Sunflowers inspire more efficient solar power system

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UW-Madison engineering professor Hongrui Jiang looked to sunflowers to help find more efficient ways to harvest solar energy.

(Phys.org) -- A field of young sunflowers will slowly rotate from east to west during the course of a sunny day, each leaf seeking out as much sunlight as possible as the sun moves across the sky through an adaptation called heliotropism.

It's a clever bit of natural engineering that inspired imitation from a UW-Madison electrical and computer engineer, who has found a way to mimic the passive heliotropism seen in sunflowers for use in the next crop of solar power systems.

Unlike other "active" solar systems that track the sun's position with GPS and reposition panels with motors, electrical and computer engineering professor Hongrui Jiang's concept leverages the properties of unique materials in concert to create a passive method of re-orienting solar panels in the direction of the most direct sunlight.

His design, published Aug. 1 in Advanced Functional Materials and recently highlighted in *Nature*, employs a combination of liquid crystalline elastomer (LCE), which goes through a phase change and contracts in the presence of heat, with carbon nanotubes, which can absorb a wide range of light wavelengths.

"Carbon nanotubes have a very wide range of absorption, visible light all the way to infrared," says Jiang. "That is something we can take advantage of, since it is possible to use sunlight to drive it directly."

Direct sunlight hits a mirror beneath the solar panel, focused onto one of multiple actuators composed of LCE laced with carbon nanotubes. The carbon nanotubes heat up as they absorb light, and the heat differential between the environment and inside the actuator causes the LCE to shrink.

This causes the entire assembly to bow in the direction of the strongest sunlight. As the sun moves across the sky, the actuators will cool and re-expand, and new ones will shrink, re-positioning the panel over the 180 degrees of sky that the sun covers in the course of the day.

"The idea is that wherever the sun goes, it will follow," says Jiang.

In Jiang's tests, the system improved the efficiency of solar panels by 10 percent, an enormous increase considering material improvements in the solar panels themselves only net increases of a few percent on average. And a passive system means there are no motors and circuits to eat into increased energy harvest.

"The whole point of solar tracking is to increase the electricity output of the system," says Jiang.

The materials driving Jiang's design have only been available in the past few years, so for now, he and his team are researching ways to refine them for use driving larger solar panels, where the net energy gain from his system will be the greatest.

But eventually, Jiang hopes to see huge industrial solar farms where fields of photovoltaic solar panels shift effortlessly along with the sunflowers that inspired him.

"This is exactly what nature does," says Jiang.

Provided by University of Wisconsin-Madison

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