Hot Electrons Could Double Solar Cell Power Efficiency

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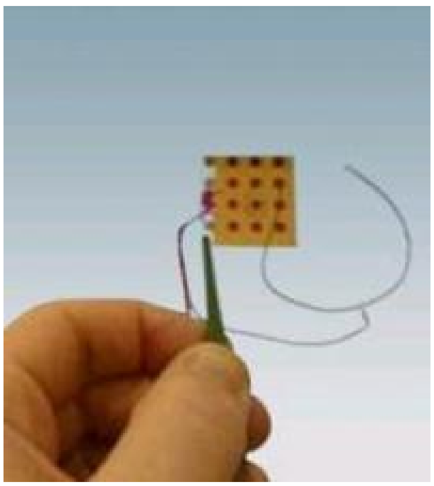

Hot electrons could pass through an ultra-thin solar cell without cooling down, with the potential for doubling solar cell efficiency. Image credit: Michael Naughton.

Scientists have experimentally verified a theory suggesting that hot electrons could double the output of solar cells. The researchers, from Boston College, have built solar cells that successfully use hot electrons to increase the cells' power ouput. Although the power increase is small, the concept could lead to solar cells that break conventional efficiency limits.

Michael Naughton, a physics professor at Boston College, and others have designed an ultra-thin (15-nanometer-thick) solar cell, which hot electrons can quickly pass through before cooling. In conventional, thicker solar cells, only the "cooler" lower-energy electrons that have longer wavelengths can pass through.

When a conventional solar cell absorbs a high-energy photon, it produces a hot electron that quickly loses much of its energy as heat before it can pass through the cell and be used to generate electricity. Although solar cells can be designed to absorb high-energy photons and use hot electrons, they aren't able to absorb low-energy photons as well. The new solar cell design, however, can absorb both.

Theoretically, solar cells that can absorb hot and cool electrons could nearly double their power efficiency. Conventional solar cells can convert at most about 35% of sunlight energy into electricity, and the rest is wasted as heat. By absorbing the hot electrons, solar cells could achieve efficiencies of up to 67%, according to an article in MIT's Technology Review. By doubling the efficiency, the cost of solar power could be cut in half.

There are still challenges with the new ultra-thin solar cells, however. Because they're so thin, most of the light passes through them, so they only convert about 3% of incoming light into electricity. But past research has shown that adding nanowires to the solar cells could allow them to absorb more light while still keeping a short travel distance for the electrons. In addition, the scientists are investigating incorporating quantum dots into the nanowires to increase the number of electrons collected from the absorbed light.

More information: Elusive 'hot' electrons captured in ultra-thin solar cells