Nanowire generates its own electricity

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Harvard chemists have built a new wire out of photosensitive materials that is hundreds of times smaller than a human hair. The wire not only carries electricity to be used in vanishingly small circuits, but generates power as well.

Charles M. Lieber, the Mark Hyman Jr. Professor of Chemistry, and colleagues created the nanowire out of three different kinds of silicon with different electrical properties. The silicon is wrapped in layers to create the wire. When light falls on the outer material, a process begins due to the interaction of the core with the shell layers, leading to the creation of electrical charges.

The work was described in the Oct. 18 issue of the journal *Nature*.

The idea of creating nanoscale photovoltaics is not new, Lieber said, but prior efforts used organic compounds in combination with semiconductor nanostructures that had lower efficiency and that degraded under concentrated sunlight. Lieber's materials have several advantages, he said. The materials are more efficient, converting 3.4 percent of the sunlight into electricity; they can withstand concentrated light without deteriorating, gaining efficiency up to about 5 percent; and they're as cheap to make as other related nanoscale photovoltaic devices.

"The real [question] is whether there's a new geometry that will lead to better photovoltaic technology," Lieber said. "We worked on coaxial geometry."

The most recent development builds on Lieber's considerable prior work on nanoscale devices. He has developed sensors with potential bioterrorism applications that can detect a single virus or other particle, nanowire arrays that can detect signals in individual neurons, and a cracker-sized detector for cancer.

A cheap nanoscale power source broadens the potential applications of such nanoscale devices. Though the tiny photovoltaic cells can generate enough electricity to power a similarly tiny circuit, Lieber said they're not yet efficient enough to have applications on the scale of commercial power generation.

Commercial solar cells, he said, have efficiencies around 20 percent, compared with 3.4 percent for his nano-solar cells. One avenue of future research, Lieber said, will be to explore ways to boost efficiency of the nanowire photovoltaics. If they can reach 10 to 15 percent, he said, their lower cost of production — they can be made from relatively inexpensive materials and don't require clean rooms to produce — may make them useful in larger-scale applications.

"There's no physical reason it couldn't be higher," Lieber said. "I'm pretty optimistic that we'll be able to track down the efficiency issue."

Until then, Lieber sees a future for the nanowire photovoltaics in niche applications, such as multiple distributed sensors or durable, flexible devices, possibly sewn into clothing or worn as a patch.

"It will have to be unique to be an economically viable application, some place where you want durability and flexibility, where if it gets destroyed, people don't care," Lieber said.

Source: Harvard University