Boosting the power of lithium batteries

DRAMATIC BREAKTHROUGHS IN BATTERY TECHNOLOGY WILL BE needed to fully harness the potential of sun and wind energy sources, power the next generation of electric and hybrid cars, and enable future portable electronics. Lithium batteries are one promising type of storage technology, but as anyone with a cell phone knows, today's rechargeable lithium batteries are limited in capacity and charging lifetimes.

To help develop tomorrow's stronger, longer-lasting batteries, an Ames Laboratory and Iowa State University research team plans to prepare and characterize a new class of particulate anode alloys for lithium batteries. To date, most other anode materials have been developed by chemists, electrochemists, and ceramics specialists. But, current lithium battery material challenges call for a broader combination of expertise, especially in metallurgy. So, Ames Lab created a multidisciplinary team that brings together experts in metal alloy processing, materials characterization, and the electrochemistry of lithium batteries.

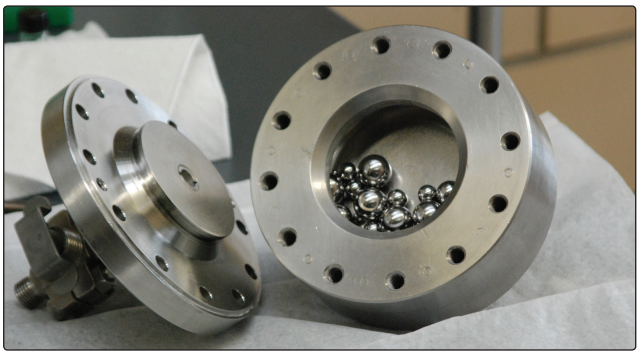
The group, with funding from Ames Laboratory's seed funding program, will use materials processing technologies at the Lab's Materials Preparation Center to create nanosized "core-shell" particles of metal alloys and carbon. The resulting materials may help not only to boost the capacity of lithium batteries, but to also increase the recharge cycle life as well.

"The race is on all across the world to develop new lithium battery technologies, and by combining expertise at the Ames Laboratory and ISU we think our new approaches may be very competitive," says ISU Anson Marston Distinguished Professor of Engineering and Ames Lab associate scientist Steve W. Martin, who leads the project.

Ames Laboratory scientist Steve Martin is working on improving lithium battery technology using nanosized particles to boost the storage capacity of all types of batteries.

Getting more hydrogen in and back out

ONE OF THE BIGGEST STUMBLING BLOCKS TO HYDROGEN FUEL technology is finding a way to store enough hydrogen on-board to make a hydrogen-powered vehicle viable. Storing hydrogen as a compressed gas or even a liquid would still require a prohibitively large tank to give a vehicle the driving range of a gasoline-powered car. It also requires considerable energy to either compress or liquefy hydrogen.



This specially constructed ball mill allows Ames Laboratory researcher Vitalij Pecharsky's group to mechanically combine metal hydrides under a high-pressure hydrogen environment to boost the amount of hydrogen the materials can store.

There are ways to store hydrogen in solid materials, such as complex metal hydrides, but because hydrogen forms such strong chemical bonds, it requires a high energy input to break those bonds to release the hydrogen. That problem can be overcome, but the net hydrogen yield isn't great. The ideal would be to find a way to "saturate" a material with hydrogen to boost the yield, but also make it easily "rechargeable."

Ames Laboratory senior scientist Vitalij Pecharsky and colleagues Marek Pruski, Scott Chumbley and Victor Lin have been working to solve those issues using a somewhat unorthodox method of forming those metal hydrides in the first place. Using a technique he calls "mechano-chemistry," Pecharsky and his research team form the complex hydride compounds without traditional solvents, opting to use high-energy ball milling to combine the materials.

To boost the hydrogen storage capacity, the team is forming the materials in specially designed equipment that allows the milling to be done in an extremely high-pressure (350 bar) hydrogen environment. The work is still in its early stages, but preliminary results show promise.