Breakthrough in magnetic devices could make computers much more powerful

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Scientists have created novel ‘spintronic’ devices that could point the way for the next generation of more powerful and permanent data storage chips in computers. Physicist at the Universities of Bath, Bristol and Leeds have discovered a way to precisely control the pattern of magnetic fields in thin magnetic films, which can be used to store information.

The discovery has important consequences for the IT industry, as current technology memory storage has limited scope for develop further. The density with which information can be stored magnetically in permanent memory - hard drives - is reaching a natural limit related to the size of the magnetic particles used. The much faster silicon-chip based random access memory - RAM - in computers loses the information stored when the power is switched off.

The key advance of the recent research has been in developing ways to use high energy beams of gallium ions to artificially control the direction of the magnetic field in regions of cobalt films just a few atoms thick.

The direction of the field can be used to store information: in this case “up” or “down” correspond to the “1” or “0” that form the basis of binary information storage in computers.

Further, the physicists have demonstrated that the direction of these magnetic areas can be “read” by measuring their electrical resistance. This can be done much faster than the system for reading information on current hard drives. They propose that the magnetic state can be

switched from “up” to “down” with a short pulse of electrical current, thereby fulfilling all the requirements for a fast magnetic memory cell.

Using the new technology, computers will never lose memory even during a power cut – as soon as the power is restored, the data will reappear.

Professor Simon Bending, of the University of Bath's Department of Physics, said: “The results are important as they suggest a new route for developing high density magnetic memory chips which will not lose information when the power is switched off. For the first time data will be written and read very fast using only electrical currents.”

“We’re particularly pleased as we were told in the beginning that our approach probably would not work, but we persevered and now it has definitely paid off.”

Professor Bending worked with Dr Simon Crampin, Atif Aziz and Hywel Roberts in Bath, Dr Peter Heard of the University of Bristol and Dr Chris Marrows of the University of Leeds.

Another approach to overcoming the problem of storing data permanently with rapid retrieval times is that of magnetic random access memory chips (MRAMs); prototypes of these have already been developed by several companies. However, MRAM uses the stray magnetic fields generated by wires that carry a high electrical current to switch the data state from “up” to “down”, which greatly limits the density of information storage.

In contrast, if the approach at Bath is developed commercially, this would allow the manufacture of magnetic memory chips with much higher packing densities, which can operate many times faster.

A paper written by the researchers appeared recently in the journal *Physical Review Letters*, entitled: *Angular Dependence of Domain Wall Resistivity in Artificial Magnetic Domain Structures*.

Source: University of Bath