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TECHNOLOGY UPDATE

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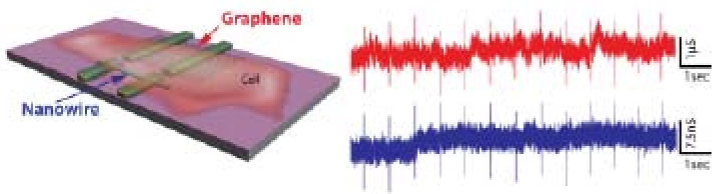
Graphene for bioelectronics

Graphene can successfully be interfaced to living cells. The discovery means that the material – which is a 2D sheet of carbon just one atom thick – could be used in future bioelectronics applications. It might even help to "blur" the boundary between electronic devices and biological systems.



(http://images.iop.org/objects/ntw/news/9/2/19/100219.jpg)
The experiment (http://images.iop.org/objects/ntw/news/9/2/19/100219.jpg)

Graphene, dubbed the "wonder material" since its discovery in 2004, makes an excellent building block for nanoelectronic devices thanks to its unique physical and mechanical properties. These include high electrical and thermal conductivity, and high strength, among others. However, scientists know little about how the material interacts with biological cells and tissue.

Now, Charles Lieber and colleagues at Harvard University and the National Center for Nanoscience and Technology (NCNST) in China have shown that they can make robust interfaces between atomically thick graphene and beating cardiac cells. The team has also demonstrated that 1D silicon nanowire FETs (SiNW-FETs) can be incorporated side by side with 2D graphene FET devices and the ensemble interfaced with living cells too.

The researchers obtained their results by making the multiplexed graphene-FET/SiNW-FET chips in two sequential steps. First, they transferred single-layer graphene flakes onto the surface of an oxidized silicon substrate by exfoliating the graphene onto the substrate. Next, they defined source/drain contacts using electron beam lithography. Finally, they assembled p-type SiNWs from solution close to the graphene-FET devices. SiNW-FETs were then defined using lithography as before.

Interfacing to cardiac cells

Lieber and co-workers interfaced both devices to beating cardiac cells, taken from embryonic chicken hearts, cultured on a thin sheet of polymer substrate immersed in physiological serum. The researchers recorded electrical signals from the cells, which proves that the cells remain intact and are unaffected by interfaces to the FETs.

"Both nanomaterials provide new and unique opportunities and allow researchers to exploit key and tunable nanomaterial properties that go far beyond the capabilities of conventional fabricated electronics in building highly sophisticated and multifunctional bioelectronic interfaces," Lieber told *nanotechweb.org*. "One obvious application is a muscle/device hybrid with input/output."

The SiNW or graphene–cell interfaces might also be used for drug assays and basic biomedical research. "Ultimately, with ever smaller structures, we could literally blur the interface between an electronic device and living systems," stated Lieber.

The Harvard University team is now looking to interface cells with nanostructures that are not directly fabricated on substrate surfaces.

The work was published in *Nano Lett.*

About the author

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