Researchers Produce Best-Yet Dye-Based Solar Cells

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In work that may help solar panels become a more viable source of mainstream power, a research group has created a dye-based solar cell with a high efficiency and high stability, and that lacks the volatile chemicals used in similar cells. This is a combination so far lacking in the newest solar-cell prototypes.

The group, including researchers from the Changchun Institute of Applied Chemistry at the Chinese Academy of Sciences (CAS) and the Swiss Federal Institute of Technology, was studying a new type of solar cell that is being widely researched across the globe, one made of bendy, low-cost, lightweight organic materials rather than rigid, pricey, and often heavy inorganic materials.

"We have uncovered new findings on old solar-cell materials and created high-performance cells," said Peng Wang, a researcher in the Changchun Institute of Applied Chemistry and the study's corresponding scientist, to *PhysOrg.com.*

The type of organic solar cell Wang and his colleagues improved contains three key parts. The first two components are a semiconductor, such as silicon, and an electrolytic liquid—a conducting solution commonly formed by dissolving a salt in a solvent liquid, such as water. The semiconductor and electrolyte work in tandem to split the closely-bound electron-hole pairs produced when sunlight hits the cell, called excitons (holes are positively charged electron vacancies).

The third component is the source of these photo-induced charge carriers, a photosensitive dye that gives the solar cells their name: "dye-sensitized," with the most common dye being iodide. In addition, a nanomaterial is also often used to hold the dye molecules in place like a scaffold.

The highest efficiency solar cell ever made is dye-sensitized, with an efficiency of 11 percent, meaning 11 percent of the solar energy is converted to electrical energy (compared to 8.2 percent achieved by Wang and his group).

But the highest efficiency dye-sensitized cells also contain volatile solvents in their electrolytes that can permeate across plastic (i.e. organic compounds) and also present problems for sealing the cells. Cells that contain these solvents are therefore unattractive for outdoor use due to potential environmental hazards. So while they perform well, they have serious drawbacks.

Researchers have developed solar cells that use solvent-free electrolytes, but the cell efficiencies are too low.

The cell developed by Wang and his group avoids these issues using a "formulation" they developed. To create their electrolyte, they took three solid salts and mixed them to form a "fascinating" liquid, says Wang. The resulting electrolyte has an impressive conductivity as well as the favorable stability properties of all three salts.

"The performance of our solar cell now matches that of cells that use volatile solvents," said Wang. "This is an important step toward the production of large-scale outdoor dye-sensitized solar cells."

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