Breakthrough synthesis method to speed commercialization of graphene

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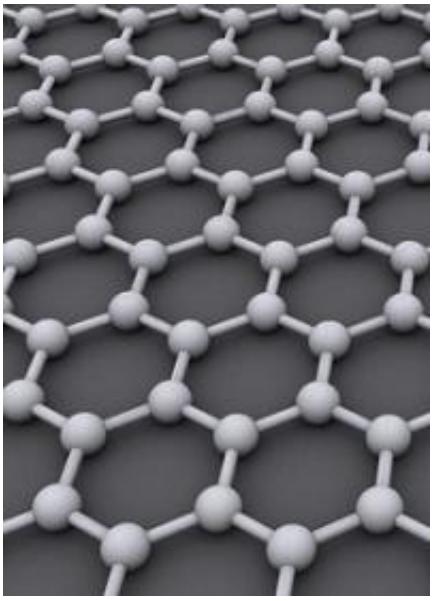

Grafene consists of a single layer of carbon atoms. Credit: Wikimedia Commons

Samsung Electronics announced a breakthrough synthesis method to speed the commercialization of graphene, a unique material ideally suited for electronic devices. Samsung Advanced Institute of Technology (SAIT), in partnership with Sungkyunkwan University, became the first in the world to develop this new method.

"This is one of the most significant breakthroughs in graphene research in history," said the laboratory leaders at SAIT's Lab. "We expect this discovery to accelerate the commercialization of graphene, which could

unlock the next era of consumer electronic technology."

Graphene has one hundred times greater electron mobility than silicon, the most widely used material in semiconductors today. It is more durable than steel and has high heat conductibility as well as flexibility, which makes it the perfect material for use in flexible displays, wearables and other next generation electronic devices.

Through its partnership with Sungkyungkwan University's School of Advanced Materials Science and Engineering, SAIT uncovered a new method of growing large area, single crystal wafer scale graphene. Engineers around the world have invested heavily in research for the commercialization of graphene, but have faced many obstacles due to the challenges associated with it. In the past, researchers have found that multi-crystal synthesis – the process of synthesizing small graphene particles to produce large-area graphene – deteriorated the electric and mechanical properties of the material, limiting its application range and making it difficult to commercialize.

The new method developed by SAIT and Sungkyunkwan University synthesizes large-area graphene into a single crystal on a semiconductor, maintaining its electric and mechanical properties. The new method repeatedly synthesizes single crystal graphene on the current semiconductor wafer scale.

Over the past several decades, the growth of the semiconductor industry has been driven by the ability to grow the area of a silicon wafer, while steadily decreasing the process node. In order to commercialize graphene to displace the industry's reliance on silicon, it is vital to develop a new method to grow a single crystal graphene into a large area.

The research results will be published in the April 4 issue of *Science* magazine and *Science Express*, one of the world's most prestigious

science journals.

Samsung and Sungkyunkwan University have been partnering in the field of nano research since 2006. This breakthrough is a testament to the strengths of the two institutions, who together were able to successfully achieve results that could become a driver of next generation technology.

More information: Wafer-Scale Growth of Single-Crystal Monolayer Graphene on Reusable Hydrogen-Terminated Germanium, *Science* DOI: 10.1126/science.1252268

ABSTRACT
The uniform growth of single-crystal graphene over wafer-scale areas remains a challenge in the commercial-level manufacturability of various electronic, photonic, mechanical, and other devices based on graphene. Here, we describe wafer-scale growth of wrinkle-free single-crystal monolayer graphene on silicon wafer using a hydrogen-terminated germanium buffer layer. The anisotropic twofold symmetry of the germanium (110) surface allowed unidirectional alignment of multiple seeds, which were merged to uniform single-crystal graphene with predefined orientation. Furthermore, the weak interaction between graphene and underlying hydrogen-terminated germanium surface enabled the facile etch-free dry transfer of graphene and the recycling of the germanium substrate for continual graphene growth.

Provided by Samsung Electronics