Nanocomposites and nanomaterials

Time dependence of resistance of single-crystal magnetic tunnel junctions with MgO barrier

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In this work, we present a study of single-crystal MgO (substrat) / V (10 nm) / Fe (0.7 nm) / MgO (1.2 nm) / Fe (5 nm) /Co (5 nm) / Au (5 nm) (capping layer) magnetic tunnel junction (MTJs) performed by molecular beam epitaxy (MBE). In this system, the anisotropy of Fe(0.7nm) can be tuned from out-of-plane to in-plane when applying a voltage bias through the MgO tunnel barrier [1]. Such behavior is very interesting for Magnetic Random Access Memory application.

Here the time dependence of resistance and tunnel magnetoresistance (TMR) after applying the voltage bias is investigated. Resistance stabilization requieres from a few minutes to a few hours after switching bias polarity. Nevertheless this phenomenon seems independent of the magnetism since the stable magnetic configuration is reached much faster. $\Delta R(t)$ measurements were carried out at parallel magnetic configuration of MTJs by switching of bias voltage polarity at full resistance stabilization for the 50, 100, 200 and 300 mV.

Time constants are deduced from the experimental data and strongly vary according to voltage bias amplitude. We will discuss our results in terms of reversible oxidation processes at Fe/MgO interface. An electric field favors the migration of positively charged species (Fe cations) in the direction of the electric field and the migration of negative species (O anions) in the opposite direction on the MTJs interfaces.

1. *Rajanikanth A., Hauet T., Montaigne F., Mangin S., Andrieu S.* Magnetic anisotripy modified by electric field in V/Fe/MgO(001)/Fe epitaxial magnetic tunnel junction // Appl. Phys. Lett.–2013.-**103**.-P. 062402-4.