MAR13-2012-020144

Abstract for an Invited Paper
for the MAR13 Meeting of
the American Physical Society

Electronic read-out of a single nuclear spin using a molecular spin transistor

FRANCK BALESTRO[1], Neel Institut - CNRS - UJF

Thanks to recent advances of nanofabrication techniques, molecular electronics devices can address today the ultimate probing of electronic transport flowing through a single molecule. Not only this electronic current can show signatures of the molecular quantum levels but it can also detect the magnetic state of the molecule. As a consequence, an entirely novel research field called *molecular spintronics* in which quantum magnetism of molecular systems can be interfaced to nanoelectronics is now emerging. One of the recent challenges of this field was to probe by this current, not the only spin state of an electron, but the state of a single nuclear spin. Such an achievement was experimentally unimaginable a few years ago. Indeed, the magnetic signal carried by a single nuclear spin is a thousand times less than that of a single electron spin ... Using a Single Molecular Magnet (TbPc2) as a molecular spin transistor in a three terminals configuration, the experiment consists in measuring the current changes when ones sweep the external magnetic field applied to the molecule. When the magnetic spin of the molecule changes its quantum state, a change of current is recorded. Because of the well-defined relationship that exists between the electron spin and nuclear spin carried by the nuclei of the Terbium atom, it is possible to perform the electronic read-out of the electronic spin state which, in turn give information on the state of a single nuclear spin. Application of this effect for quantum information manipulation and storage can be envisioned, as the observation of energy level lifetimes on the order of tens of seconds opens the way to coherent manipulations of a single nuclear spin.

Reference:

"Electronic read-out of a single nuclear spin using a molecular spin transistor," R. Vincent, S. Klyatskaya, M. Ruben, W. Wernsdorfer, F. Balestro, Nature, Vol. 488, p.357, (2012).

[1]In collaboration with R. Vincent, Neel Institut - CNRS - UJF; S. Klyatskaya, Institut of Nanotechnology - KIT; M. Ruben, Institut of Nanotechnology - KIT; and W. Wernsdorfer, Neel Institut - CNRS - UJF.