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Opportunity

To accelerate the development of graphene oxide foams, contact:

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Super-elastic graphene oxide foams

New method produces foams with extraordinary physical properties

The technology

- Highly porous graphene oxide foams, produced using a new fabrication method, can sustain loads more than 50,000 times their own weight over 1000 loading cycles, facilitating their broad commercial application.

Market need

- The commercial adoption of graphene is currently limited by manufacturing processes that are unable to mass-produce graphene materials efficiently and cost-effectively.

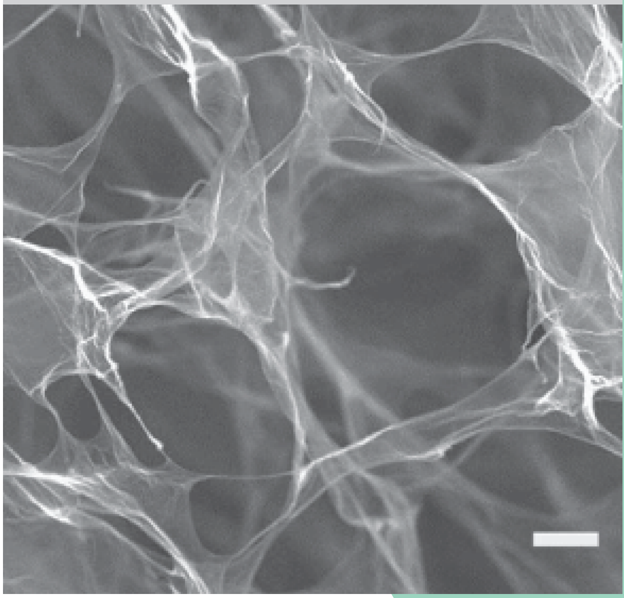
Technology status

- Proof-of-concept has demonstrated the feasibility of scalable production of foams with improved physical properties. Testing has shown that the foams can be used as flexible sensors with high sensitivity to pressures applied at a broad range of frequencies.

Market Need

Graphene is an extremely tough, flexible and light material that conducts heat and light efficiently. These characteristics make graphene an ideal substitute for existing materials in applications such as conductors, composites, coatings, sensors and catalysts. However, the widespread commercial adoption of graphene materials has been hindered in part by manufacturing limitations.

Processes such as exfoliation and chemical vapour deposition cannot produce defect-free graphene materials efficiently and cost-effectively at the volumes necessary for commercial application. The move towards the use of graphene oxide as an alternative is seen as a viable alternative due to lower manufacturing costs, higher stability and functionality. However, graphene oxide materials are generally brittle and prone to failure which limits it commercial viability.



Picture: Researcher's own.

Solution

University of Melbourne researchers, led by Professor Dan Li, have fabricated highly porous graphene oxide foams using a newly developed freeze-casting method. The simple, scalable method is the first to enable randomly structured graphene oxide foams to retain graphene's superior structural and physical properties, including mechanical toughness, good electrical conductivity and high energy adsorption. It does this using hierarchical control over the material's porosity.

Due to their unique structure – and despite their ultra-low density (5.10 mg cm–3) – the graphene oxide foams have extraordinary physical properties, including; the ability to sustain structural integrity under loads of more than 50,000 times their own weight over 1000 loading cycles, exhibit nearly frequency-independent piezoresistive behaviours and can conduct instantaneous and high-fidelity electrical responses to dynamic pressures that range in frequency from quasi-static to 2000 Hz. The foams are also highly sensitive, detecting pressures as low as 0.082 Pa.

Technology and IP status

Proof-of-concept studies have demonstrated that the graphene oxide foams are applicable as flexible, ultra-light, broad-frequency (0.03–500 Hz), high-fidelity sensors.

University of Melbourne researchers are exploring applications that exploit the graphene oxide foams' unique properties in uses such as medical sensors, separation membranes, and bioengineering.

One example of a successful application is using a graphene oxide foam as an ultrasensitive sensor, which can be stretched and manipulated while maintaining its dynamic compression response and electrical conductivity.

A patent application detailing the composition and structure of the graphene oxide foams, and the method to produce them, has been filed.

Tech name and number:	2012-086 Graphene foams
Researchers:	Professor Dan Li, Dr Ling Qiu
Publications:	Qiu L, Coskun MB, Tang Y, Liu JZ, Alan T, Ding J, Truong V-T, Li D. 2016. Ultrafast dynamic piezoresistive response of graphene-based cellular elastomers. Advanced Materials 28: 194-200
Patents:	PCT/AU2013/000939 filed on 23 August 2013.
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