Scientists Discovered Solar Panels' Surprising Weakness

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Courtesy of SynEvol

Though halide perovskites aren't precisely well-known, they have the potential to revolutionize the global supply of renewable energy.

Whether used to power spacecraft in orbit or generate power on Earth, this family of materials—named for the 19th-century Russian mineralogist Lev Perovski—promises significant improvements over the standard silicon solar cells currently employed in the industry. Unfortunately, the instability of this capability for power generation limits it. Perovskites "can decompose when they react with moisture and oxygen or when they spend extended time exposed to light, heat, or applied voltage," according to the U.S. Office of Energy Efficiency & Renewable Energy (EERE). Therefore, researchers must find a means to increase the technology's dependability before bringing this next generation of solar cells to the market.

That's precisely the situation that the latest findings from HKUST, the Hong Kong University of Science and Technology, address. Yuanyuan Zhou, a scientist at HKUST, and his colleagues examined why metal halide perovskite films deteriorated over time and whether there was a way to increase the material's durability. Their findings were published last week in the journal Nature Energy. The "hidden structure" of surface concavities on individual crystal grains was found by the researchers during their investigation, and this structure may have contributed to the film's subpar stability. Yuanyuan and his colleagues produced perovskite films that demonstrated remarkable stability increases over earlier films by removing the concavities.

Zhou, a co-author of the study, said in a press release that "we are pioneering a new way of making perovskite solar cells with efficiency and stability toward their limits by unveiling the grain surface concavities, understanding their effects, and leveraging chemical engineering to tailor their geometry." When we used atomic force microscopy to analyze the structural features of perovskite films, we were particularly fascinated by the surface concavities of the perovskite grains. These concavities are typically hidden beneath the film's bottom and are simple to miss.

The researchers examined the films to find these concavities and found that the physical continuity of the film was effectively disrupted by this "hidden structure," which is what makes these kinds of materials deteriorate so quickly in extreme humidity and light. The group was able to modify the strain evolution and ion diffusion of the film by employing potassium tridecafluorohexane-1-sulfonic acid, a type of surfactant, and effectively create a robust perovskite from the ground up. The researchers reported significant improvements in thermal cycling, moist heat, and maximum-power-point tracking tests with this new and improved material.

Yalan Zhang, a post-doc researcher at HKUST and co-author of the study, stated in a press release that "microstructure is of vital importance for perovskite solar cells and other optoelectronic devices" and that it "may be more complex than conventional materials owing to the hybrid organic-inorganic characteristics of perovskite materials."

Although one of the biggest obstacles to these films being available on solar panels near you will be removed by this discovery, scaling up production from these specialized lab gadgets will present an enormous task in and of itself. Fortunately, we now know that reduced stability in perovskites solar cells is a correctable defect rather than an unchangeable one, despite the many years of work still ahead.