# Producing graphene layers using crystallization

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(PhysOrg.com) -- Ever since it's relatively recent discovery, graphene has generated a great deal of interest. Graphene is extracted from graphite in many cases, and consists of a sheet of carbon atoms bound together in a hexagonal lattice. Because graphene is only one atomic layer thick, it is of interest for nanostructures. Additionally, its electrical and optical properties make it a possible alternative to materials currently used in electronics and in sensors. There is even speculation about the usefulness of graphene for energy applications. Graphene sheets can be layered or patterned to get different properties and perform different functions.

Unfortunately, producing graphene is a complicated process. Also, controlling the thickness of layered graphene sheets has been somewhat difficult up to this point. In an effort to address this, a group at the University of California, Berkeley has come up with a way to control the thickness of graphene produced. The process is described in *Applied Physics Letters*: “Metal-catalyzed crystallization of amorphous carbon to graphene.”

“It is desirable to control the layers of graphene that you have,” Ali Javey tells *PhysOrg.com*. He is the head of this project at UC Berkeley. “Our approach is to convert amorphous carbon to crystalline graphene. We found that by controlling the initial thickness of the amorphous carbon used, the thickness of the graphene can be controlled. Our process makes it possible to better determine what we can get from graphene in terms of properties for useful applications.”

Javey and his team used a process different from what has been used until now to produce graphene layers. “For the most part, the chemical vapor deposition process has been used,” he explains. “You have a catalytic layer on a substrate, and you heat the sample while flowing a gas phase carbon source over it that decomposes on the surface. However, this process is not closed, and it draws on the virtually unlimited number of carbon atoms in the environment. Because an infinite amount of carbon is drawn on, it is difficult to control how many layers you get.”

The key to gaining more control over graphene layers is creating an environment with a limited amount of carbon. “In our process, we use a solid carbon source which is deposited with finite thickness on the substrate. Then we put the catalytic layer on top. Because we control the initial thickness of carbon, we can control the number of graphene layers we have,” Javey says.

He continues: “This is important because thickness directly affects the electrical, optical and mechanical properties of graphene. Being able to control graphene layers would allow us to create graphene for specific purposes, increasing the overall utility of its production.”

The next step is to verify that graphene produced in this manner is of the same quality as graphene produced through chemical vapor deposition. “It looks promising,” Javey insists. “We’ve used Raman spectroscopy to compare, and from that standpoint, the quality is good. But we are starting an electrical analysis as well, in order to more fully assess the quality.”

Going forward, Javey expects that this process could help graphene gain wider use. “There are a number of possible applications for graphene, and once we understand it better, we should be able to make good use of it.”

Other members of the team included Roya Maboudian and her research group at Berkeley.

**More information:** Maxwell Zheng, et. al., “Metal-catalyzed crystallization of amorphous carbon to graphene,” Applied Physics Letters (2010). Available online: link.aip.org/link/?APPLAB/96/063110/1