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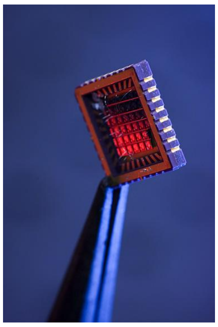
New Silicon-based "Spintronics" Device for Ultrafast Computers

A real breakthrough in the field



The device makes use of a ferromagnetic layer 5 nanometres deep sitting on top of a 10-micron-thick silicon wafer
Image: Zauner/Science

Silicon components may have reached the maximum degree of miniaturization, but this wonder-material still has an ace up its sleeve. The newest electronics field where it proved to be, yet again, the best, is spintronics."Spintronics" is an emerging field that deals with the use of the 'spin' of an electron for storing, processing and communicating information and it has known an important recent advance that may one day manifest itself in a new generation of smaller, smarter and faster computers, sensors and other devices.It relies on the spin of an electron, which makes it behave like a tiny magnet and scientists hope that this spin could be used to encode information in electronic circuits, computers and virtually every other electronic gadget, which will become smaller, faster and less power hungry.So far, there are still many problems that need to be overcome in order to make computer operate with logic devices based on manipulating and measuring the spin of electrons, rather than turning current on and off.Now, a real breakthrough has been made, as researchers have been able, for the first time, to inject spin-polarized electrons into silicon, manipulate them and measure them coming out the other side, phenomena that have been some of the most important problems since the beginning of the research.Ian Appelbaum and Biqin Huang of the University of Delaware in Newark, US and Douwe Monsma of Cambridge NanoTech, Massachusetts, US, have managed to overcome the problem with silicon electrons, which lose their spin state when other electrons from an electrical current pass through.Thus, electrons having the spin oriented opposite to the axis of the magnet will be slowed and scattered, while those having the spin oriented along the magnetic axis will be drawn through. The result is a polarized current consisting of electrons with one more direction of spin than the other.The team is the first to prove that spin can be injected and detected using a silicon-based device. To do this, they passed highly energetic electrons through thin-film ferromagnets 5 nanometers in depth, which were deposited on top of a 10-micron-thin wafer of silicon. Then they cooled the device to 85°K (-188°C or -306 F).The fact that the layers are very thin coupled with the use of high-energy electrons, gave electrons the ability to move through the silicon without losing their spin. Thus, it became possible to inject current with a particular spin state into the silicon and measure it at the other end. By using a magnetic field, the team was also able to change the spin of the electrons within the silicon.This is a very important step in the field of spintronics that paves the way for new and reliable applications.