The quest for graphene-based electronics

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Engineers at Ohio State University have made progress on research that may enable them to mass produce graphene, a form of carbon that has lots of interesting properties, courtesy of their friendly neighborhood supercomputer

> Experts believe that graphene — the sheet-like form of carbon found in graphite pencils — holds the key to smaller, faster electronics. It might also deliver quantum mechanical effects that could enable new kinds of electronics.
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> …"Graphene has huge potential — it's been dubbed 'the new silicon,'" said Padture, who is also director of Ohio State's Center for Emergent Materials. "But there hasn't been a good process for high-throughput manufacturing it into chips. The industry has several decades of chip-making technology that we can tap into, if only we could create millions of these graphene structures in precise patterns on predetermined locations, repeatedly. This result is a proof-of-concept that we should be able to do just that."

Daydreams of potential uses include chemical sensors, and in future computer chips

> Researchers have shown that a single sheet, or even a few sheets, of graphene can exhibit special properties. One such property is very high mobility, in which electrons can pass through it very quickly — a good characteristic for fast electronics. Another is magnetism: magnetic fields could be used to control the spin of graphene electrons, which would enable spin-based electronics, also called spintronics.

What's the computing angle?

> In computer simulations, they found that each material [tested as a potential substrate] interacts differently with the graphene. So success might rely on finding just the right combination of substrate materials to coax the graphene to break off in one or two layers. This would also tailor the properties of the graphene.

Those simulations were run at the Ohio Supercomputer Center using the Vienna Ab-initio Simulation Package. From OSC's web site

> "The calculations are computationally very demanding for the systems under consideration due to their size and complexity, and they couldn't have been done without our allotment at the Ohio Supercomputer Center," Windl explained. "Based on our initial success with these computer simulations, we currently model adhesion on different substrates along with the resulting electrical transport through the graphene to optimize the stamping process and the resulting devices."

More in the article at the link above, along with a pointer to a detailed paper in the journal *Advanced Materials*.

Posted in Applied HPC by John West
3 comments