TORONTO STAR

Hair-like nanowires at root of solar's future

Microscopic slivers, a thousand times thinner than a human hair, are excellent at trapping light, scientists discover

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MCMASTER UNIVERSITY PHOTO

McMaster University physics professor Ray LaPierre points to images taken by the Titan electron microscope showing nanowires he has grown in the lab.

HAMILTON–McMaster University professor Ray LaPierre holds up a thin wafer of silicon with a smooth, jet-black surface that, at first glance, looks like a typical solar cell.

Zoom in – really, zoom in – and you quickly realize there's something different with this cell. Images from McMaster's Titan electron microscope show that the wafer's smooth surface, when magnified 16,000 times, looks more like the cross-section of densely grown golf turf.

But what appear to be tightly packed slivers of grass are actually nanowires, each one a thousand times thinner than a human hair.

"It kind of sticks up like hair," says LaPierre, whose research team recently received $579,000 from the Ontario Centres of Excellence and Cleanfield Energy, a local developer of renewable energy technologies. The money will go toward a three-year initiative, announced in January, aimed at creating high-efficiency solar cells that are flexible and easy to mass manufacture.

Using nanowires in solar cells has many advantages, says LaPierre, who joined McMaster's faculty after working as an engineer at fibre-optics giant JDS Uniphase in Ottawa.

Nanowires made from silicon or more exotic compounds like gallium-arsenide are excellent at trapping light. When densely packed together, they offer more surface area than conventional cells for absorbing the sun's energy. The thinness of each nanowire also makes it easier to collect the electrons knocked loose by the sun's photons, allowing for greater electrical output per square centimetre of a solar cell.

"And, because you're using nanowires, you're using less material, which will reduce cost," says LaPierre.

How are nanowires grown? You start by planting tiny balls of gold or aluminum on a surface that is exposed to gallium and arsenide gases. The gas atoms are sucked up by the gold to form a layer. As each layer is added, the nanowire begins to sprout. The process is repeated until a desired length and thickness is reached.

"It's really a beautiful process," says LaPierre.

His team is now exploring different ways of growing nanowires on a variety of surfaces or "substrates" that include silicon, glass, flexible metal foils and even a kind of high-tech fabric made of carbon nanotubes.

They're also looking at ways of harvesting nanowires that are grown and scraped from one material and later embedded in flexible plastics.

"We're just fabricating prototypes right now," LaPierre says. "They have low efficiencies at the moment, but we have ways of improving that." The aim is to achieve 20 per cent efficiency in five years, and about 40 per cent over long term. "This would be competitive with existing silicon solar cells."

Tony Verrelli, chief executive of Cleanfield Energy, describes McMaster's nanowire research as "thinking outside the box" and a path to developing a unique product for the market.

"What Cleanfield will be doing is commercializing the system," he says. "But it's unproven on a large scale, and that's the challenge."

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