Researchers demonstrate how graphene-metal interfaces influence electrons

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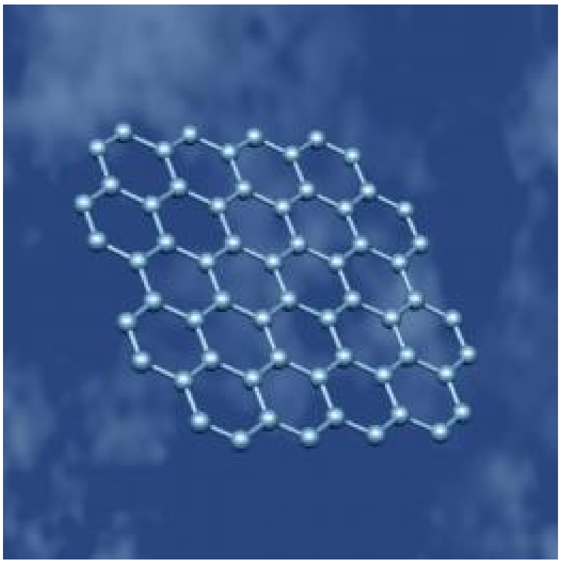

Artistic impression of graphene molecules. Credit: University of Manchester

(Phys.org)—Graphene, an atom-thin layer of pure carbon, appears to have many of the properties needed to usher in the next generation of electronic devices. The next step in building those devices, however, requires creating junctions that connect graphene to the "external world" through at least two metal wires. A "two-terminal junction" is a graphene "ribbon" with two metal contacts. A University of Arkansas researcher and his colleagues have developed a better understanding of how these graphene-metal interfaces affect the movement of electrons through two-terminal junctions.

Salvador Barraza-Lopez, assistant professor of physics, Markus Kindermann of Georgia Institute of Technology and M.Y. Chou of Georgia Tech and the Academia Sinica in Taiepi, Taiwan, report their findings in the journal Nano Letters.

"If you want to use graphene for devices, you want to understand what will happen with metal contacts," Barraza-Lopez said.

Current theories about graphene devices assume that the contacts that move electricity from one point to another will also be composed of "doped" graphene, meaning that the contacts have a large amount of electronic charge, as actual metals would have. But contacts in real devices are made of transition metals, and those metal contacts will form bonds with graphene.

"When you form covalent bonds, you destroy the unique electronic properties of graphene," Barraza-Lopez said. "So we thought it was important to calculate the transport of electrons going beyond the assumption that the contacts themselves are (doped) graphene."

He and his colleagues set out to look at how electrons can move through graphene junctions with titanium, which is used by many experimental teams as a contact with graphene: they considered the material properties of actual junctions, and contrasted their findings with more basic models already available. Their calculations were done using the principles of quantum mechanics and state-of-the-art computational facilities.

Within quantum mechanics, the electrons at these graphene-metal junctions behave much like a light beam does when it is shone on a crystal—some of the light scatters and some of it goes through. For graphene junctions the electronic transparency of the material indicates how many of the electrons on one contact make it through the other metal contact. In this work, the researchers have provided the most accurate calculations of the electronic transparency of realistic graphene-metal junctions to date.

"Our results shed light on the complex behavior of graphene junctions … and pave the way for realistic design of potential electronic devices," the researchers wrote.

More information: *Nano Lett.* 12, pp 3424 [2012]

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