

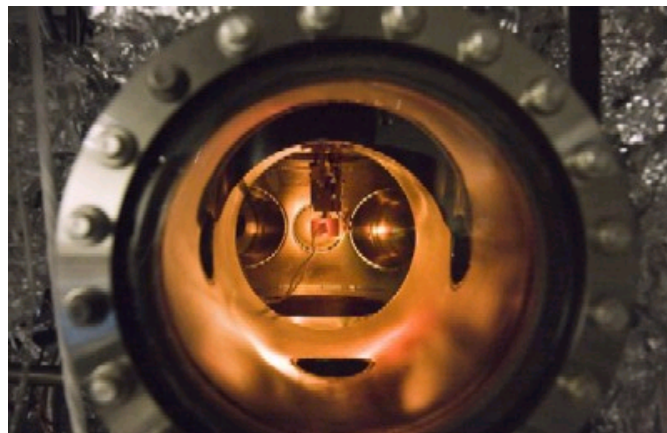
News archive

2010

- ▶ [December 2010](#)
- ▶ [November 2010](#)
- ▶ [October 2010](#)
- ▶ [September 2010](#)
- ▶ [August 2010](#)
- ▶ [July 2010](#)
- ▶ [June 2010](#)
- ▶ [May 2010](#)
- ▶ [April 2010](#)
- ▶ [March 2010](#)
- ▶ [February 2010](#)
- ▶ [January 2010](#)

- ▶ [2009](#)
- ▶ [2008](#)
- ▶ [2007](#)
- ▶ [2006](#)
- ▶ [2005](#)
- ▶ [2004](#)
- ▶ [2003](#)
- ▶ [2002](#)
- ▶ [2001](#)
- ▶ [2000](#)
- ▶ [1999](#)
- ▶ [1998](#)
- ▶ [1997](#)

Squeezing more out of solar power

Aug 9, 2010 [4 comments](#)

A small PETE device

Scientists in the US have designed a new kind of solar cell that could generate electricity using both the Sun's light and heat. They claim that the device could be more efficient than either photovoltaic panels or "solar-thermal" plants operating on their own – and potentially allow solar power to compete with fossil fuels in terms of cost per kilowatt-hour.

In an ordinary semiconductor photovoltaic cell, incoming photons excite electrons from the cell's valence band to its conduction band. The electrons are then collected at an electrode to generate a current. Unfortunately, photons with less energy than the semiconductor's "bandgap" cannot excite electrons, while photons with more energy than the bandgap lose their surplus energy as heat. The result is that most of the incident solar energy is lost.

This waste heat could, in principle, be recouped by using it to warm up a liquid with a high boiling point, transferring the energy to water and then using the resulting steam to drive a turbine. But in practice attempts to combine photovoltaic and such solar-thermal devices have not borne fruit. The problem is that whereas photovoltaic cells are most efficient at low temperatures (below 100 °C), solar-powered engines work best at high temperatures (above 200 °C).

However, Nick Melosh and colleagues at Stanford University in the US now say they have designed a new kind of device that relies on electron photoexcitation but that actually becomes more efficient at higher temperatures. What they did was to adapt a "thermionic energy convertor" – a device that can convert solar heat directly into electricity. The device was originally developed by both NASA and the Soviet Union to power deep-space missions, although it never succeeded commercially as it could not convert more than 15% of incoming photons into current.

Exploiting the excess

A thermionic energy convertor consists of a cathode and an anode separated by a vacuum gap. A current can flow if a heat source provides electrons in the cathode with enough energy to break free from their host material – usually tungsten – and cross the gap.

In the Stanford design, the cathode is made from a semiconductor and electrons are first excited into the conduction band before

Sign up

To enjoy free access to all high-quality "In depth" content, including topical features, reviews and opinion [sign up](#)

Share this

 [E-mail to a friend](#)
 [Twitter](#)
 [Facebook](#)
 [Connotea](#)
 [CiteUlike](#)
 [SHARE](#) [f](#) [t](#) [e](#) ...

Related stories

[Quantum dots for highly efficient solar cells](#)

[Solar cell grabs hot electrons](#)

Related links

[Stanford University press release](#)

[Nick Melosh](#)

Restricted links

[Nature Materials](#)
10.1038/nmat2814

Related products

[Edwards nEXT - the new experience in turbo pumps](#)

Edwards
Nov 16, 2010

[Cryogenically Serviceable Epoxy Meets NASA Low-Outgassing Specifications](#)

Master Bond Inc.
Sep 13, 2010

[Low Vibration ST-500 series Micro-manipulated Cryogenic Probe Station](#)

Janis Research Company Inc
Jun 11, 2010

Webinar series



Free webinar – Multiphysics simulation on clusters

[Register now](#)

Corporate video

"Moving the nanoworld" by Physik Instrumente (PI)

Learn more – [view video](#)

Key suppliers



Corporate partners



Contact us for advertising information

crossing the vacuum to reach the anode. With the energy needed to cross the gap coming from the excess thermal energy provided by the incident photons, this "photon-enhanced thermionic emission" (PETE) can, claim the researchers, generate higher voltages than a conventional photovoltaic device with the same bandgap.

The trick, they say, is to make the photons leave the semiconductor rather than remain within it because in a purely solid-state photovoltaic, increased heating can cause electrons to travel away, rather than towards, the cathode, which reduces the output voltage.

Testing times

Melosh and co-workers have not yet built a solar cell based on this technology but have tested the principle by placing a caesium-coated gallium nitride wafer inside a vacuum chamber, heating the chamber at temperatures of up to 400 °C, and then illuminating the wafer with different wavelengths of light. They found that the electrons were emitted more readily as they raised the temperature and also that the emitted electrons carried more energy than they started out with. In other words, the electrons picked up thermal energy in addition to the photon energy.

The researchers say that a PETE cell would work best by operating it with a solar-thermal power plant that uses parabolic mirrors to concentrate sunlight. The cell would harvest a portion of the incoming light and output that energy as electricity and then dump its waste heat into the working fluid of the solar thermal plant, where it would drive a steam engine and generate additional electricity. Placed at the focus of each parabolic dish, the cell would be a disc of material with a diameter not more than about 15 cm, the Stanford group estimates.

Melosh says that in this way 50–60% of the incoming solar energy could be converted into electricity, compared to a peak of just 42% achieved to date with photovoltaic cells exposed to concentrated sunlight and a 31% record for solar thermal plants. But he admits that the figure of 50–60% is theoretical. In fact in its experiment, his group achieved efficiencies of just 0.1%.

However, Melosh emphasizes that the experiment was designed to prove the underlying principle and not to achieve high efficiencies, with the caesium-coated gallium nitride having been used to ensure stability at high temperatures. His group is now looking at more high-performance materials, such as gallium arsenide, and Melosh hopes to have a device ready for commercial deployment within three years.

This research is published in *Nature Materials*.

About the author

Edwin Cartlidge is a science writer based in Rome

4 comments

Comments on this article are now closed.

1

Oliver K. Manuel

Aug 11, 2010 5:06 AM
United States

Congratulations!

This looks good on paper! I hope it will in fact work better than existing technology.

With kind regards,
Oliver K. Manuel

[Offensive? Unsuitable? Notify Editor](#)

2

tpersing

Aug 19, 2010 5:30 PM

cost-benefit analysis

while the costs of producing the energy may be competitive with current fossil fuels how will the costs of capital investment for the initial setup and maintenance compare? Obviously the question is semi-rhetorical but it something that warrants consideration as the transition from lab to commercialization is considered (and should be considered in the lab so that the research efforts are more likely to gain further investment and a greater chance of implementation for society's benefit)

[Offensive? Unsuitable? Notify Editor](#)

3

jasem.alfawwaz

Aug 25, 2010 10:43 AM
Syria

I think

It seems interesting but will it be the factual findings in the right ..?

[Offensive? Unsuitable? Notify Editor](#)

4

jkujyhgtr

Sep 8, 2010 10:16 AM

Re:

Shop the latest styles Juicy Couture handbags, juicy couture tracksuit.
Juicy couture sale, juicy couture outlet.

[Juicy Couture](#)

[Juicy Couture Bags](#)

[Juicy Couture handbags](#)

An online shop specializing in Herve Leger, Herve Leger Dress, Herve Leger Skirt, Herve Leger Sale, Herve Leger Dresses.All new style in our store.

[Herve Leger](#)

[Herve Leger Dresses](#)

[Offensive? Unsuitable? Notify Editor](#)