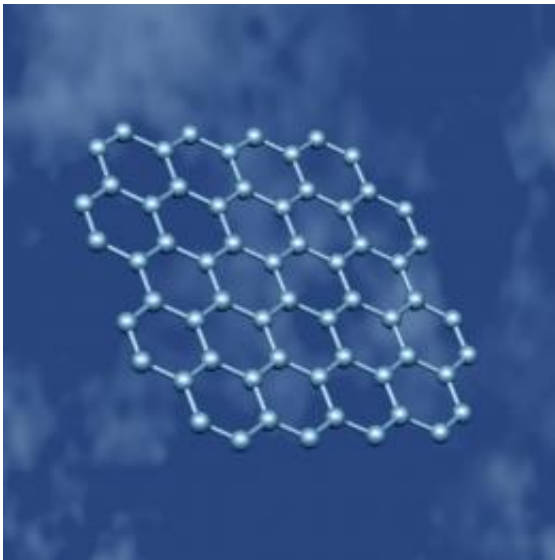


# Graphene's 'Big Mac' creates next generation of chips

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Artistic impression of graphene molecules. Credit: University of Manchester

The world's thinnest, strongest and most conductive material, discovered in 2004 at the University of Manchester by Professor Andre Geim and Professor Kostya Novoselov, has the potential to revolutionize material science.

Demonstrating the remarkable properties of [graphene](#) won the two scientists the Nobel Prize for Physics last year and UK's Chancellor of the Exchequer George Osborne has just announced plans for a £50m graphene research hub to be set up.

Now, writing in the journal *Nature Physics*, the University of Manchester team have for the first time demonstrated how graphene inside electronic circuits will probably look like in the future.

By sandwiching two sheets of graphene with another two-dimensional material, boron nitrate, the team created the graphene 'Big Mac' – a four-layered structure which could be the key to replacing the silicon chip in computers.

Because there are two layers of graphene completely surrounded by the boron nitrate, this has allowed the researchers for the first time to observe how graphene behaves when unaffected by the environment.

Dr Leonid Ponomarenko, the leading author on the paper, said:  
"Creating the multilayer structure has allowed us to isolate graphene from negative influence of the environment and control graphene's electronic properties in a way it was impossible before.

"So far people have never seen graphene as an insulator unless it has been purposefully damaged, but here high-quality graphene becomes an insulator for the first time."

The two layers of boron nitrate are used not only to separate two graphene layers but also to see how graphene reacts when it is completely encapsulated by another material.

Professor Geim said: "We are constantly looking at new ways of demonstrating and improving the remarkable properties of graphene."

"Leaving the new physics we report aside, technologically important is our demonstration that graphene encapsulated within boron nitride offers the best and most advanced platform for future graphene electronics. It solves several nasty issues about graphene's stability and

quality that were hanging for long time as dark clouds over the future road for graphene electronics.

We did this on a small scale but the experience shows that everything with graphene can be scaled up."

"It could be only a matter of several months before we have encapsulated graphene transistors with characteristics better than previously demonstrated."

Graphene is a novel two-dimensional material which can be seen as a monolayer of carbon atoms arranged in a hexagonal lattice.

Its remarkable properties could lead to bendy, touch screen phones and computers, lighter aircraft, wallpaper-thin HD TV sets and superfast internet connections, to name but a few.

**More information:** "Tunable metal–insulator transition in double-layer graphene heterostructures"

Provided by University of Manchester

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