

Zinc oxide gives green shine to new photoconductors

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Photodetectors -- devices found in cell phones, digital cameras and other consumer gadgets that utilize photoconducting materials -- are a green technology in performance (converting light into electricity), but the manufacture of very powerful photodetectors needs to be improved before they can qualify for solid green status.

This is especially true if photoconducting [materials](#) are to be widely used for producing [solar energy](#).

Northwestern University researchers have designed a high-performing photoconducting material that uses [zinc oxide](#) -- an environmentally friendly [inorganic compound](#) found in baby powder and suntan lotion -- instead of lead sulfide. (Currently, the best performing [photoconductor](#) is based on lead sulfide nanoparticles.)

The new material converts light into electricity but, unlike conventional materials, also features a novel combination of attractive attributes: environmentally benign chemistry, low-cost production, a high level of detectivity, mechanical flexibility and wavelength tunability (ability to design the material to absorb the most important part of the solar spectrum).

This impressive package of features holds promise for the material's use in large-area photovoltaic solar cells as well as flexible electronics -- even in clothing and newspapers. Conventional photoconducting materials are expensive to manufacture, making them unsuitable for

widespread solar energy use, and they are rigid, making them unsuitable for flexible electronics.

Features of the new hybrid material and its synthesis are detailed in a study published by the journal [Nature Materials](#).

"One property of our hybrid material that is especially important for solar-energy devices is its high level of detectivity -- less light is needed to get a good strong and clear signal," said lead researcher Samuel I. Stupp, Board of Trustees Professor of Materials Science and Engineering, Chemistry and Medicine at Northwestern. "This comes from the material's highly ordered architecture, which helps transport the electrons efficiently."

The material has a detectivity level comparable to amorphous silicon, which is widely used in large-area electronics applications, such as liquid-crystal displays (LCDs).

Stupp and his research team designed a novel nanoscale architecture that places the inorganic component (zinc oxide) right next to the organic component, with this pattern alternating over and over, like pages in a book. The pages are packed very tightly.

Each organic page -- which can be one of thousands of different types of molecules -- absorbs light, and an electron is transferred directly to the zinc oxide page, generating current. This works -- and works extremely efficiently -- because the organic and inorganic components are so close together.

To build a book, the researchers grow a precursor material to zinc oxide in the presence of self-assembling organic molecules. (The material can be grown on any metallic or conducting substrate.) The precursor, zinc hydroxide, is formed using electrodeposition and then thermally

converted to zinc oxide. Each zinc oxide page is a nanometer thick while the organic page is one to two nanometers thick, depending on the molecule being used.

In the *Nature Materials* paper the researchers demonstrate that they can build orderly books with high detectivity. But in order for their materials to be used for solar energy, Stupp says, they must build entire "macroscopic libraries" of these books. And, like the books, the libraries must be highly ordered.

"Right now our library is a little disordered, but we are working on optimizing our materials for use in solar [energy devices](#)," said Stupp, director of the Institute for BioNanotechnology in Medicine at Northwestern.

More information: Scientific paper is titled "A Synergistic Assembly of Nanoscale Lamellar Photoconductor Hybrids." In addition to Stupp, the other authors are Marina Sofos, Joshua Goldberger, David A. Stone, Jonathan E. Allen, Qing Ma, David J. Herman, Wei-Wen Tsai and Lincoln J. Lauhon, all from Northwestern.

Source: Northwestern University ([news](#) : [web](#))

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