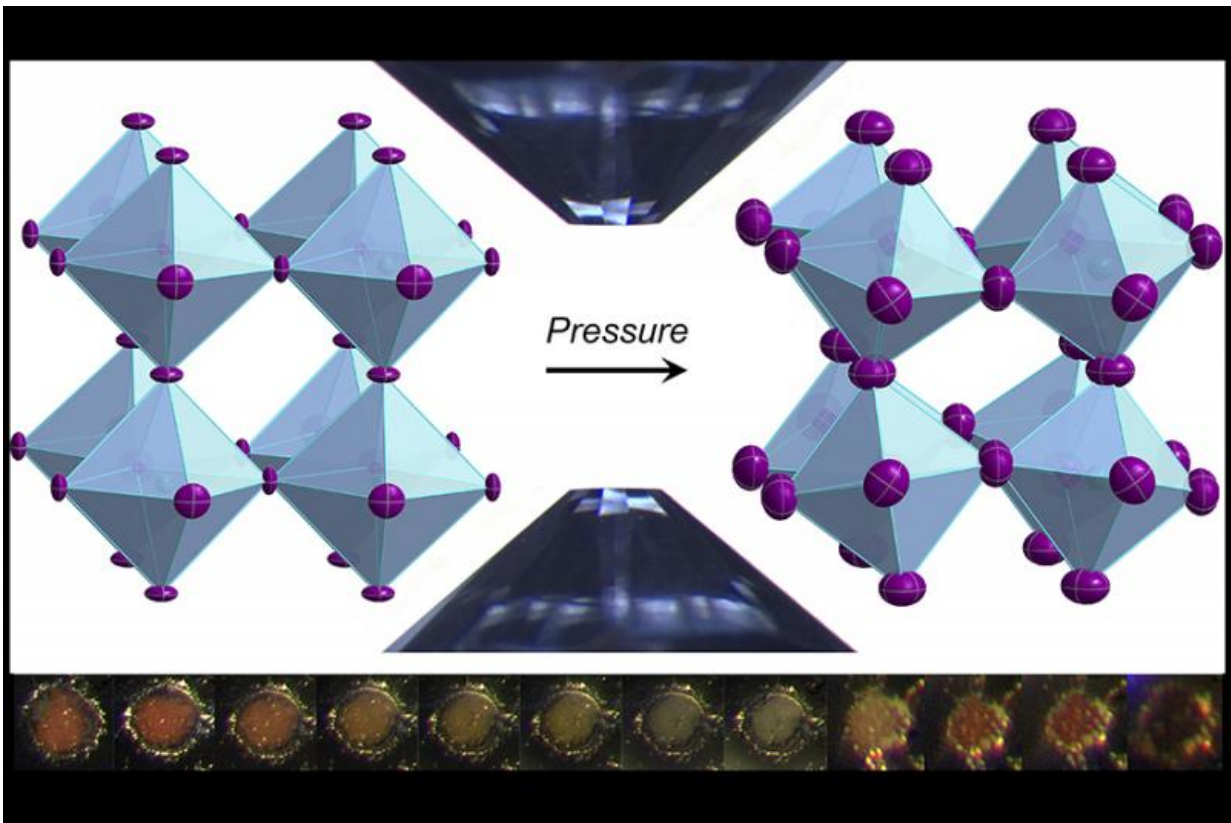


Scientists improve perovskite solar-cell absorbers by giving them a squeeze

April 6 2016



Top: A normal perovskite crystal (left) bends and twists after being squeezed between two diamonds. Bottom: The orange perovskite crystal changes color as pressure is applied, indicating that different wavelengths of light are being absorbed. Credit: Adam Jaffe and Yu Lin/Stanford & SLAC

Solar cells made of artificial metallic crystalline structures called

perovskites have shown great promise in recent years. Now Stanford University scientists have found that applying pressure can change the properties of these inexpensive materials and how they respond to light.

"Our results suggest that we can increase the voltages of perovskite solar cells by applying external pressure," said Hemamala Karunadasa, an assistant professor of chemistry at Stanford. "We also observed a dramatic increase in the electronic conductivity of these promising materials at high pressures."

Karunadasa and Stanford colleague Wendy Mao presented their findings in the April 6 online edition of the journal *ACS Central Science*.

Perovskites come in several crystalline structures, including hybrid perovskites made of lead, iodine or bromine, and organic compounds. The inexpensive materials have potential applications in advancing LEDs and lasers, but one of the hottest areas of research involves solar cells. Recent studies have shown that hybrid perovskites efficiently absorb sunlight and convert it to electricity. Several labs have achieved efficiencies above 20 percent, rivaling commercially available silicon solar cells.

In the *ACS Central Science* study, Karunadasa and Mao sought to assess how pressure affects the way hybrid perovskites respond to light. To find out, the researchers loaded perovskite samples in a diamond-anvil cell, a high-pressure device consisting of two opposing diamonds. Each tiny sample was placed between the diamonds and then squeezed at very high pressures.

The results were visible. One sample, which is normally orange, turned lighter in color under compression, an indication that the perovskite was absorbing higher-energy light waves. But as the pressure increased, the sample darkened, indicating that lower-energy light was also being

absorbed.

"Our findings suggest that compression can allow us to tailor the wavelength of absorbed light," said Mao, an associate professor of geological sciences at Stanford and of photon science at SLAC. "This compression may be attained through either mechanical or chemical means."

Several research groups have been developing low-cost tandem solar cells made of perovskite stacked on top of silicon. But obtaining the high voltages required for high-efficiency tandem cells has proven difficult. The results of the new Stanford study suggest that pressure can increase the voltages of perovskite solar cells and should be investigated further.

"By tracking the positions of atoms upon compression using X-ray diffraction, we can explain exactly how the materials' structure responds to pressure," Karunadasa said. "Overall, this work shows that pressure is a tuning knob for improving the properties of perovskite absorbers in a predictable way."

More information: High-Pressure Single-Crystal Structures of 3D Hybrid Lead-Halide Perovskites and Pressure Effects on their Electronic and Optical Properties,

pubs.acs.org/doi/full/10.1021/acscentsci.6b00055

Provided by Stanford University

Citation: Scientists improve perovskite solar-cell absorbers by giving them a squeeze (2016, April 6) retrieved 20 April 2024 from <https://phys.org/news/2016-04-tuning-perovskite-solar-cell-absorbers.html>

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.