

UC San Diego physicists devise viable design for spin-based electronics

June 1 2007

Physicists at the University of California, San Diego have proposed a design for a semiconductor computer circuit based on the spin of electrons. They say the device would be more scalable and have greater computational capacity than conventional silicon circuits.

The “spintronic”—or spin-based electronic—device, described this week in the journal *Nature*, would extend the scope of conventional electronics by encoding information with the magnetic—or spin—state of electrons, in addition to the charge of the electrons. The researchers used a novel geometry to overcome the weakness of the magnetic signal, the current limitation to developing spintronics in silicon semiconductors.

“The breakthrough of our research is the device geometry, the way it is activated, and the way it could be integrated in electronic circuits,” said Lu J. Sham, a professor of physics at UCSD and the senior author on the paper. “All of these features are novel and our results show for the first time a spin-based semiconductor circuit.”

One advantage of spintronics is that it shrinks the size of the circuit that is needed to perform a given logic operation. The researchers say that their proposed device has other important advantages compared with conventional electronics.

“Spin-based electronic devices allow the construction of reprogrammable circuits without hindering performance,” explained

Hanan Dery a postdoctoral fellow working with Sham and the lead author on the paper. “This will allow flexible electronic devices which fit into any application while providing the best performance. For example, the same circuit can serve as i-Pod, cellular phone, microprocessor, et cetera.”

The proposed spintronic circuit is an interconnected series of logic gates. Each logic gate consists of five magnetic contacts lying on top of a semiconductor layer. The magnetic state of each of these contacts, determined by the electrons’ spins, corresponds to the “0” and “1” in each bit of information. The logic operation is performed by moving electrons between four of the magnetic contacts and the semiconductor. The result of the operation is read by the fifth magnetic contact.

The proposed device has not yet been made, but according to the researchers it should be feasible with currently available technology.

“We are using only experimentally-verified constraints,” said Sham. “We have presented our results to experimentalists in the field of spin electronics. They claimed that the realization of this device is within reach.”

Source: University of California - San Diego

Citation: UC San Diego physicists devise viable design for spin-based electronics (2007, June 1) retrieved 24 April 2024 from <https://phys.org/news/2007-06-uc-san-diego-physicists-viable.html>

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