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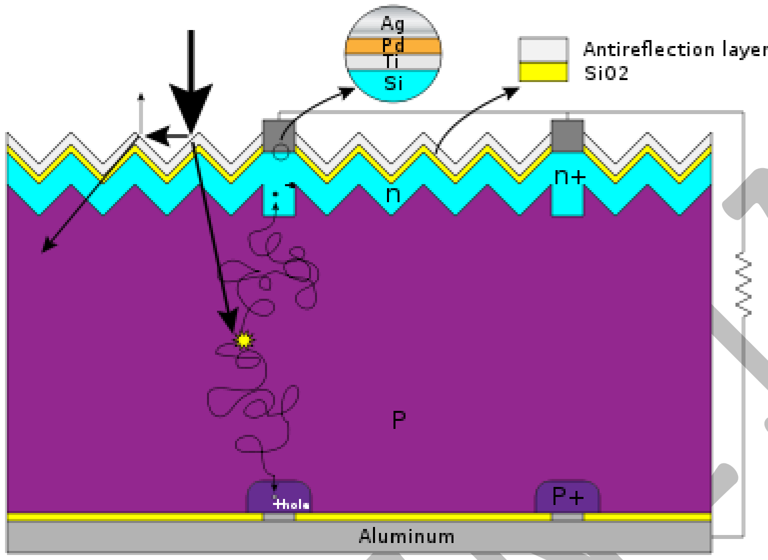
Solar Power: Thin-film Photovoltaic Cells

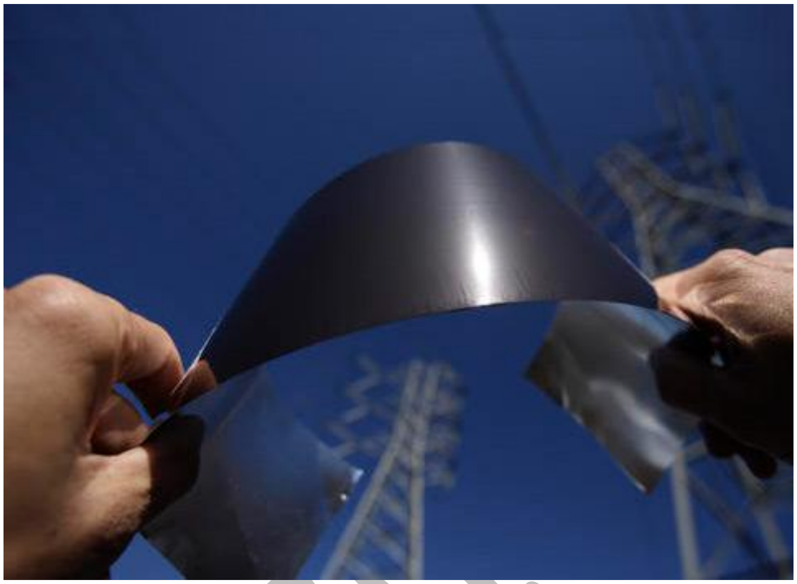


In theory, silicon solar panels are great. The reality remains, however, that they are an expensive investment—though they certainly yield valuable results—that few American families are willing to make. As a result of an increase in demand in 2004, prices rose to nearly 500 dollars per kilogram by 2008. Now, new technology is leading to a more affordable way to harness solar energy. Researchers at the U.S. Department of Energy's National Renewable Energy Laboratory, along with numerous other independent companies, have been working on a thin-film solar cell that relies on copper indium gallium selenide technology—CIGS for short—as a means of converting solar energy into electrical power.

Silicon Solar Panels

There are two types of silicon technology used in silicon solar-absorbing panels. Monocrystalline silicon (which consists of slivers of silicon up to 150 mm in diameter and 350 microns thick), and multicrystalline silicon (wafers acquired through the division of a solid block of silicon), serve as semi-conducting solar absorbers, although crystalline silicon is actually a weak absorber of light. Because of this property, the material must be pretty thick—however, crystalline silicon is used because it is relatively and durable.

New Thin-film Technology



Since the cost of crystalline silicon is out of reach for the average consumer, there has been a push toward technology that is readily available and affordable. By identifying materials that are efficient absorbers of solar power and cost-effective for both the manufacturer and the consumer, three new forms of thin-film solar panels have been developed: amorphous silicon, cadmium telluride, and CIGS technology. All three forms are highly-absorbent and can operate effectively at a thickness of about 1 micron, which means they are less expensive than the thick crystalline silicon alternative.

Amorphous silicon differs from traditional crystalline silicon in that it is arranged spontaneously and thinly layered, whereas crystalline silicon is almost grid-like in pattern and thick. It was the earliest attempt at a thin-filmed solar cell, and was initially applied to items such as calculators. In attempts to create thinner films, many companies have tried using combinations of crystalline silicon and amorphous silicon. In the spring of 2008, amorphous silicon comprised about 60 percent of the solar-cell market.

Cadmium telluride is the most eco-friendly of solar panels because the least amount of energy is used to create it, yet it comprised only 30 percent of the solar-cell market in 2008. Its band gap—1.4 electron-volts—is very near to that of the solar spectrum, making it an effective semiconductor.

Copper indium gallium selenide (CIGS) is the newest technology and only accounted for 1 percent of the solar market in 2008, yet it has been achieving a high-level of success in studies. It has obtained efficiency levels as high as 20.3 percent, which is the highest any thin-film has ever reached.

CIGS Technology

Although it isn't in wide use, perhaps due to its novelty, CIGS seems to be a promising form of solar cell. However, difficulty in manufacturing reliably efficient cells could be a problem when it comes to mass-production, despite the fact that CIGS cells have already surpassed other forms of technology in efficiency in the lab. For more info, try here: http://www.nrel.gov/news/press/2008/574.html.

In other forms of solar panels, a base material's surface is coated using a variety of materials, such as silicon or cadmium telluride, to create an absorbent device. In CIGS technology, if selenium is left exposed (as it would be if used to coat a base plate) atoms of the semi-toxic element become hard to control. To avoid this potential problem and create a cell that both protects and maximizes the potential of the materials, several companies have been making strides in how the panels are manufactured. Using glass, stainless steel sheets, flexible metal foils, or high temperature polymers to form two backing plates, thin layers of cadmium selenide and indium selenide are then deposited. The plates are joined together using heat and electromagnetic forces, keeping selenium between the plates and preventing exposure.

Thin-film solar technology offer several advantages over traditional silicon panels. Because these panels are thin-filmed, they can easily be incorporated into existing structures, such as windows and roof shingles, so as to be inconspicuous. Manufacturing components with thin-film technology built in could cut down on cost, eliminating the need to spend money on a separate solar device and installation.

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