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Novel solar photovoltaic cells achieve record efficiency using nanoscale structures

The devices could lead to better, cheaper solar power.

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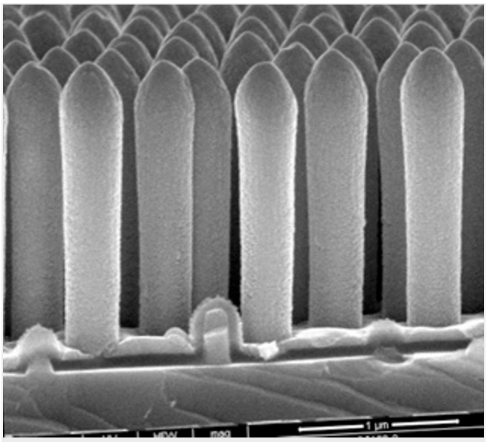

Courtesy of Wallentin et al.

Here's how to make a powerful solar cell from indium and phosphorus: First, arrange microscopic flecks of gold on a semiconductor background. Using the gold as seeds, grow precisely arranged wires roughly 1.5 micrometers tall out of chemically tweaked compounds of indium and phosphorus. Keep the nanowires in line by etching them clean with hydrochloric acid and confining their diameter to 180 nanometers. (A nanometer is one billionth of a meter.) Exposed to the sun, a solar cell employing such nanowires can turn nearly 14 percent of the incoming light into electricity—a new record that opens up more possibilities for cheap and effective solar power.

According to research published online in *Science*—and validated at Germany's Fraunhofer Institute for Solar Energy Systems—this novel nanowire configuration delivered nearly as much electricity as more traditional indium phosphide thin-film solar cells even though the nanowires themselves covered only 12 percent of the device's surface. That suggests such nanowire solar cells could prove cheaper—and more powerful—if the process could be industrialized, argues physicist Magnus Borgström of Lund University in Sweden, who led the effort.

The promise starts with the novel semiconductor—a combination of indium and phosphorus that absorbs much of the light from the sun (a property known as its band gap). "Now we absorb 71 percent of the light above the band gap and we can certainly increase that," Borgström says.

The key will be even finer control of the nanowires themselves as they grow as well as the chemical tweaking of the constituent compounds. At the same time the novel cells could be built into so-called multijunction solar cells—compound devices that incorporate several different types of semiconductor material in layers like a sandwich to absorb as much of the energy in sunlight as possible. Such multijunction cells have converted more than 43 percent of the energy in sunlight into electricity—currently, the highest efficiency photovoltaic devices in the world.

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Such multijunction solar cells are also the most expensive type of photovoltaic, but they can be made cheaper by combining them with low-cost lenses to concentrate the sunlight onto smaller versions of the cells. Borgström, for one, suspects that nanowire solar cells will stand on their own once the production process can be simplified, such as growing the nanowires by applying simple heat and evaporation techniques in future. He explains: "Once large-area structures can be grown, concentration will not be necessary anymore."

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