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TRACKING TRENDS & PERFORMANCE IN BASIC RESEARCH

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Special Topics : Graphene : Motohiko Ezawa - Special Topic of Graphene

AUTHOR COMMENTARIES - From Special Topics

Graphene - December 2008

Interview Date: March 2009



Motohiko Ezawa

From the Special Topic of [Graphene](#)

In our Special Topic on Graphene, the paper "Peculiar width dependence of the electronic properties of carbon nanoribbons" (Phys. Rev. B 73[4]: art. no. 045432, January 2006) by Professor Motohiko Ezawa is a key part of the Research Front on [Graphene Nanoribbons](#). According to [Essential Science IndicatorsSM](#) from [Thomson Reuters](#), this paper has been cited 63 times since its publication up to October 31, 2008. In the [Web of Science[®]](#), this paper shows 80 citations to date.

Professor Ezawa is an Assistant Professor in the Department of Applied Physics at the University of Tokyo.

In the interview below, he talks with [ScienceWatch.com](#) about this highly cited paper.

SW: Would you please describe the significance of your paper and why it is highly cited?

In my paper I have presented many classes of graphene nanoribbons and proposed their systematic classification in terms of the edge shape and the width. Nanoribbons have a wide variety of electronic properties depending on the edge shape and the width. These electronic properties are amazingly rich in comparison with those of carbon nanotubes. My paper is highly cited probably because my work on nanoribbons provides the inspiration that graphene nanostructure will be a promising candidate of future nanoelectronic devices as an alternative of silicon devices.

SW: How did you become involved in this research, and were there any particular successes or obstacles that stand out?

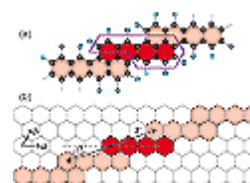
This is the first paper in my academic career, constituting a part of my master thesis. When I was an undergraduate student, I was walking around in the library of the chemistry department. I had an encounter with a bulletin displaying a series of chemical polymer structures such as polyacene and polyphenanthrene, which are now called graphene nanoribbons. These polymers are studied in the context of chemical synthesizing. I was attracted to these polymers since I thought their electronic properties would be exceedingly interesting.

After coming back home, I immediately made a systematic analysis of nanoribbons. I named this class of polymers "carbon nanoribbons" after carbon nanotubes. I was unaware of experiments on graphene at that time. Carbon nanoribbons are now known as graphene nanoribbons, as the

Figure 1: [+ details](#)



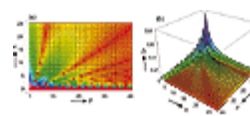
Figure 2:



graphene physics is expanding dramatically.

The main obstacle is that I had very great difficulties publishing this paper. It took 10 months for the paper to be published; in contrast, it took only two months for calculations. Furthermore, my paper was rejected by the first journal to which I submitted it.

Figure 3:



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

Graphene nanoribbon is one of the graphene nanostructure derivatives. It is a one-dimensional object. We may as well consider a zero-dimensional derivative, which is graphene nanodisk (Ezawa M, "Metallic graphene nanodisks: Electronic and magnetic properties", *Phys. Rev. B* 76: art. no. 245415, 2007). Nanoribbons will be used as quantum wires, while nanodisks will be used as quantum dots. Combinations of nanoribbons and nanodisks will form electronic circuits. In future, nanoelectronic devices will be made solely of graphene, where nanoribbons and nanodisks are basic components. Graphene-based circuits will replace silicon-based circuits in future.

SW: What are the implications of your work for this field?

First, my work has revealed that the electronic properties are very sensitive to the edge shape and the width. This leads to a rich variety in the electronic properties of nanoribbons. Second, the theoretical treatment is relatively easy. Simple tight-binding calculations have been proven to be very successful in contrast to the study of the transition metals. This makes it possible to carry out a systematic analysis of many classes of nanoribbons rather easily. Third, my work suggests applications of nanoribbon to future nanoelectronic devices. I have suggested that the combinations of nanoribbons will lead to further interesting physics. ■

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Motohiko Ezawa's current most-cited paper in *Essential Science Indicators*, with 63 cites:

Ezawa M, "Peculiar width dependence of the electronic properties of carbon nanoribbons," *Phys. Rev. B* 73(4): art. no. 045432, January 2006. Source: *Essential Science Indicators* from Thomson Reuters.

KEYWORDS: GRAPHENE, CARBON NANORIBBONS, ELECTRONIC PROPERTIES, SHAPE, WIDTH, GRAPHENE NANOSTRUCTURE DERIVATIVES, GRAPHENE NANODISKS, NANO-ELECTRIC DEVICES.

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