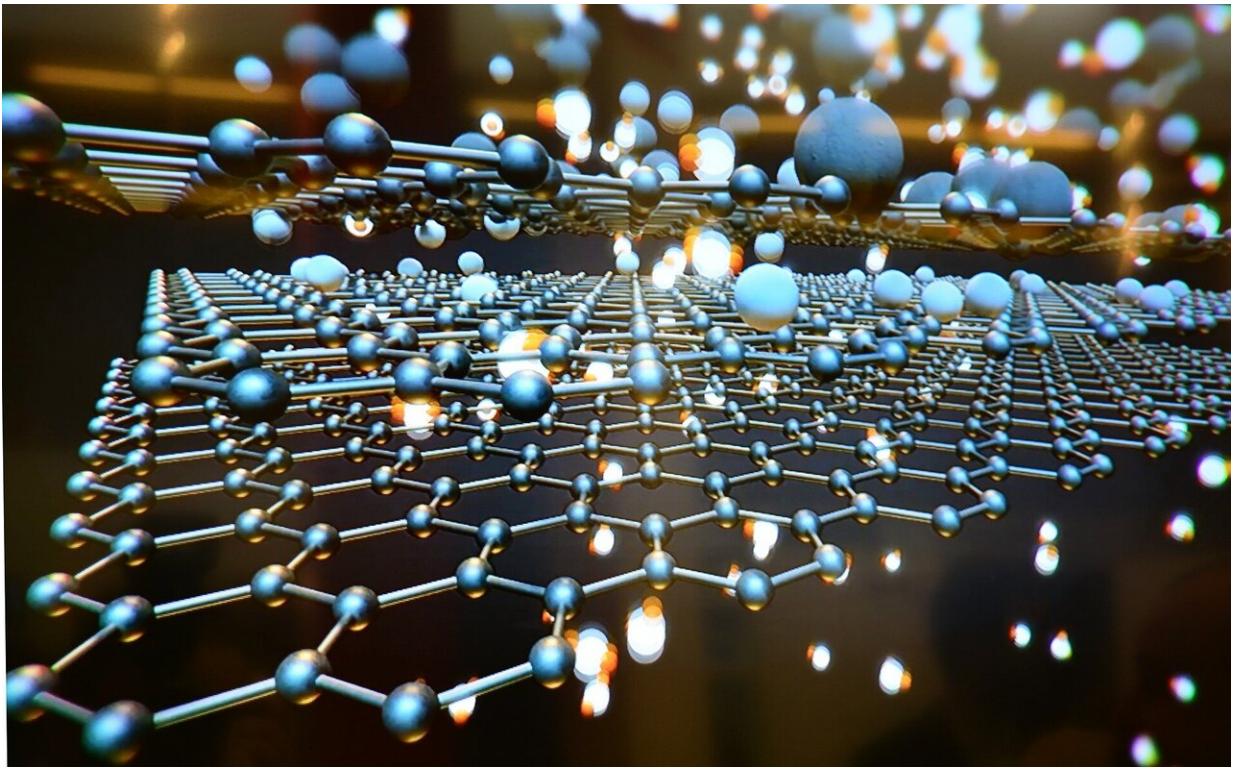


# New tech extracts potential to identify quality graphene cheaper and faster

August 26 2020

---



Credit: CC0 Public Domain

Engineers at Australia's Monash University have developed world-first technology that can help industry identify and export high quality graphene cheaper, faster and more accurately than current methods.

Published today in international journal *Advanced Science*, researchers used the data set of an optical microscope to develop a machine-learning algorithm that can characterize graphene properties and quality, without bias, within 14 minutes.

This technology is a game changer for hundreds of graphene or graphene oxide manufacturers globally. It will help them boost the quality and reliability of their graphene supply in quick time.

Currently, manufacturers can only detect the quality and properties of graphene used in a product after it has been manufactured.

Through this algorithm, which has the potential to be rolled out globally with commercial support, graphene producers can be assured of quality product and remove the time-intensive and costly process of a series of characterisation techniques to identify graphene properties, such as the thickness and size of the atomic layers.

Professor Mainak Majumder from Monash University's Department of Mechanical and Aerospace Engineering and the Australian Research Council's Hub on Graphene Enabled Industry Transformation led this breakthrough study.

Study co-authors are Md. Joynul Abedin and Dr. Mahdokht Shaibani (Monash, Department of Mechanical and Aerospace Engineering), and Titon Barua (Vimmaniac Ltd., Bangladesh).

"Graphene possesses extraordinary capacity for electric and thermal conductivity. It is widely used in the production of membranes for [water purification](#), [energy storage](#) and in smart technology, such as weight loading sensors on traffic bridges," Professor Majumder said.

"At the same time, graphene is rather expensive when it comes to usage

in bulk quantities. One gram of high quality graphene could cost as much as \$1,000 AUD (\$720 USD) a large percentage of it is due to the costly quality control process.

"Therefore, manufacturers need to be assured that they're sourcing the highest quality graphene on the market. Our technology can detect the properties of graphene in under 14 minutes for a single dataset of 1936 x 1216 resolution. This will save manufacturers vital time and money, and establish a competitive advantage in a growing marketplace."

Discovered in 2004, graphene is touted as a wonder material for its outstanding lightweight, thin and ultra-flexible properties. Graphene is produced through the exfoliation of graphite. Graphite, a crystalline form of carbon with atoms arranged hexagonally, comprises many layers of graphene.

However, the translation of this potential to real-life and usable products has been slow. One of the reasons is the lack of reliability and consistency of what is commercially often available as graphene.

The most widely used method of producing graphene and graphene oxide sheets is through liquid phase exfoliation (LPE). In this process, the single layer sheets are stripped from its 3-D counterpart such as graphite, graphite oxide film or expanded graphite by shear-forces.

But, this can only be imaged using a dry sample (i.e. once the graphene has been coated on a glass slide).

"Although there has been a strong emphasis on standardization guidelines of graphene materials, there is virtually no way to monitor the fundamental unit process of exfoliation, product quality varies from laboratory to laboratory and from one manufacturer to other," Dr. Shaibani said.

"As a result, discrepancies are often observed in the reported property-performance characteristics, even though the material is claimed to be graphene.

"Our work could be of importance to industries that are interested in delivering high quality graphene to their customers with reliable functionality and properties. There are a number of ASX listed companies attempting to enter this billion-dollar market, and this technology could accelerate this interest."

Researchers applied the algorithm to an assortment of 18 graphene samples—eight of which were acquired from commercial sources and the rest produced in a laboratory under controlled processing conditions.

Using a quantitative polarized optical microscope, researchers identified a technique for detecting, classifying and quantifying exfoliated graphene in its natural form of a dispersion.

To maximize the information generated from hundreds of images and large numbers of samples in a fast and efficient manner, researchers developed an unsupervised [machine-learning algorithm](#) to identify data clusters of similar nature, and then use image analysis to quantify the proportions of each cluster.

Mr Abedin said this method has the potential to be used for the classification and quantification of other two-dimensional materials.

"The capability of our approach to classify stacking at sub-nanometer to micrometer scale and measure the size, thickness, and concentration of exfoliation in generic dispersions of graphene/graphene oxide is exciting and holds exceptional promise for the development of energy and thermally advanced products," Mr Abedin said.

Professor Dusan Losic, Director of Australian Research Council's Hub on Graphene Enabled Industry Transformation, said: "These outstanding outcomes from our ARC Research Hub will make significant impact on the emerging multibillion dollar graphene industry giving graphene manufacturers and end-users new a simple quality control tool to define the quality of their produced [graphene](#) materials which is currently missing."

**More information:** Md. Joynul Abedin et al, A High Throughput and Unbiased Machine Learning Approach for Classification of Graphene Dispersions, *Advanced Science* (2020). [DOI: 10.1002/advs.202001600](https://doi.org/10.1002/advs.202001600)

Provided by Monash University

Citation: New tech extracts potential to identify quality graphene cheaper and faster (2020, August 26) retrieved 8 May 2024 from <https://phys.org/news/2020-08-tech-potential-quality-graphene-cheaper.html>

<p>This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.</p>
------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------