Materials Science and Technology Division and Wigner Committee Seminar

"Toward graphene electronics"

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10:00 a.m.
4515/HTML, Room 265

Abstract

In this seminar, I will present my recent works on mechanical properties and device applications of graphene.

Although stress and mechanical instability are conventionally understood as phenomena of classical mechanics, they should be affected by quantum effects, such as quantum size effect, in nanoscale low-dimensional structures. So far, however, quantum effects have been shown mostly for electronic structure and energetic quantities of low-dimensional nanostructures. Here we demonstrate a unique example of quantum manifestations of mechanical quantities in graphene edge stress. We show that quantum confinement can lead to stress oscillations and spin polarization can reduce stress, which in turn quantum mechanically modify the edge twisting and warping instability. Our findings, which cannot be captured by classical mechanics, provide new insights into the understanding of mechanical stability of graphene-based nanostructures.

The continued miniaturation of Si electronic device based CMOS technology is approaching the physical and geometrical limits. It is anticipated that future generations of nanoelectronics will likely go beyond CMOS technology to new device paradigms based on exotic nanomaterials. Here, I will show the field effect transistor applications based on patterned graphene. We demonstrate that the electronic devices built on patterned graphene can be made with atomic-perfect-interface junctions and controlled doping via manipulation of edge terminations. Using first-principle transport calculations, we show that graphene transistors can achieve very high performance levels. Edge doping is an effective way to control the transformation between ambipolar transistor and p-type (or n-type) transistors.

Finally, I will outline my future research plan on designing graphene oxides related absorbers for organic photovoltaic applications.

Host: Zhenyu Zhang (576-5346, zhangz@ornl.gov)