FAST BREAKING PAPERS - 2008

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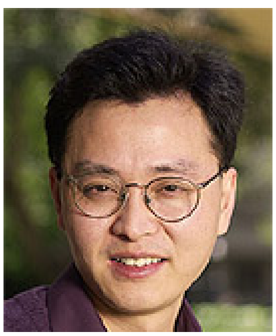
Hongjie Dai talks with *ScienceWatch.com* and answers a few questions about this month's Fast Breaking Paper in the field of Chemistry.



Article Title: Chemically derived, ultrasmooth graphene nanoribbon semiconductors
Authors: Li, XL;Wang, XR;Zhang, L;Lee, SW;Dai, HJ
Journal: SCIENCE
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SW: Why do you think your paper is highly cited?

This is the first time that graphene nanoribbons with true nanometer width and very smooth edges were made. And it is the first experimental demonstration showing that all the sub-10nm ribbons are semiconducting at room temperature. This proves the theory that all graphene nanoribbons with very narrow width are semiconducting, and puts graphene nanoribbons at the forefront of making real field-effect transistors for computer chips or other electronic devices.

Because the graphene nanoribbon is a new type of electronic material and also a promising candidate to replace silicon in future electronics, it also offers a number of things for scientists to play with. I think this paper is of primary interest to chemists, material scientists, experimental and theoretical physicists, and also to electrical engineers. This is probably why it is being highly cited.

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

This paper describes a new discovery. We developed a chemically derived method to make graphene nanoribbons with a very smooth edge and a width ranging from about 50nm to sub-10nm. We found that all these sub-10nm graphene ribbons are semiconductors and gave a high on/off ratio field-effect transistor at room temperature, which proved previous theoretical predictions.

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

We developed a chemical method to make a new type of material with high-quality, well-defined structure, and very narrow width (10-9nm). This kind of material might be used to make future electronic devices when silicon has met its limits.

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

Our group has always worked to achieve pure semiconducting carbon nanotubes and assemble/align them into field-effect transistor arrays for future nano-electronics. We have already made great progress.

Graphene nanoribbons could be looked at as unzipped single-wall carbon nanotubes, only all are semiconducting when they have a very narrow width. This enabled graphene nanoribbons to be another kind of promising material for use in future nanoelectronics. Thus, we began to work in the field of graphene nanoribbons, where it is quite difficult to separate graphene sheets into a freestanding form from bulk graphite. As the yield of a graphene nanoribbon is not very high, we spent quite a bit of time in trying to improve the ribbon yield.

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

We developed a chemical method to make graphene nanoribbons that could be transformed into good field-effect transistors. We are trying to improve the graphene nanoribbon yield and the ribbon quality, which then might lead to a bottom-up method of assembly for making logical circuits.

Our research has helped lead many other scientists toward the development of newer methods for making sub-10nm graphene nanoribbons and also in the investigation of their physical properties. We believe we will continue to be a leader in the area of making logical circuits, and even computer chips, using these sub-10nm graphene nanoribbons.

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

Our graphene nanoribbons could possibly be used in future graphene-based electronics such as computer chips or gas sensors.

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Related information:

- View a Research Front Map from the Special Topic of Graphene titled: "Graphene Nanoribbons." Dia is also listed in the 2-year top 20 papers for the Special Topic of Graphene.
- Emerging Research Front and New Hot Paper comments from Hongjie Dai.
- From the Stanford News Service, Jan. 2008.
- Hongjie Dai's research lab at Stanford University

Keywords: graphene nanoribbons, field-effect transistors, electronic devices, graphene nanoribbon, silicon, sub-10nm graphene ribbons, semiconductors, high on/off ratio field-effect transistor, room temperature, field-effect transistor arrays, nano-electronics, graphene-based electronics, computer chips, gas sensors.