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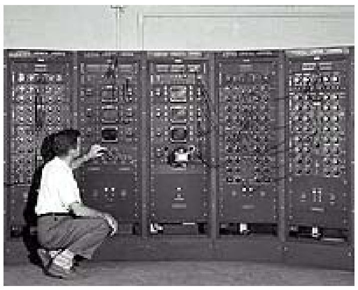
Mechanical Memory Switch Outstrips Chip Technology

Boston MA (SPX) Oct 04, 2004



if only they knew they'd be fashionable again

There are no gears or levers involved, nor even, for those who remember such things, punch cards transported in oblong boxes. Yet research by a Boston University team led by physicist Pritiraj Mohanty does update a decidedly "old" technology in a bid to build better, faster data storage systems for today's computers.

Mohanty, an assistant professor in BU's Department of Physics, has carved tiny switches out of silicon, fabricating mechanical switches that are thousands of times smaller than a human hair.

When put through their paces as data storage tools, these nano-sized devices were capable of functioning at densities that far exceed the physical limitations of electromagnetic systems and could retrieve information at speeds that cruise in the megahertz and gigahertz ranges, millions and billions of cycles per second, respectively.

Mohanty also found that the switches operated

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on miniscule amounts of power, about a million-fold less than that demanded by current systems.

"This is a new ball game," say Mohanty. "By taking a new look at old technology, we have produced memory cells that are faster and better than those currently used. This mechanical device is a completely new approach to improving data storage."

The researchers used electron-beam lithography to produce the beam-and-pad design of the tiny devices, carving the switches from wafers made of single-crystal layers of silicon and silicon oxide.

E-beam lithography, developed for use by the integrated circuit industry, has become a staple fabrication technique for microelectromechanical (MEMS) devices, the ultra-small sensors, switches, and gears integral to the microtechnology and nanotechnology industries.

To test the device's capabilities, the researchers clamped the nanostructure on each end, effectively suspending the beam, then drove a megahertz-frequency current through an attached electrode.

When driven strongly enough, the beam switched between two different and distinct states, the needed "0" and "1" conditions commonly used to describe the process for accessing stored data.

The tiny dimensions of the device allowed it to vibrate quickly, achieving a millions-of-cycles-per-second frequency of 23.57 megahertz. This speed reflects the rate at which the device could "read" stored information.

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As a comparison, the hard drives in current laptops can read at a speed of a few hundred kilohertz (thousands of cycles per second) in actual operation.

The researchers speculate that even smaller beams could be produced and that such devices could achieve true read speeds in the gigahertz range - billions of cycles per second.

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Other advantages of this tiny mechanical memory system include its angstrom-sized "range of motion," allowing it vibrate between states using only femtowatts of power, compared with the milliwatts or microwatts of power needed for read-write functions in current machines.

The device also overcomes the superparamagnetic effect that limits contemporary systems, allowing the beams to be packed at densities that exceed the 100 gigabits per square inch that is the current ceiling.

In addition, unlike conventional electronic or magneto-electronic storage systems, these nanomechanical memory cells are resilient in electrical and magnetic fields.

"They are extremely robust," says Robert Badzey, a team member and graduate student in BU's Department of Physics. "Not only can these mechanical switches withstand radiation disturbances, like solar flares, they also are tough enough to work even after being dropped."

In addition to Mohanty and Badzey, the BU research team included Guiti Zolfagharkhani, a graduate student in physics, and Alexei Gaidarzhy, a graduate student in the College of Engineering's Department of Aerospace and Mechanical Engineering.

Their paper will appear in the October 18 issue of Applied Physics Letters, a journal of the American Institute of Physics.

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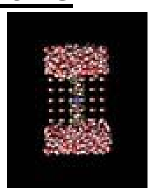
Control Of Molecular Switches Increased By Tailored Intermolecular Interactions

University Park PA (SPX) Sep 30, 2004



A means to stabilize molecular switches based on chemical interactions with surrounding molecules has been developed by a research team led by Penn State Professor of Chemistry and Physics Paul S. Weiss.

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