Observation, electric current control of a local spin in a single-molecule magnet

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By successfully changing the spin of a molecule, researchers have been able to perform an on/off operation for a molecular magnet. Such reversible switching paves the way for single molecule memory.

Japan Science and Technology Agency and Tohoku University announced on March 2, 2011 that Professor Tadahiro Yoneda of Tohoku University and his colleagues have succeeded in on/off operation of a single molecule magnet. Details are published in *Nature Communications*.

A single spin is a basic unit of magnetism and molecular spintronics is attracting attentions in which a spin state of a molecule is switched on and off by changing the molecular structure. Terbium-phthalocyanine complex (TbPc2) forms a single magnet with double-decker structure in which a single Terbium (Tb) atom is sandwiched by two planar phthalocyaninato (Pc) ligands. Electric current is applied to TbPc2 adsorbed on a gold (111) surface via a scanning tunneling microscope. The dI/dV curve of the tunneling current shows a Kondo peak which appears by the presence of unpaired spin of π-orbital electron of Pc ligand. The upper Pc ligand in TbPc2 was rotated by applying controlled electric current, leading to the disappearance and reappearance of Kondo peaks.

Theoretical analysis has shown that an angle formed by two ligands changes the strength of the magnet. The rotation shifts the molecular frontier-orbital energies, quenching the π-electron spin. Reversible

switching between two stable ligand orientations by applying a current pulse should make it possible to code information at a single-molecule level. Further development to a single molecule memory will be expected.

More information: Tadahiro Komeda, et al. "Observation and electric current control of a local spin in a single-molecule magnet", *Nature Communications*, Volume: 2, Article number: 217, doi:10.1038/ncomms1210 . Published 01 March 2011

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