Graphene reinvents the future

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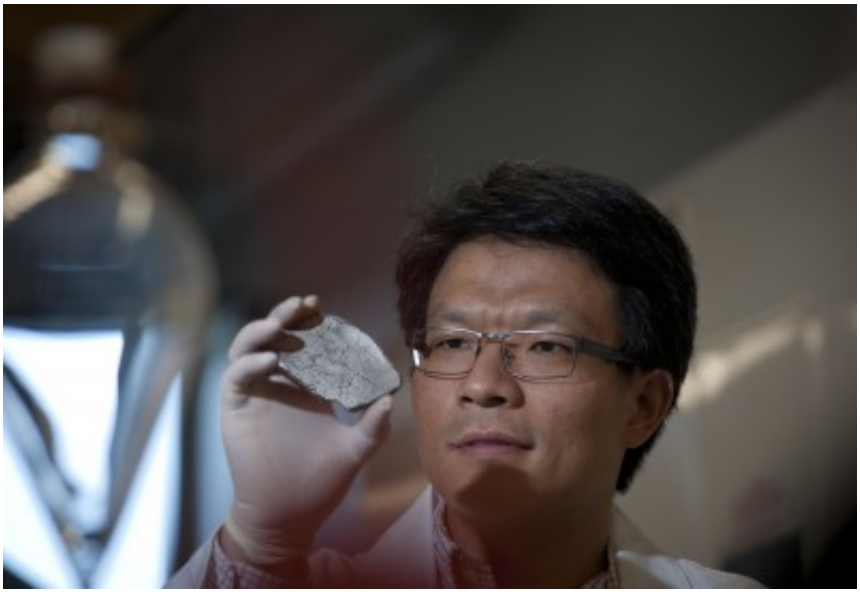

Professor Dan Li

For many scientists, the discovery of one-atom-thick sheets of graphene is hugely significant, something with the potential to affect just about every aspect of human activity and endeavour.

Graphene is "hidden" inside graphite, an ore that has not been particularly sought after in the past. But a few years ago, it revealed a secret. At the molecular level it is a unique two-dimensional molecule: an electrically conductive lattice-like layer just one carbon atom thick.

"We have opened a door and found a vast room with no walls or ceiling.

It is potentially limitless," said Professor Dan Li, of Monash University's Department of Materials Engineering.

Graphene has usually cautious physicists and chemists itching with excitement, mesmerised by the possibilities starting to take shape – from flexible electronics embedded into clothing, to biomedicine (imagine synthetic nerve cells), vastly superior forms of energy storage (tiny but immensely powerful batteries) and an array of new materials that could make many of today's common metals and polymers redundant.

But despite the extraordinary potential for graphene's properties, the stumbling block has been to get it into a useable form.

Professor Li has invented a cost-effective and scalable way to split graphite into microscopic graphene sheets and dissolve them in water. From this he has developed two new graphene technology platforms – the starting points for developing commercial applications. One is a graphene gel that works as a supercapacitor electrode, and the second is a 3-D porous graphene foam.

The graphene gel provides the same functionality as porous carbon – a material currently sourced from coconut husks for use in supercapacitors and other energy-conversion and storage technologies – but with vastly enhanced performance.

Supercapacitors have an expanding range of applications as their capabilities increase, from powering computer memory backup to powering electric vehicles.

Professor Li's team has also been able to give graphene a more functional 3-D form by engineering it into an elastic graphene foam that retains its extraordinary qualities.

Professor Li likened his developments to having invented bricks, and said it was time to bring in architects and builders to create new technologies based on his platforms.

"The opportunities now are limitless," he said.

Provided by Monash University