ENERGY

Solar Times Two

A hybrid approach combines the benefits of photovoltaic and solar-thermal technologies into a device the size of a fingernail

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The two most common ways of generating power from the sun both have their drawbacks. Photovoltaic cells, which absorb photons from sunlight and convert them to electricity, operate with only 20 percent efficiency. That is because they can use only photons within a certain range of wavelengths to excite electrons. Solar-thermal systems, which turn sunlight into heat and then into electricity, are more efficient than photovoltaics—because they can use the entire solar spectrum, they can reach efficiencies of 30 percent—but they are impossible to scale down to rooftop size. The usual solar-thermal setup involves vast mirror arrays that concentrate sunlight, heating liquid that eventually powers an electricity-generating turbine.

To overcome the limitations of the two approaches, researchers at the Massachusetts Institute of Technology have created a device that combines elements of both, which they described in a February study in *Nature Nanotechnology.* (*Scientific American* is part of Nature Publishing Group.)

Their fingernail-size invention is known as a solar-thermophotovoltaic device. The first thing it does is produce heat from sunlight. Carbon nanotubes—extremely efficient absorbers of sunlight, which convert nearly the entire solar spectrum into heat—take care of that step. The heat then flows into a photonic crystal, which is composed of layers of silicon and silicon dioxide. Once the photonic crystal reaches approximately 1,000 degrees Celsius, it begins to glow, emitting mostly photons of a wavelength well matched to the photovoltaic cell below. When those photons strike the photovoltaic cell, they generate electricity.

The process of transforming light into heat and then back into light—and, finally, into electricity—is not simple. So far the thermophotovoltaic device has achieved only 3 percent efficiency. But "this is just a starting point," says senior author Evelyn Wang. The key will be making it work on a larger scale. "If we can scale up, then we can get over 20 percent efficiencies," Wang says. *—Geoffrey Giller*