Surprise discovery could see graphene used to improve health

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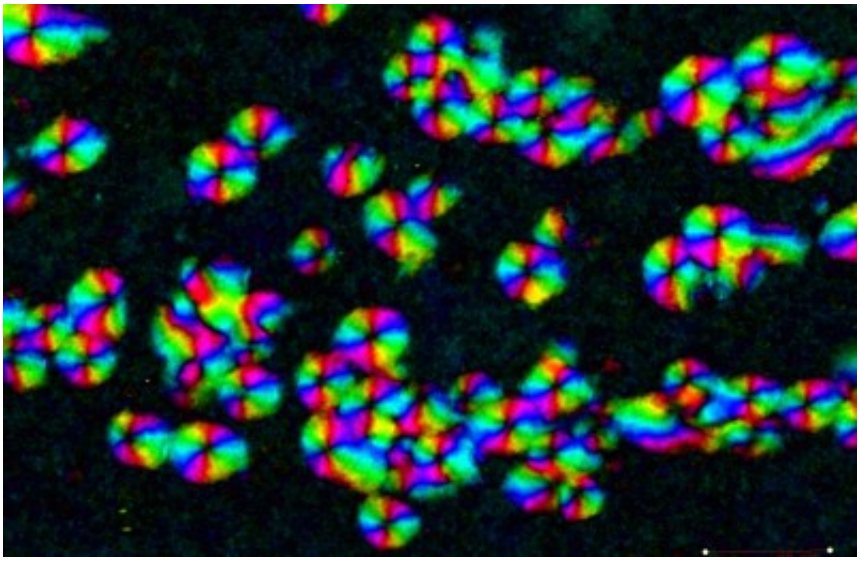

(Phys.org) —A chance discovery about the 'wonder material' graphene – already exciting scientists because of its potential uses in electronics, energy storage and energy generation – takes it a step closer to being used in medicine and human health.

Researchers from Monash University have discovered that graphene oxide sheets can change structure to become liquid crystal droplets spontaneously and without any specialist equipment.

With graphene droplets now easy to produce, researchers say this opens up possibilities for its use in drug delivery and disease detection.

The findings, published in the journal *ChemComm*, build on existing knowledge about graphene. One of the thinnest and strongest materials known to man, graphene is a 2D sheet of carbon just one atom thick. With a 'honeycomb' structure the 'wonder material' is 100 times stronger than steel, highly conductive and flexible.

Dr Mainak Majumder from the Faculty of Engineering said because graphene droplets change their structure in response to the presence of an external magnetic field, it could be used for controlled drug release applications.

"Drug delivery systems tend to use magnetic particles which are very effective but they can't always be used because these particles can be toxic in certain physiological conditions," Dr Majumder said.

"In contrast, graphene doesn't contain any magnetic properties. This combined with the fact that we have proved it can be changed into liquid crystal simply and cheaply, strengthens the prospect that it may one day be used for a new kind of drug delivery system."

Usually atomisers and mechanical equipment are needed to change graphene into a spherical form. In this case all the team did was to put the graphene sheets in a solution to process it for industrial use. Under certain PH conditions they found that graphene behaves like a polymer - changing shape by itself.

First author of the paper, Ms Rachel Tkacz from the Faculty of Engineering, said the surprise discovery happened during routine tests.

"To be able to spontaneously change the structure of graphene from

single sheets to a spherical assembly is hugely significant. No one thought that was possible. We've proved it is," Ms Tkacz said.

"Now we know that graphene-based assemblies can spontaneously change shape under certain conditions, we can apply this knowledge to see if it changes when exposed to toxins, potentially paving the way for new methods of disease detection as well."

Commonly used by jewelers, the team used an advanced version of a polarised light microscope based at the Marine Biological Laboratory, USA, to detect minute changes to grapheme.

Dr Majumder said collaborating with researchers internationally and accessing some of the most sophisticated equipment in the world, was instrumental to the breakthrough discovery.

"We used microscopes similar to the ones jewelers use to see the clarity of precious gems. The only difference is the ones we used are much more precise due to a sophisticated system of hardware and software. This provides us with crucial information about the organisation of graphene sheets, enabling us to recognise these unique structures," Dr Majumder said.

Dr Majumder and his team are working with graphite industry partner, Strategic Energy Resources Ltd and an expert in polarized light imaging, Dr. Rudolf Oldenbourg from the Marine Biological Laboratory, USA, to explore how this work can be translated and commercialised.

Mr Mark Muzzin, CEO of Strategic Energy Resources Ltd said the collaboration with Monash was progressing well.

"We are so pleased to be associated with Dr Majumder's team at Monash University. The progress they have made with our joint project has been

astonishing," he said.

The research was made possible by an ARC Linkage grant awarded to Strategic Energy Resources Ltd and Monash University and was the first linkage grant for graphene research in Australia.

Provided by Monash University

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