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UA researchers make semiconductor advances in electron-spin study

By WIL SHANE
Staff Writer

A team of physicists from the University of Arkansas has achieved the highest efficiency ever in transferring polarized electrons into a semiconductor surface. This advance could lead to the creation of small but powerful computational devices that could revolutionize the electronics industry.

Vincent LaBella, D.W. Bullock, Z. Ding, C. Emery, A. Venkatesan, William F. Oliver, Greg Salamo and Paul Thibado of the University of Arkansas, and M. Mortazavi of the University of Arkansas at Pine Bluff, reported their findings in the current issue of Science magazine.

Physicists hope to harness the power of an electron's spin to make multifunctional computational devices to replace hundreds of conventional devices, thus leading to faster, smaller electronics that consume less power. Currently, electronic devices use an electron's mass and charge to do the necessary work, but those devices have limitations in their size and power.

For about 10 years, researchers have been exploring the idea of exploiting an electron's spin to enhance the performance of devices. Spins can rotate in a coherent manner and thus alter the resistance of a device in a controlled manner. These properties may enable greater storage capacity and information processing from spintronic devices.

LaBella and his colleagues found that areas with an atomic "step," a spot where the atoms do not form an even surface, cause spin disruption. The places where these steps occurred turned out to be the source of electron disruption, causing the spins to flip.

"Until now, no one has pinned down the fact that steps scatter spins," LaBella said.

It takes a free electron to scatter another electron's spin, and usually within a crystal all electrons are paired up, unless there is a broken bond. The researchers plan to study other semiconductor surfaces using the same techniques.

"We can use this as a tool to study the effects of defects on the spin injection process," LaBella added.

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