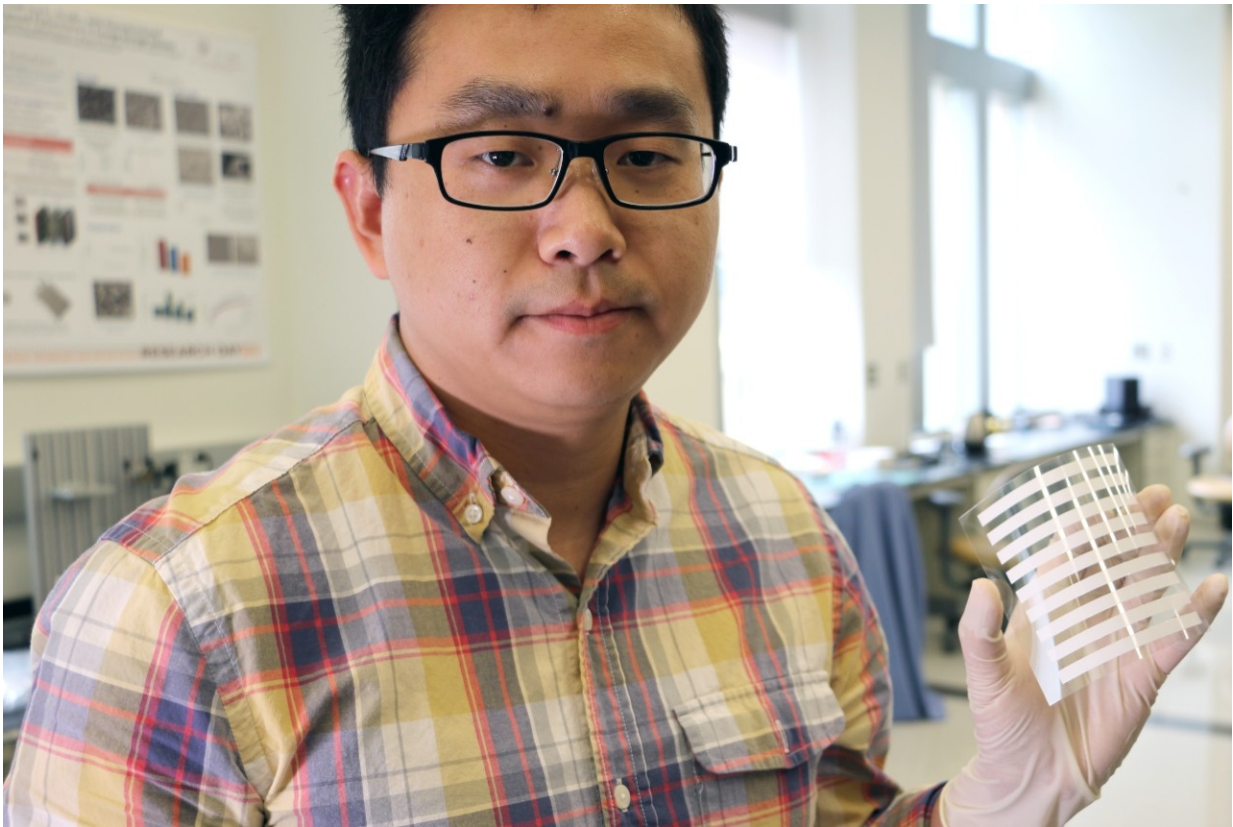


# Virginia Tech flexible solar panel goes where silicon can't

October 31 2016, by Rosaire Bushey

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Post-doctoral researcher Congcong Wu, who is working in the lab of Shashank Priya, the Robert E. Hord Jr. Professor of Mechanical Engineering, holds up a layer of the flexible solar panel the group is working on. The process to adhere a thin film of titanium oxide to the panel takes less than 10 seconds using screen-printing technology. Credit: Virginia Tech

In the very near future, recycling light energy may be easier than recycling any other item in your house.

Led by Shashank Priya, a team of mechanical and materials engineers and chemists at Virginia Tech, including post-doctoral researchers Xiaojia Zheng and Congcong Wu, as well as College of Science chemistry Professor Robert Moore and Assistant Professor Amanda Morris, is producing [flexible solar panels](#) that can become part of window shades or wallpaper that will capture light from the sun as well as light from sources inside buildings.

Solar modules less than half-a-millimeter thick are being created through a screen-printing process using low-temperature [titanium oxide](#) paste as part of a five-layer structure that creates thin, flexible panels similar to tiles in one's bathroom. These tiles can be combined together to cover large areas; an individual panel, roughly the size of a person's palm, provides about 75 milliwatts of power, meaning a panel the size of a standard sheet of paper could easily recharge a typical smart phone.

Most silicon-based panels can absorb only sunlight, but the flexible panels are constructed to be able to absorb diffused light, such as that produced by LED, incandescent, and fluorescent fixtures, according to Priya, the Robert E. Hord Jr. Professor of Mechanical Engineering in the College of Engineering.

"There are several elements that make the technology very appealing," said Priya. "First, it can be manufactured easily at low temperature, so the equipment to fabricate the panels is relatively inexpensive and easy to operate. Second, the scalability of being able to create the panels in sheet rolls means you could wallpaper your home in these panels to run everything from your alarm system, to recharging your devices, to powering your LED lights."

The panels, Priya said, can also be made to any design, so they could become window shades and curtains as well, absorbing sunlight through windows.

"The properties of the panels are such that there are really few limitations in terms of light source," Priya said. "And the fact that we are dealing with an emerging technology, means we will be able to expand the utility of the panels as we go forward."

Currently, the efficiency of the cells is nearly on par with the heavier, rigid silicon structures, but, Priya said, at panel-level there is some research required. Still, it is likely the new flexible panels will overtake their rigid cousins soon.

"Amorphous silicon is a fairly mature technology running at about 13-15 percent efficiency," he said. "Our panels right now operate around 10 percent at the panel size. At smaller, less-useful sizes, the efficiency increases, and so we can see a potential for much greater energy collection efficiencies."

The flexible panels, as they approach the conversion efficiency of rigid silicon and glass, can also be incorporated into products that the older technology cannot compete with – such as military uniforms and backpacks, items Priya's lab is working on now with the U.S. Army's Communications-Electronics Research, Development, and Engineering Center. By adding flexible panels to these items, soldiers will become their own recharging stations, resulting in reduction of the logistical footprint of a fighting force in the field, as well as the weight each individual soldier must carry on his or her back.

"Right now we are on the cutting edge of this technology," Priya said. "Our edge is in the ability to fabricate large-area modules with high efficiency. We are actively working to integrate the product with the

market and we see a wide variety of uses for the technology, from clothing to windows, to smart buildings to UAVs to mobile charging stations."

The work of Priya and his team is detailed in the papers, The Controlling Mechanism for Potential Loss in  $\text{CH}_3\text{NH}_3\text{PbBr}_3$  Hybrid Solar Cells, published in the July issue of ACS Energy Letters, and Scaling of the Flexible Dye Sensitized Solar Cell Module, available online now in the journal *Solar Energy Materials and Solar Cells*. The article will be published in the journal's December edition.

By creating panels that capture a wide variety of light wavelengths, Virginia Tech engineers are opening a door to an entirely new area of light and energy recycling that could make saving energy as easy as hanging a curtain. Another paper demonstrating the stability of the cells will be published by ACS Energy Letters later in October under the title, Improved Phase Stability of Formamidinium Lead Triiodide Perovskite by Strain Relaxation.

**More information:** Xiaojia Zheng et al. The Controlling Mechanism for Potential Loss in  $\text{CH}_3\text{NH}_3\text{PbBr}_3$  Hybrid Solar Cells, *ACS Energy Letters* (2016). [DOI: 10.1021/acsenergylett.6b00215](https://doi.org/10.1021/acsenergylett.6b00215)

Xiaojia Zheng et al. Improved Phase Stability of Formamidinium Lead Triiodide Perovskite by Strain Relaxation, *ACS Energy Letters* (2016). [DOI: 10.1021/acsenergylett.6b00457](https://doi.org/10.1021/acsenergylett.6b00457)

Provided by Virginia Tech

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