Boosting the efficiency of solar panels

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A gel developed by chemistry professor Challa Kumar that enhances the ability of solar cells to absorb energy from sunlight and could double the efficiency of existing solar cell panels. Credit: Peter Morenus/UConn Photo

A UConn researcher has developed a light-harvesting antenna that could double the efficiency of existing solar cell panels and make them cheaper to build.

Professor Challa V. Kumar, who holds appointments in the departments of Chemistry, Molecular and Cell Biology, and the Institute of Materials Science, and his team have created a gel that enhances the ability of solar cells to absorb energy from sunlight.

Sunlight strikes Earth every day with more energy than is used globally in a year. But finding an efficient way to capture and store solar energy to replace fossil fuels as the world's go-to energy source remains a challenge.

"Most of the light from the sun is emitted over a very broad window of wavelengths," says Kumar, who recently presented his work at the 250th National Meeting & Exposition of the American Chemical Society in Boston. "If you want to use solar energy to produce electric current, you want to harvest as much of that spectrum as possible."

Silicon photovoltaic solar cells, the most common type currently used on rooftop panels to convert photons – tiny particles of light – into electricity, can't take advantage of the blue part of the light spectrum. Only photons with the right amount of energy get absorbed by the photovoltaic cell.

The antenna built by Kumar and his team, collects unused blue photons in the light spectrum and, via a process of "artificial photosynthesis," converts them to lower energy photons that the silicon can then turn into current, Kumar explains.

Taking inspiration from plants, the team used a mixture of biodegradable materials to collect sunlight, much like plant chlorophyll. The concoction includes cow blood protein (a waste product in the meat industry), fatty acid from coconuts, and different organic dyes.

Together these substances form a gel that, when placed in a Gratzel cell,

a particular type of solar cell, increases their absorption of unused photons and the power output of the cell.

"This process is great for coating solar cells' light-emitting diodes, which mostly emit in the blue region," Kumar says. "Our vision is to integrate this technology into the manufacturing process of solar panels, which cost homeowners thousands of dollars, to make them more affordable and efficient.

Kumar says that many groups around the world are working to make this kind of antenna, but claims his is the first of its kind.

He says the gel is easy to make and relatively inexpensive, but the mixture needs to be stable and tough enough to last multiple years to be incorporated into existing manufacturing techniques.

The University has filed a provisional patent application, and Kumar is working with a Connecticut company to figure out how to apply the gel to silicon solar cells.

Provided by University of Connecticut