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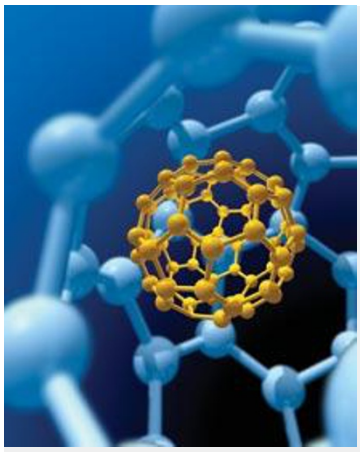
News

Buckyballs give flash a boost

Fullerenes could be used to reduce amount of power needed in memory devices.

Eric Hand

Flash memory, the workhorse of mobile phones and digital cameras, could be made more efficient by using buckyballs. These spherical fullerene molecules, comprised of 60 carbon atoms, would allow flash memory to operate at a lower voltage and save on power, researchers reported last week.



Spherical carbon molecules such as these could be used to make flash memory drives less power-hungry.

Victor Habbick Visions/SPL

"We're the first ones trying to borrow molecular electronics concepts and put them into non-volatile memory," says electrical engineer Tuo-Hung Hou of Cornell University in Ithaca, New York, who led the research (T.-H. Hou et al. Appl. Phys. Lett. 92, 153109; 2008).

Most desktop computers use a type of random access memory (RAM) that is lost when the power is shut off. Non-volatile memory, however, keeps its content even without power, and flash has become the dominant type. Flash memory holds its zeros and ones in a circuit that contains an island transistor, insulated by a thin layer of silicon oxide.

To write or erase the memory, current is pumped across the barrier, either injecting electrons into the transistor or sucking them out. The charge stays put — most flash memory is guaranteed to last for ten years — but electrons eventually leak through the barrier. The barrier has to be thick enough to prevent leakage, but thin enough for current to pass through during a write or erase.

The necessary current is relatively high, which translates to relatively high voltages. Cycle after cycle, the voltage can wear down the flash memory circuits. It also requires peripheral circuitry — which takes up precious space — to boost the low voltages available from batteries or USB ports. And most importantly, it wastes power that could otherwise extend battery life. "The major bottleneck of the current flash memories is the voltage," says Hou.

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Enter the buckyball. By adding buckyballs to the barrier layer, the Cornell engineers create resonances that amplify the current during the high-voltage write or erase phase. So the voltage needed during writing or erasing is lowered, by an order of magnitude or more. "It's a very interesting twist," says Sanjay Banerjee, an electrical engineer at the University of Texas at Austin, who was not involved in the research.

Chenming Hu, an electrical engineer at the University of California, Berkeley, says that the concept is attractive, and could help extend the tenure of flash as the dominant form of non-volatile memory. But he cautions that other types are already nipping at the heels of flash, such as magnetic RAM, which stores information using the polarity of ferromagnetic plates, and phase-change RAM, which relies on switching between amorphous and crystalline phases of tiny glass filaments. "The general feeling is something else will replace flash," he says.

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