Influence of interfaces on magnetic and electric properties in epitaxial films and heterostructures based on oxide materials

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Metal oxides show fascinating physical properties such as high temperature superconductivity, ferro- and antiferromagnetism, ferroelectricity or even multiferroicity. Progress in oxide thin film technology allows us to integrate these materials with semiconducting, normal conducting, dielectric, in complex oxide heterostructures. The combination of magnetic with dielectric, semiconducting, or ferroelectric materials in one material (e.g. magnetic semiconductors (MS) or intrinsic multiferroic) as well as in artificial heterostructures (e.g. ferromagnetic/dielectric heterostructures for magnetic tunnel junctions (MTJs) or artificial multiferroic heterostructures) allows for the design of materials with novel functionalities. For many possible electronic applications as well as fundamental studies, it is essential to fabricate epitaxial layered films and multilayers of these materials having complex lattice structures with sharp interfaces, preserving epitaxiallity through the whole structure. We have grown these kind of oxide heterostructures on single crystal (001) oriented $SrTiO_3$ substrates by using an in-situ DC sputtering technique at high oxygen pressures. We report the study of the temperature dependence of magnetization (polarization), isothermal hysteretic M(H) loops and magneto transport properties in ferromagnetic/ antiferromagnetic, ferromagnetic/ferroelectric, ferromagnetic/multiferroic heterostructures based on magnetic $La_{1-x}Ca_xMnO_3$, ferroelectric PZT, multiferroic $BiFeO_3$ and $BaTiO_3$. We found that both internal stress of the films generated during growth and interfacial interactions contribute to the magnetic, electric and magnetotransport properties of the heterostructures. Here I will discuss the cases where the interfacial effects influence physical properties.

This research was supported by "El patrimonio Autónomo Fondo Nacional de Financiamiento para la Ciencia, la Tecnología y la Innovación Francisco José de Caldas" under contract RC-No. 275-2011 with the Excellence Center for Novel Materials (CENM) and "Influencia de la microestructura interfacial sobre propiedades magnéticas y eléctricas en multicapas multifuncionales basadas en materiales óxidos", Univalle CI 7864.