FAST BREAKING PAPERS - 2008

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Alessandra Lanzara talks with *ScienceWatch.com* and answers a few questions about this month's Fast Breaking Paper in the field of Materials Science.

Article Title: Substrate-induced bandgap opening in epitaxial graphene
Authors: Zhou, SY;Gweon, GH;Fedorov, AV;First, PN;De Heer, WA; Lee, DH;Guinea, F;Neto, AHC; **Lanzara, A**
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* Univ Calif Berkeley, Dept Phys, Berkeley, CA 94720 USA.
(addresses have been truncated)

SW: Why do you think your paper is highly cited?

Graphene, a single layer of carbon atoms arranged in a honeycomb lattice, has shown great application potential as a host material for next-generation electronic devices, with properties that may exceed current silicon-based technology. For example, electrons in graphene can move 100 times faster than those in silicon. However, despite its intriguing properties, graphene is a zero-gap semiconductor, which limits its application.

Therefore, how to engineer graphene in order to have a finite bandgap is an important issue that needs to be resolved. Although several approaches have been proposed so far, each one requires complex engineering of the graphene sheet down to a few nanometers and hence, a low reproducibility rate. Our work proposes a novel and relatively easy way to induce a finite bandgap in graphene by epitaxially growing graphene on a substrate.

SW: Does it describe a new discovery, methodology, or synthesis of knowledge?

Although the epitaxial growth of graphene was studied previously, our work is the first one to show how one can use the graphene/substrate interaction to induce a finite bandgap in the graphene spectra. This provides a much easier method to induce a bandgap in a large epitaxial graphene sample without requiring the complicated engineering of graphene nanostructures.

SW: Would you summarize the significance of your paper in layman's terms?

Our study points out that graphene-substrate interaction can be an effective way of engineering the bandgap in graphene, and also suggests that, by growing graphene on different substrates, tuning of the bandgap in a large range could possibly be achieved.

SW: How did you become involved in this research, and were there any problems along the way?

Lead author: Shuyun Zhou

I have been working on high-temperature superconductors for 10 years. It is an intriguing system which shares many similarities in its fundamental electronic structure with that of graphene.

When Shuyun Zhou joined my group in 2002 for her Ph.D., she immediately realized the potential of carbon materials and how they could be used to help us understand several of the still obscure aspects of the physics of high-temperature superconductors.

She soon became involved working with graphite—an infinite stack of graphene layers—as graphene had not been discovered at that time. With her enthusiasm and determination, she brought significant and novel contributions to a field which, in some ways, was thought of as old-fashioned.

Soon thereafter, graphene was discovered and we both were quite prepared to expand the parameters of our previous research so as to include this emerging field. The extensive application potential of graphene was another important factor which had attracted us immediately to its study and also led to the idea of how to engineer graphene in order to tune a finite bandgap in its electronic spectra.

SW: Where do you see your research leading in the future?

Graphene is a new emerging material which has the potential to marry the high-quality performance of our best semiconductors to the novel functionality of our best nanostructures, thus promising revolutionary new applications that span a broad range of technologies and have the potential to change our world.

Because of this, my research group is currently involved in several aspects of the physics of graphene: from exploring new ways of synthesizing graphene on a desired substrate, which will also allow a more targeted control on the engineering of the gap, using graphene engineered with magnetic systems for spintronics applications, and to combine graphene with other materials in order to generate high-strength materials and new systems for use in alternative energy.

SW: Do you foresee any social or political implications for your research?

I hope that, with more research activities turning toward graphene bandgap engineering, we can eventually achieve a finer control of semiconducting graphene with a bandgap tunable in a large energy range. This should eventually make graphene quite useful in the manufacture of electronic devices and also in the making of solar cells.

Professor Alessandra Lanzara
Department of Physics
University of California Berkeley
Berkeley, CA, USA
Web ¦ See also

Keywords: graphene, graphene sheet, a single layer of carbon atoms arranged in a honeycomb lattice, host material for next-generation electronic devices, silicon-based technology, finite bandgap, graphene substrate interaction, epitaxially growing graphene on a substrate, graphene nanostructures, graphene-substrate interaction, physics of high-temperature superconductors.

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