Single-atom spin flip

A new technique is a magnetic version of an inelastic electron tunnelling spectroscopy that IBM scientists call single-atom spin-flip spectroscopy. To use it, the scientists place a magnetic atom on a surface and use a strong magnetic field to orient its spin. Next, they position the non-magnetic tip of a scanning tunnelling microscope above the studied atom. Applying a voltage to the tip, electrons are made to flow, or ‘tunnel’, from tip to magnetic atom.

IBM researchers measured the energy required to flip the spin of a single manganese atom from ‘up’ to ‘down.’ If the voltage is great enough, some electrons can transfer energy to the atom, causing a spin flip and the flow of electrons to increase. By measuring the voltage at which the electron flow begins to increase, the scientists can determine the energy required to flip the spin.

Experiments are conducted in a vacuum and at less than 1°K to achieve enough resolution to measure the very small energy required to flip the single spin of a lone manganese atom. They found the energy, which varies with the strength of the orienting magnetic field, to be about 0.0005eV – some 10,000 times less than the energy of a single molecular hydrogen bond.

IBM’s technique is so sensitive that scientists learned that it takes 6% more energy to flip the spin of atoms positioned near the edge of an insulating patch on the surface, than for atoms in the middle of the patch. This is invaluable detail for understanding and engineering the properties of nanoscale spintronic devices.

Plastic-metal hybrid ousts soldering

Siemens researchers have developed a composite made of plastic and metal that can be processed like a plastic, but has the electrical and electromagnetic properties of metal. The new plastic-metal hybrid is designed to simplify the production of electrical components such as transmission and engine control units. When heated, the material can be processed with conventional injection moulding machines as used in the plastics industry. Numerous experiments have shown that conductor paths as well as contacts for plug-in connections or cables can be injection-moulded with the material in one operation. Time-consuming soldering processes are no longer necessary and the production process is speeded up.