

HUIMING YIN

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If Huiming Yin has his way, solar panels will one day all but disappear from view on rooftops—and from a builder's bottom line. Yin is working on a prototype for an inexpensive photovoltaic (pv) cell that produces both electricity and hot water. He is also attempting to integrate his new design into roofing materials, perhaps one day eliminating the need for both solar panels and roofing shingles.

Sunlight spans a wide range of the electromagnetic spectrum—from nearly 120 to 20,000 nanometers, but the typical pv cell can only convert a narrow sliver of this to electricity. The rest is wasted or converted to heat—the enemy of many pv cells. In particular, the most inexpensive silicone-based cells virtually stop producing a current above 85 degrees Celsius, but rooftop solar cells often reach temperatures exceeding 100 degrees Celsius, making them all but useless in most parts of the world.

“As civil engineers, we want to produce something that really changes peoples’ lives,” said Yin. His design incorporates a functionally graded material (FGM), a relatively new type of material made up of two components that, instead of meeting in an abrupt transition, change gradually in composition from one to the other. This allows designers to take advantage of the physical properties of both components without having to create a physical bond between them—often the weakest point in any composite.

The FGM that Yin uses in his solar panels helps both draw heat from the base of the photovoltaic cell and insulate the roof. Water-filled tubes embedded in the thin FGM layer carry that heat away to be used in the building. By cooling the cell, Yin is aiming to improve the efficiency of existing silicone pv cells.

His earlier research focused on improving the wear and durability of roads using FGMs to prevent buckling and heat stress. The shingled roof, which is essentially another asphalt-covered surface, seemed like the next obvious focus of Yin's attention—particularly when that surface is forced into double duty as both a shelter and an energy producer. Installing solar panels on an existing roof, he says, is a quintessential civil engineering problem, one that involves structural dynamics, wind loading, and heat dissipation.

The next step is to fashion his cells into durable roofing elements that can take the place of shingles. Yin envisions a day when any building will be able to convert sunlight to electricity and hot water for less than the cost of a conventional roof. Until that time, he will continue trying to change the world, one rooftop at a time.

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