cost of alane even further by improving on the electrochemical generation process. Research activities at SRNL in this area will focus on novel cell designs, electrode materials, solvent choices, and separation methods.”

The ability to have this material created in an affordable and safe manner is expected to revolutionize portable energy storage systems. “This research and innovation will have an immediate and direct impact on our nation’s energy needs,” said SRNL Laboratory Director Dr. Terry Michalske. “Cooperative agreements with companies such as Ardica Technologies put the results of SRNL research into the hands of the consumer and the user, and encourage novel solutions to world-wide problems.”

The Savannah River National Laboratory (SRNL) is a multi-program applied research and development laboratory for the U.S. Department of Energy. SRNL applies state-of-the-art science and engineering to provide practical, high-value, cost-effective solutions for our nation’s environmental cleanup, nuclear security and clean energy challenges. Visit us on the web at <http://srnl.doe.gov>

Ardica Technologies, Inc. is a spin-off company from Stanford University located in San Francisco. Ardica is creating mobile power solutions to provide freedom from the Grid with Ardica’s unique technology for the military and consumer markets. Using novel fuel chemistries, fuel cells, and clever engineering, the company is designing products that deliver more energy for less weight and volume than ever before. For more information, visit <http://ardica.com>