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Spinning into the future of data storage

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Scientists from Queen Mary, University of London have improved their understanding of the inner workings of our computers and mp3 players, thanks to an exciting new field of research called 'organic spintronics'.

Dr Alan Drew from Queen Mary's Department of Physics and the University of Freiburg, Switzerland, along with colleagues from the Paul Scherrer Institute (PSI), Switzerland, has become the first to measure how the magnetic polarisation is lost in a device similar to a hard drive 'read-head' found in every computer produced in the last ten years.

Computers and mp3 players have become increasingly efficient at information storage thanks to an effect that physicists call 'giant magnetoresistance'; this allows scientists to produce electronic components which are very sensitive to external magnetic fields, known as magnetic read-heads. These read-heads allow magnetically-encoded data to be very densely packed, resulting in very small hard drives which can store more than 100 CDs worth of data in a device the size of half a cigarette box.

Unlike most electronic components, where the electron's intrinsic electric field or charge is used to carry a signal, magnetic read-heads use the electron's intrinsic magnetic field - known as their 'spin' - to carry information. Spinvalves are made up of at least three layers, two magnetic layers separated by a non-magnetic layer. Dr Drew and his team wanted to investigate how spins travel across the middle of these three layers, in the hope of improving future generations of data storage.

His findings contribute significantly to the fundamental understanding of spintronic devices, and will allow new concepts to develop and aid in the discovery of novel devices and applications, as Dr Drew explains: "Spintronics promise low-power circuits, possibly at the quantum level, and the possibility of combining communication, memory and logic on the same chip. The efficient transfer of spin in these devices remains one of the most difficult challenges facing physicists. One way of improving the efficiency of these devices could be to change the materials they are made from, but currently we are unable to predict what effects the different materials will have. Dr Drew's measurements hope to address this.

One particularly exciting part of this research is that a new combination of materials was used to make the device. Dr Drew continues "When devices are made from organic materials, which have low manufacturing costs and are very flexible, the magnetic information can be preserved for extremely long times – over a million times longer than many materials used in today's technology. These new materials have the potential to create an entirely new generation of spin-enabled devices."

Writing in the journal *Nature Materials*, Dr Drew explains how the researchers used muons, elementary particles that act like tiny magnets, to measure the magnetic field within the device. As Dr Morenzoni from PSI explains, "The muons have a high energy and must be slowed down before they can be used in the experiment and the equipment we used to do this is unique – PSI is the only source of 'slow' muons in the world, and the only equipment that can measure depth resolved magnetism."

In the long-run, experiments such as this will help understand the fundamental operation of spintronics and hard drive read-heads, and will help to show engineers how they can optimise the heads, and improve computer storage, vital to the next generation of technology.

Source: Queen Mary, University of London