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Breakthrough Could Mean 40-Hour Laptop Batteries (NewsFactor)

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Imagine running your laptop nonstop from New York to Tokyo -- crunch some numbers, work on a memo pop in a few DVDs -- and then do a full day of meetings, using your machine throughout the day and into the night. Imagine doing all this without ever plugging in your computer to recharge its battery.

This scenario may become reality in the near future, if Stanford University scientists succeed in commercializing a breakthrough in the laboratory. Assistant Professor Yi Cui and associates at Stanford's Department of Materials Science and Engineering said they have developed a method to increase the life of rechargeable lithium ion batteries to a whopping 40 hours.

Publishing in the journal Nature Nanotechnology, the Stanford researchers have shown that by using silicon nanowires as the battery anode instead of today's graphite, the amount of lithium the anode can hold is extended tenfold.

Revolution in Battery Design

"It's not a small improvement," Cui said. "It's a revolutionary development." And Cui means to move the development out of the lab as soon as possible. "We are working on scaling up and evaluating the cost of our technology," Cui said. "There are no roadblocks for either of these."

Cui has filed a patent on the technology and is evaluating the formation of a company or licensing the technology to a battery manufacturer. Potentially two-day batteries could be on the market within "several years," he said.

Silicon anodes are not a new idea. Researchers have known for some 30 years that they have the "highest theoretical charge capacity," but, until now, they haven't been practical because they change volume by 400 percent as lithium is inserted and extracted, the journal said. Cui's solution: a sponge-like network of tiny silicon nanowires, each of which expands but doesn't fracture.

"Nanowires grown directly on the current collector do not pulverize or break into smaller particles after cycling," the journal reports.

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"Rather, facile strain relaxation in the nanowires allows them to increase in diameter and length without breaking."

The Many Advantages of Nanowires

Not only can the nanowires handle the extreme volume changes, they also "provide good electronic contact and conduction, and display short lithium insertion distances," Cui wrote. "We achieved the theoretical charge capacity for silicon anodes and maintained a discharge capacity close to 75 percent of this maximum, with little fading during cycling."

The nanowires are grown directly on the metallic substrate that collects current, a process that has several advantages, Cui explained. First, the nanowires' small diameter can better accommodate the four-fold expansion in volume without fracturing. In addition, each nanowire is electrically connected to the metallic current collector, so all the nanowires contribute to battery capacity.

The nanowires also offer efficient "charge transport" and eliminate the need for additives to conduct electricity, which add weight, the journal stated. In addition to Cui, the researchers were Candace K. Chan, Hailin Peng, Gao Liu, Kevin McIlwrath, Xiao Feng Zhang and Robert A. Huggins.