MAGNETIC PROPERTIES OF OXIDE INTERFACES

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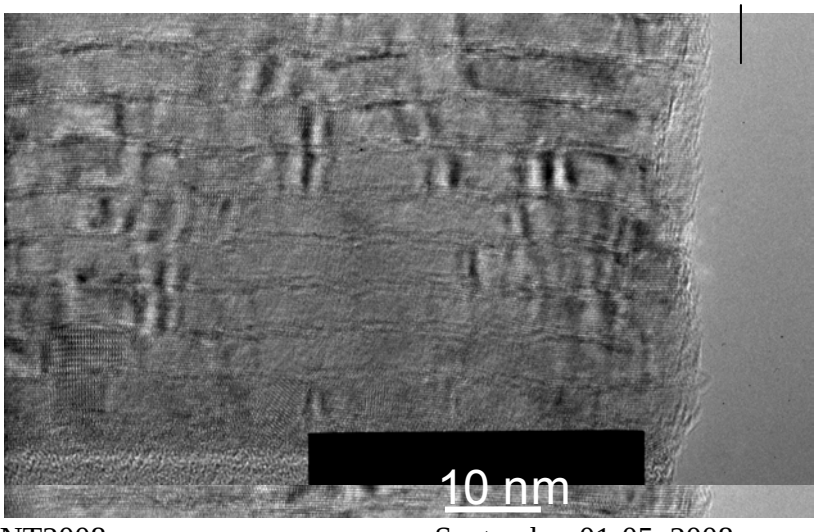
Introduction

The appearance and control of magnetism in traditionally non-magnetic oxides is nowadays one of the most active and pursued goals of material physics [i]. In the last years the research has been focussed mainly on oxides doped with magnetic ions (the so called Diluted Magnetic semiconductors). Recent results [ii,iii,iv,v] indicate that the appearance of magnetism in these oxides (mainly ZnO, and TiO2) is related to the presence of defects and surface/interface effects [vi,vii] but the origin of most of the experimental results is still unclear. Actually, results are hardly reproducible and findings from different groups are commonly contradictory. Understanding this lack of reproducibility is a challenge and will help in determining the origin of this magnetism. A common feature of all the experimental observations of magnetism is that signals are weak, suggesting that only few atoms are involved in the magnetic response. Thus, it has been proposed that the emerging magnetism in oxides correspond to surface/interface magnetism. We have recently demonstrated that ferromagnetism at room temperature can be observed in mixtures of ZnO/MnO_2 [viii,ix] and ZnO/Co_3O_4 [x] in powder form after a partial reaction of both oxides leading to certain interfaces. We have grown and characterized extensively, oxide thin films and multilayers.

It is really difficult to understand the origin of this magnetism based only on magnetic measurements, since signals are very weak and effects from the rest of the material such as impurities could mask the signals coming from interfaces. In this framework, correlating the magnetic properties with other measurements sensitive to the electronic structure can help to clarify its magnetic properties. This has been done for optical XPS,



transport, XANES, EPR…. measurements. This work studies the magnetic properties of oxide interfaces, among them, ZnO, Al_2O_3, SiO_2, MnO_2, CCTO, TiO_2 and Co_3O_4. Both thin film, multilayers, and mixed powders are studied. Special attention is paid to optical and transport measurements, quite useful to identify the origin of the observed room temperature magnetism. The difficulty to reproduce experiments in this kind of materials is also addressed.

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