New solar product captures up to 95 percent of light energy

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Efficiency is a problem with today's solar panels; they only collect about 20 percent of available light. Now, a University of Missouri engineer has developed a flexible solar sheet that captures more than 90 percent of available light, and he plans to make prototypes available to consumers within the next five years.

Patrick Pinhero, an associate professor in the MU Chemical Engineering Department, says energy generated using traditional photovoltaic (PV) methods of solar collection is inefficient and neglects much of the available solar electromagnetic (sunlight) spectrum. The device his team has developed – essentially a thin, moldable sheet of small antennas called nantenna – can harvest the heat from industrial processes and convert it into usable electricity. Their ambition is to extend this concept to a direct solar facing nantenna device capable of collecting solar irradiation in the near infrared and optical regions of the solar spectrum.

Working with his former team at the Idaho National Laboratory and Garrett Moddel, an electrical engineering professor at the University of Colorado, Pinhero and his team have now developed a way to extract electricity from the collected heat and sunlight using special high-speed electrical circuitry. This team also partners with Dennis Slafer of MicroContinuum, Inc., of Cambridge, Mass., to immediately port laboratory bench-scale technologies into manufacturable devices that can be inexpensively mass-produced.

"Our overall goal is to collect and utilize as much solar energy as is theoretically possible and bring it to the commercial market in an inexpensive package that is accessible to everyone," Pinhero said. "If successful, this product will put us orders of magnitudes ahead of the current solar energy technologies we have available to us today."

As part of a rollout plan, the team is securing funding from the U.S. Department of Energy and private investors. The second phase features an energy-harvesting device for existing industrial infrastructure, including heat-process factories and solar farms.

Within five years, the research team believes they will have a product that complements conventional PV solar panels. Because it's a flexible film, Pinhero believes it could be incorporated into roof shingle products, or be custom-made to power vehicles.

Once the funding is secure, Pinhero envisions several commercial product spin-offs, including infrared (IR) detection. These include improved contraband-identifying products for airports and the military, optical computing, and infrared line-of-sight telecommunications.

A study on the design and manufacturing process was published in the *Journal of Solar Energy Engineering.*

More information: Theory and Manufacturing Processes of Solar Nanoantenna Electromagnetic Collectors, *J. Sol. Energy Eng.* -- February 2010 -- Volume 132, Issue 1, 011014 (9 pages)
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Abstract

The research described in this paper explores a new and efficient approach for producing electricity from the abundant energy of the sun, using nanoantenna (nantenna) electromagnetic collectors (NECs). NEC devices target midinfrared wavelengths, where conventional photovoltaic

(PV) solar cells are inefficient and where there is an abundance of solar energy. The initial concept of designing NECs was based on scaling of radio frequency antenna theory to the infrared and visible regions. This approach initially proved unsuccessful because the optical behavior of materials in the terahertz (THz) region was overlooked and, in addition, economical nanofabrication methods were not previously available to produce the optical antenna elements. This paper demonstrates progress in addressing significant technological barriers including: (1) development of frequency-dependent modeling of double-feedpoint square spiral nantenna elements, (2) selection of materials with proper THz properties, and (3) development of novel manufacturing methods that could potentially enable economical large-scale manufacturing. We have shown that nantennas can collect infrared energy and induce THz currents and we have also developed cost-effective proof-of-concept fabrication techniques for the large-scale manufacture of simple square-loop nantenna arrays. Future work is planned to embed rectifiers into the double-feedpoint antenna structures. This work represents an important first step toward the ultimate realization of a low-cost device that will collect as well as convert this radiation into electricity. This could lead to a broadband, high conversion efficiency low-cost solution to complement conventional PV devices.

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