Research team develops cost-effective technique for mass production of high-quality graphene

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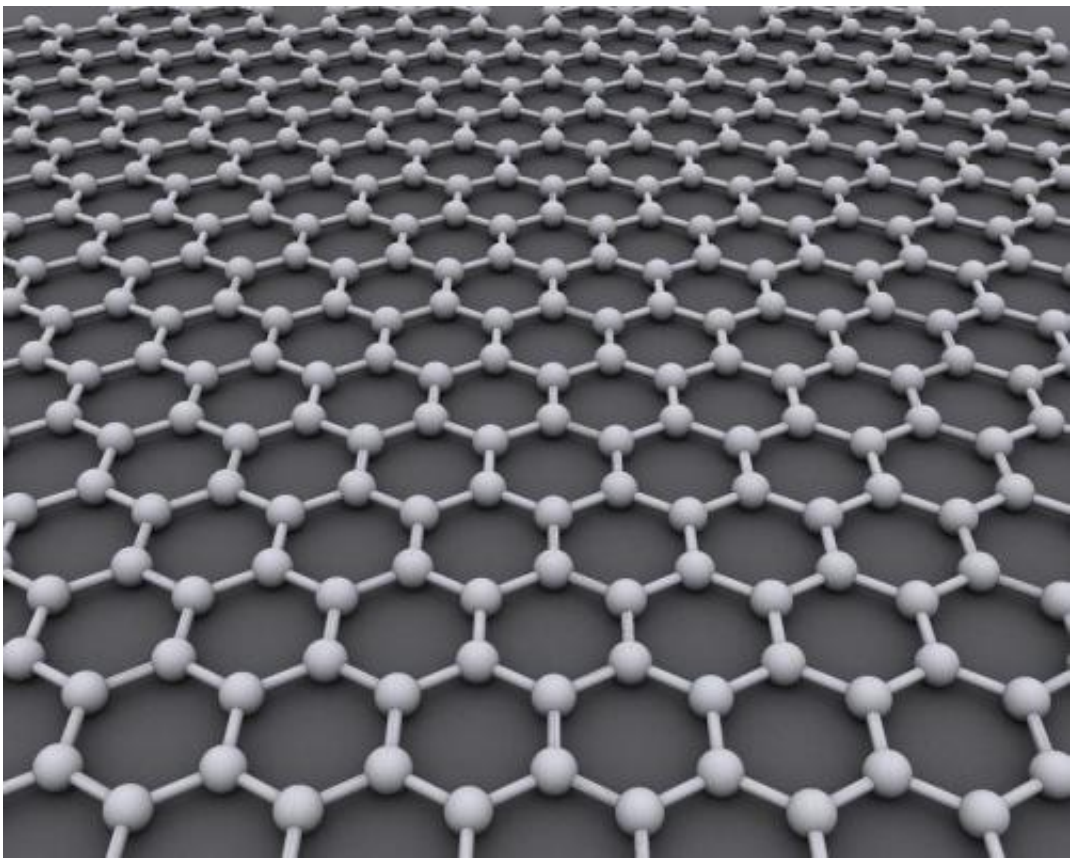

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A research team led by the National University of Singapore (NUS) have developed an economical and industrially viable strategy to produce

graphene. The new technique addresses the long-standing challenge of an efficient process for large-scale production of graphene, and paves the way for sustainable synthesis of the material.

Graphene is a two-dimensional material with a honeycomb structure of only one atom thick. Dubbed as the material of the future, graphene exhibits unique electronic properties that can potentially be employed for a wide range of applications such as touch screens, conductive inks and fast-charging batteries. The difficulty to produce high-quality graphene affordably on a large scale, however, continues to pose hindrance to its widespread adoption by industries.

The conventional method of producing graphene utilises sound energy or shearing forces to exfoliate graphene layers from graphite, and then dispersing the layers in large amounts of organic solvent. As insufficient solvent causes the graphene layers to reattach themselves back into graphite, yielding one kilogram of graphene currently requires at least one tonne of organic solvent, making the method costly and environmentally unfriendly.

Producing graphene with 50 times less solvent

The NUS-led development research team, on the other hand, uses up to 50 times less solvent. This is achieved by exfoliating pre-treated graphite under a highly alkaline condition to trigger flocculation, a process in which the graphene layers continuously cluster together to form graphene slurry without having to increase the volume of solvent. The method also introduces electrostatic repulsive forces between the graphene layers and prevents them from reattaching themselves.

The resulting graphene slurry be easily separated into monolayers when required or stored away for months. The slurry can also be used directly to 3-D-print conductive graphene aerogels, an ultra-lightweight sponge-

like material that can be used to remove oil spill in the sea.

Professor Loh Kian Ping from the Department of Chemistry at NUS Faculty of Science who is also the Head of 2-D Materials Research at the NUS Centre for Advanced 2-D Materials led the research. He said, "We have successfully demonstrated a unique exfoliation strategy for preparing high quality graphene and its composites. Our technique, which produces a high yield of crystalline graphene in the form of a concentrated slurry with a significantly smaller volume of solvent, is an attractive solution for industries to carry out large scale synthesis of this promising material in a cost-effective and sustainable manner."

More information: Lei Dong et al. A non-dispersion strategy for large-scale production of ultra-high concentration graphene slurries in water, *Nature Communications* (2018). DOI: 10.1038/s41467-017-02580-3

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