Transfer-free Growth of Graphene on Non-metal Substrates

Summary:
KU researchers in Dr. Judy Wu’s lab have developed a novel process for large-area graphene growth directly on non-metal substrate templates.

Overview:
In prior methods of growing graphene using chemical vapor deposition (CVD), metal foils are necessary to catalyze decomposition of hydrocarbons (as carbon sources) on the surface of the metal foils, and hence facilitate graphene nucleation and evolution. The CVD graphene has to be transferred to dielectric surfaces for most applications. The transfer process requires multiple steps of chemical treatment to dissolve metal foils, to rinse off residues, and to eliminate the polymer supporting layer used to carry graphene during the transfer. Many additional defects form during this transfer process, and there are difficulties in scaling up the process for large size sheets of graphene. Direct growth of graphene on dielectric surfaces is therefore desired for practical applications. The KU method allows such direct growth, avoiding transfer defects and providing for a superior scalable approach.

Application:
Graphene growth on dielectric substrates for various applications including electronics, optics, and optoelectronics.

How It Works:
In this invention, a Cu film is evaporated onto textured MgO templates that are generated using ion beam assisted deposition (IBAD). The Cu film dewets during heating and at the graphene growth temperatures. Nucleation of graphene has been observed on the islands surrounded by the retreating Cu. Graphene growth from the nuclei continues following the retreating Cu until the entire surface of the IBAD MgO is covered with graphene.

Benefits:
This method can be applied to almost any substrate that can sustain a graphene growth temperature near 1000 degrees C. The resulting graphene layer has fewer defects than graphene produced with existing methods and subsequently transferred to the required substrate.

Why It Is Better:
The elimination of the need to transfer graphene reduces the possibility of defects. The process also eliminates the need for high temperature hydrogen annealing and allows a slow H2 flow rate that provides enhanced control of the graphene growth process.

Inventors: Judy Wu, Jianwei Liu, Vladimir Matias, Chunrui Ma