Resistive relaxation of a manganite perovskite nanocontacts

J. Baszyński and W. Kowalski

Institute of Molecular Physics Polish Academy of Sciences
M. Smoluchowskiego 17, 60-179 Poznań, Poland

We have investigated a significant slow time resistive relaxation of the perovskite nanocontacts (NC), which we are formed by pressing the tip onto target. These nanoconstrictions were prepared from $La_{0.7}Sr_{0.3}MnO_3$ ceramic. The time *t* dependence of the NC resistivity *R* has been measured by 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 of the basis current *J* (up to 100 MA/cm^2). After several minutes, the direction of *J* is turned to any –*J*/n value and the measurement starts.
The relaxation effects of *R vs. t* can be described by two-term formula [1]:

$$R(t) = C + R_0 \exp [- (t/\tau)^{\beta}] + S \ln (t).$$

The appearance of both contributions evidences the existence of two relaxation mechanisms that act in series. These two times of relaxation can be assigned to inhomogeneous changes of the angle between the magnetic moments of the neighboring Mn ions at different zones of nanocontact. The relaxation times values are about few seconds and dependent (~10%) of the basis current flowing trough the nanocontacts. The magnetic viscosity coefficient *S* of the systems displayed characteristic like bell-shaped curves *vs.* basis current. These results point out the important role of structural arrangements of the Mn-ions clusters on the surfaces of the tip and target, respectively. Due to the close relation between transport properties and the magnetization in manganese compounds, according to Zener model [2, 3], the resistivity measurements provide an excellent indirect method to characterize the magnetic relaxation observed in atomic scale constrictions.
We therefore suggest that the magnetization reversal occurs by wall motion or changed the magnetization direction of the Mn-ions at contact zones of the tip-target constrictions 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.

[1] G. Sinha, R. Chatterjee, M. Uehara, A.K. Majumdar, J. Magn. Magn. Mater. **164** (1996) 345
[2] C. Zener, Phys. Rev. **82** (1951) 403
[3] M. Sirena, L.B. Stern, J. Guimpel, Phys.Rev. B **64** (2001) 104409

Name of the presenting author (poster session I): Janusz Baszyński
e-mail address: jbasz@ifmpan.poznan.pl
http://www.ifmpan.poznan.pl