New research finds graphene can act as surfactant

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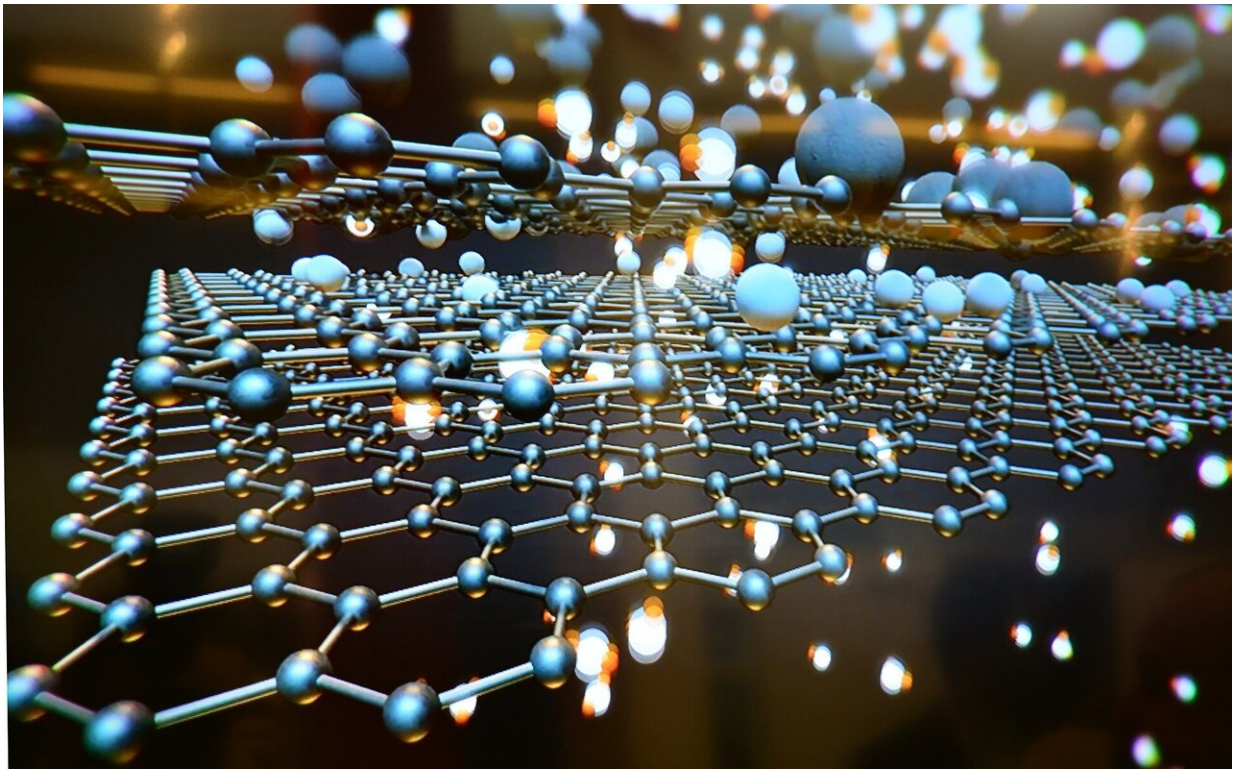

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New research into graphene flakes has discovered that the material can act as a surfactant, for the first time demonstrating how it can be a versatile 2-D stabiliser ideal for many industrial applications from oil extraction to paper processing.

Pristine graphene is completely water repellent, but the researchers found that at a particular size (below 1-micron lateral size), amphiphilic behaviour is possible. This graphene flake attracts water at its edges but repels it on its surface, making it a new generation of surfactant that can stabilise oil and water mixtures.

Krzysztof Koziol, professor of composites engineering and head of the Enhanced Composites and Structures Centre at Cranfield University, said, "This new finding, and clear experimental demonstration of surfactant behaviour of graphene, has exciting possibilities for many industrial applications. We produced pristine graphene flakes, without application of any surface treatment, at a specific size which can stabilise water/oil emulsions even under high pressure and high temperature. Unlike traditional surfactants which degrade and are often corrosive, graphene opens new level of material resistance, can operate at high pressures, combined with high temperatures and even radiation conditions; and we can recycle it. Graphene has the potential to become a truly high-performance surfactant."

The qualities of this graphene flake make it an ideal material to be combined with water and used as a surfactant in environmentally friendly extraction of minerals, crude oil and other ores from rock. There is also need for better quality surfactants as plasticisers for fluid concrete, additives in flameproofing and waterproofing as well as lubricants in drilling fluids to improve effectiveness of drilling operations.

The surfactants currently in use are corrosive and degrade under intense heat and pressured environments. Graphene offers a more stable, cost-effective and environmentally friendly way to operate in harsh geological or chemical environments.

Mike Payne, Professor of Computational Physics at Cambridge

University, who was one of the co-researchers for this project, said: "There is an enormous volume of scientific research on graphene. In some ways this is to be applauded but it can also lead to conflicting results in the literature—as in the present example of whether graphene flakes are hydrophobic or amphiphilic. Our work combines exciting experiments on well characterised material with a range of theoretical simulations, including quantum mechanical calculations. Together they provide a detailed understanding of the properties of the graphene flakes and a definitive answer to this question."

More information: Anna W. Kuziel et al. The True Amphipathic Nature of Graphene Flakes: A Versatile 2D Stabilizer, *Advanced Materials* (2020). DOI: 10.1002/adma.202000608

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