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Science Research

Materials: Inspiration from Nature on Graphene Film Production
Novel bio-inspired way to grow high-quality graphene for high-end electronic devices

A team of researchers led by Professor Loh Kian Ping, who heads the Department of Chemistry at the NUS Faculty of Science, has developed an innovative one-step method to grow and integrate high-quality graphene on silicon and other stiff substrates, opening up opportunities for graphene to be used in high-value electronic applications.

This breakthrough, inspired by how beetles and tree frogs keep their feet attached to submerged leaves, is the first published technique that accomplishes both the growth and transfer steps of graphene onto a silicon wafer.

The innovation was first published online in the prestigious scientific journal Nature on 11 December 2013.

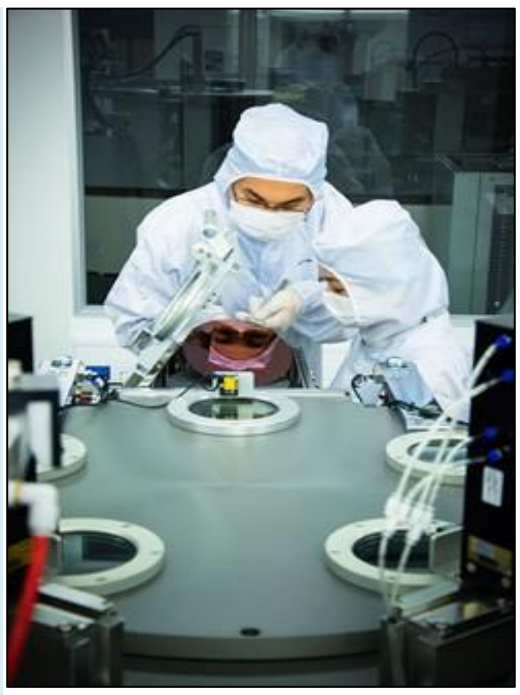

Figure 1: Researchers at NUS Graphene Research Centre

Drawing Inspiration from Beetles and Tree Frogs

Although graphene has outstanding electronic, optical and mechanical properties, the production of high quality wafer-scale graphene films has many challenges, among which is the absence of a suitable growth technique to integrate effectively with other electronic components for use in the semiconductor industries.

To address this issue, the NUS team draw an inspiration from beetles and tree frogs that use tiny bubbles on their feet to stick to submerged leaves. These tiny bubbles form capillary bridges and it tends to keep the creature's feet adhered to the leaves underwater – similar to how sandcastles are held together. The team mimicked this effect and developed a process known as "face-to-face transfer" - such that the grown graphene film is able to adhere to the silicon substrate.

The technique involve using a copper-based catalyst on silicon wafer for the graphene growth. After growth, the copper catalyst is removed via etching. In conventional approaches, the graphene layer will delaminate. The trick is to pre-treat the wafer by injecting gases into the wafer prior to the growth process. This facilitates the formation of capillary bridges which holds the graphene to the silicon wafer when the copper catalyst is removed.

The researchers are now focusing on producing larger pieces of graphene films and extending this methodology to other two dimensional materials. They are also in discussion with industry partners on the commercialization potential.

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