Ferromagnetic resonance at the atomic scale

Magnetoresistance, giant or tunnel, is at the heart of several ‘spintronic’ components, a new branch of electronics based on the spin of the electron with applications in information technology. Because of the never ending drive for miniaturization, spintronics is about to reach the ballistic regime of electronic transport for which spin dependent properties are still not completely understood. Further size reductions can even be achieved in constrictions of atomic sizes obtained by slowly stretching a nanostructure in a sensitively controlled manner. In these systems, static magnetotransport measurements result from the low-dimensional magnetism of a few relevant atoms. In parallel ferro-magnetic resonance (the magnetization precession induced by a radio-frequency magnetic field) has seen a renewed interest lately as it has been shown that magnetization dynamics interacts with spin currents. Its correlation with DC transport is being widely studied and it is now possible to electrically measure ferromagnetic resonance using the inverse spin Hall effect or the Anisotropic Magnetoresistance (AMR). The latter can be scaled down to atomic sizes thus giving the possibility to open the unknown field of the dynamical magnetic properties of a single atom in a low dimensional local geometry. We have very recently demonstrated that FMR can be detected in narrow constrictions using the AMR mixed with the RF current auto induced in the magnetic circuit, leading to a measurable DC voltage. After a strong experimental effort, an original setup has been built which allows us to electrically detect the ferromagnetic resonance at 77K in samples that can be broken in real time during the measurements. This unique tool will allow us to study the resonance properties of a single atom in a low-dimensional configuration. It may even allow us to demonstrate that some metals like platinum could become magnetic in these atomic contacts.

This subject is proposed for a ‘stage’ but we are looking for a candidate interested to continue in ‘thèse’.

Indiquez le ou les parcours (ex DEA) qui vous semblent les plus adaptés au sujet :

Physique de la matière condensée : OUI  Physique des Liquides  NON
Physique Quantique: OUI  Physique Théorique  NON