Magnetic relaxation in manganite perovskite nanocontacts

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Magnetic relaxation is a rather complex phenomenon and many models based both on phenomenological studies and first principles have been proposed to explain it. In strongly interacting materials a slow magnetic relaxation is usually described by the so called stretched exponential function of the form: $M(t) = M_0 \exp[-(t/\tau)^{\beta}]$ where $0 < \beta < 1$ [1].

For the manganese compounds the generally accepted Zener "double exchange" model [2]: the magnetic field aligns the local Mn-t_{2g} spins ferromagnetically and facilitates hopping of the conduction electrons Mn-e_g between adjacent Mn-ions sites. Due to this close relation between transport properties and the magnetization in manganese compounds [3], the resistivity measurements provide an excellent indirect method to characterize the magnetic relaxation observed in atomic scale constructions.

We have investigated a significant slow time magnetic relaxation in the perovskite nanocontacts (*NC*) obtained by break technique at *LN*. The time *t* dependence of the *NC* resistivity *R* has been measured in computer devices at several temperatures, between *LN* and 370 K. For each *R vs. t* measurement, the magnetization of the nanocontacts is first saturated with a circular magnetic field H_{cir} of the basis current *J* (up to 10^8 A/cm^2). After several minutes *J* is turned to any –*J*/n value and the *R*(*t*) measurement starts. The relaxation effects of *R vs. t* can be described by two-term formula: $R(t) = C + R_0 \exp[-(t/\tau)^{\beta}] + S \ln(t)$ stretched exponential function + *ln (t)* (logarithmic one can describe a slower relaxation processes determined by viscosity S). The appearance of both contributions evidences the existence of two sources of relaxation, which can be assigned to inhomogeneous changes of the angle between the magnetic moments of the neighbouring Mn ions at different zones of nanocontact. The magnetic relaxation times are about a few seconds and are dependent of the basis current flowing trough the nanocontacts. The magnetic viscosity coefficient *S* of the systems *versus* the basis current displayed characteristic bell-shaped curves. These results point out the important role of structural arrangements of the Mn-ions clusters on the surfaces of the nanocontact constrictions.

We therefore suggest that the magnetization reversal occurs by wall motion or changed of the magnetization direction of the Mn-ions clusters, and that thermal activation is responsible for the observed after-effect. However, a complete interpretation of the present experiments would need the direct observation of the relaxation as a function of *NC* diameter and temperature.

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