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Proposal for an All-Spin Transistor with Built-in Memory

A new spin-based transistor design drastically reduces power consumption, enables non-volatile memory in the chip, and offers enhanced scalability for next-generation electronics.

The basic building block for digital electronics is the transistor, which acts like an electronic switch and combines together to perform the digital logic on which electronics are based. The current standard for transistor design is complementary metal-oxide semiconductor (CMOS) technology, which uses the electric behavior of semiconductors to switch between charge based binary values. Logical ones or zeroes are represented by the presence or absence of an electrical charge at the transistor's input/output. Such devices require a continuous electric current to run thereby limiting their energy efficiency and scalability.

Researchers at Purdue University have proposed a new transistor design that relies on the spin of electrons instead of a charge. This new design, all-spin transistor (AST), only requires electricity at the moment a switch occurs, significantly reducing power usage and allowing the transistor to "remember" its current state even if the chip lost power, which means computers could boot almost instantly. It is also well-suited for hybrid (analog/digital) design methodology. The AST transistor could be scaled to a size that is smaller than CMOS transistors due to its lower temperature during operation.

Advantages:

- Low-power operation

- Scalability

- Transistor memory

Potential Applications:

-Electronics industry

Technology ID

65337

Category

Semiconductors/Fabrication & Process Technologies

Semiconductors/Devices & Components

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