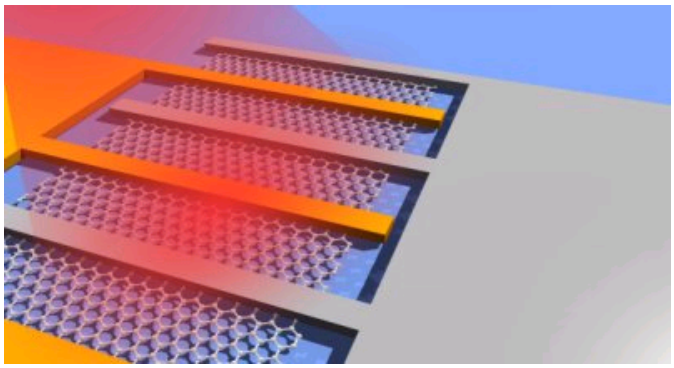
News archive

- 2010
  - April 2010
  - March 2010
  - February 2010
  - January 2010
- 2009
- 2008
- 2007
- 2006
- 2005
- 2004
- 2003
- 2002
- 2001
- 2000
- 1999
- 1998
- 1997

Graphene photodetector is a first

Apr 1, 2010 3 comments

Researchers at IBM have made the first photodetector from graphene – a sheet of carbon just one atom thick. The device, which can accurately detect optical data streams at speeds of 10 Gbit/s, could be used to create new types of circuits that use both light and electrical current to process and transmit information.



Graphene sees the light

Photodetectors are devices that detect light by converting optical signals into electrical current. They are widely employed in both science and technology, for communications, sensing and imaging.

Modern light detectors are usually made using III-V semiconductors, such as gallium arsenide. When light strikes these materials, each absorbed photon creates an electron-hole pair. These pairs then separate and produce an electrical current.

Good at absorbing light

Graphene has many unique physical and mechanical properties that make it suitable for detecting light. One benefit is that electrons and holes move much faster through graphene than through other materials. Also, graphene is very good at absorbing light over a very wide range of wavelengths, ranging from the visible to the infrared. This is unlike III-V semiconductors, which do not work over such a wide range.

Despite all these advantages, graphene suffers from one serious flaw – the electrons and holes created in the bulk of the material normally recombine too quickly, which means no free electrons to carry current.

But now Phaedon Avouris and colleagues at the IBM TJ Watson Research Center in New York have overcome this problem by separating the electron-hole pairs using internal electric fields so that the electrons and holes are separated.

Separating electrons and holes

The researchers did this by placing palladium or titanium electrodes on top of a piece of multilayered or single-layered graphene. The metal "fingers", which have different work functions, produce electric fields at the interface between the electrodes and graphene. The field effectively separates the electrons and holes, and a photocurrent is produced when light is shone onto the device.

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"In this arrangement, the resulting 'built-in' fields act on the entire area of the device," explains Avouris. "Moreover, we do not need to apply a bias voltage for the device to operate, which also allows us to eliminate unwanted noise at the same time."

At present, the graphene photodetector can achieve the error-free detection of optical data streams at rates of 10 Gbit/s, a figure that compares well to that of optical networks made of other materials, like III-V semiconductors.

The IBM team is now working on optimizing the photodetector's performance and integrating it with other optical devices. "We expect that graphene-based integrated electronic-photonic circuits could find a wide range of applications," Avouris told *physicsworld.com*. "The graphene photodetector would be particularly competitive in the long wavelength range of the electromagnetic spectrum and for ultrafast measurements."

The work was reported in *Nature Photonics*.

About the author

Belle Dumé is a contributing editor to *nanotechweb*.

3 comments

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1 **reader01**
Apr 1, 2010 2:04 PM

electric and optic signals

I dont know about any device which lead electric and optic signals (electrons and photons) both at one time. I am aware that this (what I have written) dont have much common with the article, but I would like to know wheather such device exist.
Graphen one atomic layer may be used as solar panel (I think it is possibly similar principle as TiO2 nanofibres solar panels have). If I am not right I apology for it.

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2 **gurjot singh87**
Apr 1, 2010 6:26 PM

Quote:

> *Originally posted by* ***reader01***
> I dont know about any device which lead electric and optic signals (electrons and photons) both at one time. I am aware that this (what I have written) dont have much common with the article, but I would like to know wheather such device exist.
> Graphen one atomic layer may be used as solar panel (I think it is possibly similar principle as TiO2 nanofibres solar panels have). If I am not right I apology for it.

Yes it can be used as a solar panel,what i thought in that this will lead to energy saving era.Though our scientists are
trying to control the nuclear fusion to solve the power problem,these things are quite benificial to make more photosensitive devices..... good luck

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3 **gunslingor**
Apr 1, 2010 7:12 PM
United States

NICE

Really only matter of time. I think the technical feasaqbility of creating a micro chip with quantum, organic, nanotech and optical components is just over the horizon, no question its the ne

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