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Graphene and 'spintronics' combo looks promising

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A team of physicists has taken a big step toward the development of useful graphene spintronic devices. The physicists, from the City University of Hong Kong and the University of Science and Technology of China, present their findings in the American Institute of Physics' *Applied Physics Letters*.

Graphene, a two-dimensional crystalline form of carbon, is being touted as a sort of "Holy Grail" of materials. It boasts properties such as a breaking strength 200 times greater than steel and, of great interest to the semiconductor and data storage industries, electric currents that can blaze through it 100 times faster than in silicon.

Spintronic devices are being hotly pursued because they promise to be smaller, more versatile, and much faster than today's electronics. "Spin" is a quantum mechanical property that arises when a particle's intrinsic rotational momentum creates a tiny magnetic field. And spin has a direction, either "up" or "down." The direction can encode data in the 0s and 1s of the binary system, with the key here being that spin-based data storage doesn't disappear when the electric current stops.

"There is strong research interest in spintronic devices that process information using electron spins, because these novel devices offer better performance than traditional electronic devices and will likely replace them one day," says Kwok Sum Chan, professor of physics at the City University of Hong Kong "Graphene is an important material for spintronic devices because its electron spin can maintain its direction for a long time and, as a result, information stored isn't easily lost."

It is, however, difficult to generate a spin current in graphene, which would be a key part of carrying information in a graphene spintronic device. Chan and colleagues came up with a method to do just that. It involves using spin splitting in monolayer graphene generated by ferromagnetic proximity effect and adiabatic (a process that is slow compared to the speed of the electrons in the device) quantum pumping. They can control the degree of polarization of the spin current by varying the Fermi energy (the level in the distribution of electron energies in a solid at which a quantum state is equally likely to be occupied or empty), which they say is very important for meeting various application requirements.

More information: The article, "Spin current generation by adiabatic pumping in monolayer graphene," by Qingtian Zhang, K. S. Chan, and Zijing Lin appears in the journal *Applied Physics Letters*. See: link.aip.org/link/applab/v98/i3/p032106/s1

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