Investigation of Resistive Switching in $Pb(Fe_{0.5},Nb_{0.5})O_3$: Thin Film Synthesis and Characterization

Master Thesis abstract

Julien Mialet

The resistive switching effects correspond to the change of resistance of a dielectric insulator towards two resistance states under the application of an external voltage.

The main aim of my work was the investigation of the resistive switching in the complex oxide PFN50 of chemical formula $Pb(Fe_{0.5},Nb_{0.5})O_3$. Thin film of thickness ranging from 50nm to 600nm have been deposited by RF magnetron sputtering on several substrate (Si(100), Si(111), Al_2O_3 m and Si-SiO_2-TiO_2-Pt(111)). The morphology of the films has been characterized by X-ray diffraction, Energy-Dispersive X-ray Spectroscopy and Atomic Force Microscopy. The electrical properties have been characterized by complex dielectric permittivity measurement, polarization hysteresis and current-voltage measurement. The last test allowing to investigate the RS effect has been performed using conventional technique and C-AFM.

The main results and outcomes are:

- Resistive Switching has been obtained in PFN 600nm film.
- Hysteretic dependence of the current with the applied voltage attributed to unstable filaments is obtained in PFN 60nm films.
- Resistivity of 600nm film of PFN equals to $10^8\,\Omega$cm in agreement with literature.
- PFN films synthetized have a grain size lower than 50 nm.
- Temperature of crystallization of 450°C allows to obtain PFN crystal with few pyrochlore.
- Complex permittivity dependence with the thickness at the nano-micro-scale has been observed: difference of 10^2 between 50nm and 600nm films.