2009 IGERT PBL Course
Problem 2: A Solar-Hydrogen Transportation Solution
Phase 1: Clean Car Breakthroughs – Hope or Hype?

Group 4. Batteries

A tenfold improvement in battery life?

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Stanford University researchers have made a discovery that could signal the arrival of laptop batteries that last more than a day on a single charge.

The researchers have found a way to use silicon nanowires to give rechargeable lithium ion batteries--used in laptops, iPods, video cameras, and mobile phones--as much as 10 times more charge. This potentially could give a conventional battery-powered laptop 40 hours of battery life, rather than 4 hours.

The new batteries were developed by assistant professor Yi Cui and colleagues at Stanford University's Department of Materials Science and Engineering.

"It's not a small improvement," Cui said. "It's a revolutionary development."

Citing a research paper they wrote, published in Nature Nanotechnology, Cui said the increased battery capacity was made possible though a new type of anode that utilizes silicon nanowires. Traditional lithium ion batteries use graphite as the anode. This limits the amount of lithium--which holds the charge--that can be held in the anode, and it therefore limits battery life.

Silicon anodes have the "the highest theoretical charge capacity" according to Cui's paper, but they expand when charging and shrink during use: a cycle that causes the silicon to be pulverized, degrading the performance of the battery. For 30 years, this dead end stumped researchers, who poured their battery life-extending energy into improving graphite-based anodes.

Cui and his colleagues looked at this old problem and overcame it by constructing a new type of silicon nanowire anode. In Cui's anode, the lithium is stored in a forest of tiny silicon nanowires, each with a diameter that is a thousandth of the thickness of a sheet of paper. The nanowires inflate to four times their normal size as they soak up lithium, but unlike previous silicon anodes, they do not fracture.

Cui said there are a few barriers to commercializing the technology.

"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 considering formation of a company or an agreement with a battery manufacturer. He expects the battery to be commercialized and available within "several years," pending testing.