Lithium Air Battery Gives IBM Hope of Power Without Fire: Energy
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By Christopher Martin
Feb. 21 (Bloomberg) -- Everyone who's held a smartphone to the ear or watched a movie with a laptop balanced on their knees knows the devices get hot. Most are unaware the same battery technology is widely used in electric cars and has made few notable advances in a decade.
Rechargeable lithium-ion batteries became costly for General Motors Co. after they caught fire in its plug-in Volt car during safety tests in 2011. They grounded Boeing Co.'s newest Dreamliner airplane in January.
International Business Machines Corp. plans to release a prototype next year of an alternative it calls "lithium air" that would mark a big step forward by packing in more storage capacity. While improving the technology depends on chemical processes that take longer to perfect than the systems that brought cheap electronics, finding a solution to the shortcomings of batteries has the potential to revolutionize everything from transportation to hand-held gadgets.
"We picked the path with the biggest risks and the biggest rewards," Spike Narayan, science and technology director at IBM Research in San Jose, California, said in an interview. "This is a moonshot."
Risk of fires sparked by lithium-ion batteries is what grounded Boeing's most advanced plane, and the company is said to be meeting with regulators Feb. 22 to propose ways to address the issue.
The power packs designed for electric cars use a different design that means excess heat isn't an issue, said Aaron Chew, an analyst at Maxim Group LLC. His concern is that there's no good way to increase the size or expand production profitably to make a car battery with the capacity needed for a practical vehicle.

Technology Needed

"Lithium-ion has been around for decades, and if there was an obvious cost reduction by scaling up we would have seen it by now," Chew said in an interview from New York. "It's highly likely the common battery in the next generation of electric vehicles won't be lithium-ion."
Engineers handle the heat of lithium-ion batteries with cooling systems and safety shut-off systems, as Tesla Motors Inc. has done in its vehicles. The bigger problem is that the power density in the current generation of batteries is too low

-- they can’t bottle up enough power for drivers to feel comfortable they’ll always reach their destination.

IBM’s Work

For IBM, its effort to build a better battery began in 2009 at an annual meeting it hosts with government agencies and engineers. The “lithium-air” concept relies on the electricity released when the metal reacts with oxygen in the atmosphere. If it works on a commercial scale, it would provide as much energy per weight of the battery as a gallon of gasoline in as little as five years, Narayan said.

The first step was for scientists to demonstrate the technology can store and release power through 10 charges. Now they’re pushing the unit to work over hundreds of cycles, and build a prototype. That would require further improvements in the materials used for the cathodes, anodes and electrolytes, which form the guts of batteries, Narayan said.

“We could see a radical advance if our prototype excites a manufacturer with a compatible technology,” Narayan says. “We’ll have a prototype ready next year, and then with our partners we’ll look at the engineering timeline. Five to 10 years is a reasonable time to commercialization.”

IBM is not alone. Researchers at universities, government laboratories and auto companies are also vying to produce the next-generation battery.

Rival Projects

Toyota Motor Corp. and Bayerische Motoren Werke AG on Jan. 24 announced plans for lithium-air batteries. Scientists at Massachusetts Institute of Technology are working on a product using carbon nanotubes replacing lithium-ion. Seeo, a start-up backed by billionaire Vinod Khosla, is building lithium-ion units that use a lighter, dry electrolyte instead of liquid.

There’s skepticism whether any of them can succeed. Laboratories working on batteries have failed to replicate the successes they’ve had with semiconductors in multiplying efficiencies.

That’s because storing electricity is a chemical process where improvements come slowly, unlike the efforts to scale up efficiencies in manufacturing electronics, said Tom Gage, who led production of the Tesla drivetrain at AC Propulsion Ltd. “Moore’s Law doesn’t apply to batteries,” said Gage. It may take another 10 years to 20 years before the industry can produce an electric vehicle with the range and flexibility consumers expect, he said.

Lithium's Dominance

Until then, proponents of an oil-free auto industry will be stuck with incremental advances in lithium-ion batteries. Tesla says the technology is good enough for now. It already boasts the longest range of any all-electric vehicle in production.

"We can already achieve 300 miles," Christina Ra, a spokeswoman for Silicon Valley's only carmaker. "This is sufficient for the majority of the market."

Tesla missed its goal of producing 5,000 of its $57,000 Model S electric sedans in 2012. Competitors including General Motors Co.'s Chevrolet Volt and Nissan Motor Co.'s Leaf have also missed targets.

It's a frustration for governments seeking a replacement for internal-combustion engines to reduce greenhouse-gas emissions and reliance on fossil fuels.

President Barack Obama and Premier Wen Jiabao are set to miss targets they set for higher U.S. and Chinese electric vehicle sales by 2015. Just one in 600 car sales were electric in the $2 trillion global market last year, according to data compiled by Bloomberg.

Government Targets

President Obama in 2009 set a goal of 1 million electric vehicles on U.S. roads by 2015. With fewer than 50,000 sold to date, that figure appears out of reach, according to Bloomberg New Energy Finance. China's sales of 13,000 EVs by the end of last year mean the country probably won't meet a target of 500,000 EVs on the road by 2015.

Storage issues are the main reason EV sales are falling short of optimistic growth forecasts, said Amy Smith, global head of clean technology investment banking at Jefferies & Co. in San Francisco. Early adopters are driving Teslas and other high-end electric cars, while the mass market is waiting on the sideline for the technology to improve.

"Higher costs, lack of substantial infrastructure and range anxiety are all issues for consumers," Smith said. "There's a belief that new and different materials, beyond lithium ion, could provide a more substantial leap forward."

The current storage technology will probably be supplanted eventually, said Kevin Landis, co-founder of the San Francisco-based technology fund Firsthand Capital Management Inc. "Lithium-ion is what we have now but probably not what we'll have in the future," he said.

The technology will "need an upgrade." if only because of the size the batteries take up in cars, including the vehicle he drives from Fisker Automotive Inc. "It's a battery-

transportation device with a little room left for me.”

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