IBM aims for a battery breakthrough

Steve Hamm

A consortium led by IBM hopes to develop lithium-air batteries that will power electric vehicles for 300 to 500 miles on a single charge.

Eager to place itself at the forefront of technology considered crucial to transportation's future, Big Blue is throwing its weight behind batteries.

On June 23, IBM announced a multiyear effort to increase the performance of rechargeable batteries by a factor of 10. The aim is to design batteries that will make it possible for electric vehicles to travel 300 to 500 miles on a single charge, up from 50 to 100 miles currently. "We want to see if we can find a radically different battery technology," says Chandrasekhar "Spike" Narayan, who manages the Science & Technology Organization at IBM Research's Almaden lab in San Jose, Calif.

To do that, IBM (IBM) is leading a consortium that will create batteries using a combination of lithium and oxygen rather than the potentially combustible lithium-ion mix that now dominates advanced consumer electronics and early electric-vehicle batteries. The new batteries could be used to store energy in electric grids as well.

IBM is also eager to reclaim U.S. leadership in battery tech from Asia. While many of the original breakthroughs for the batteries that power today's laptop computers and cell phones happened in the U.S., those batteries now come primarily from Japan and Korea.

Industry leaders have called for just this kind of concerted effort amid concern that the U.S. will miss out on one of the most important technology shifts in history—the switch from gasoline to electricity as the primary power source for light vehicles. The worry is that the U.S. will trade its current dependency on the Middle East for oil with a new dependency on Asia for vehicle batteries. "We lost control of battery technology in the 1970s," laments Andy Grove, former chairman of chip giant Intel (INTC). "Battery technology will define the future, and if we don't act quickly it will go to China and Japan."

General electric is making a battery play, too

The initiative grew from an internal "grand challenge" contest late last year at IBM's Almaden lab. It now includes collaborators from the country's five national laboratories, as well as universities, including the University of California at Berkeley. IBM expects nearly 300 top scientists and battery experts to gather for a conference about the project that is scheduled for late August. IBM is the lead organization in a research proposal now being considered by the Energy Dept. If approved, the effort would also tap stimulus funds.

IBM isn't the only large U.S. corporation making a significant play in new battery technology. General Electric (GE) is investing $150 million over five years to develop massive sodium batteries for use in locomotives and electrical grids. It has also made an equity investment in A123, a small company that supplies lithium-ion batteries for plug-in electric vehicles.

IBM's decision to pursue next-generation battery technology was sparked by Winfried W. Wilcke, program director for nanoscale science at the Almaden lab. He will lead a research team that could number 40 members, including IBM researchers and scientists from the national labs and universities. It's part of the company's two-year-old Big Green Innovations program.

Why lithium-air technology? After proposing the "grand challenge" project, Wilcke and a handful of colleagues quickly surveyed published research to see what materials and processes

might achieve the dramatic improvements they sought. Lithium-ion technology has serious limitations, including the possibility of overheating and bursting into flames. Soon the team settled on a combination of lithium and oxygen as the most promising approach. A lithium-air battery can pack much more punch per square inch because oxygen, one of the key ingredients in the chemical reaction, is added as needed by drawing on ambient air rather than being packaged within the battery from the start.

Building on big blue nano knowledge

Narayan says IBM is well-positioned to lead the project, thanks to its expertise in materials science, nanotechnology, chemistry, and supercomputing. Big Blue plans to get a jump on the process by using nano membrane technology it developed for water-purification systems to separate water and other elements from the oxygen in air. It will use nano-structure expertise it developed for the semiconductor industry to help it distribute oxygen evenly around the interior of the battery cells—preventing blockages. Supercomputing will be used to model techniques for moving individual atoms through the membranes.

IBM's Narayan doesn't softpedal the challenges. "We'll know in two years if there are any show-stoppers," he says. Jack Wells, group leader at the Nanomaterials Theory Institute at Oak Ridge National Laboratory, says figuring out how to make rechargeable lithium-air batteries will be one of the major hurdles. In experiments by a research team at the U.K.'s University of St. Andrews, it was determined that a lot of energy is wasted in the recharging process. "We need to solve that problem," Wells says.

The IBM-led team faces competition. Toyota recently began looking into litium-air technology. And there are other technologies with breakthrough potential as well, including lithium-sulfur. Still, there's considerable enthusiam in the scientific community for IBM's approach. "It's a very promising idea—one among a very few," says Oak Ridge's Wells.

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