SURFACE STUDIES IN ULTRATHIN BINARY IRON OXIDE FILMS: ANCIENT MATERIALS, NEW OPPORTUNITIES

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Binary iron oxides (FeO, Fe_3O_4, γ-Fe_2O_3, α-Fe_2O_3) are well-known compounds. From the Mössbauer spectroscopic point of view they have been extensively studied and an overwhelming amount of information is available in the literature both for the bulk materials as for other forms of these materials (for example, nanoparticles). The properties of these oxides in ultrathin films (a few atomic layers thick), however, have not been studied at too much extent. This is mainly due to the difficulties of (i) handling ultra high conditions to avoid sample contamination and/or deterioration and (ii) dealing with a small number of atoms where sample enrichment in ^{57}Fe is compulsory. The recent communication of the interesting catalytic activity of FeO for CO oxidation [1], as well as the potential application of Fe_3O_4 and γ-Fe_2O_3 in spintronic devices, have boosted the interest in studying these oxides in ultrathin film form [2]. The use of Mössbauer spectroscopy in this type of studies has been, nevertheless, limited.

Relevant aspects in the investigation of these type of systems as, for example, the influence of the fabrication parameters on the structural, chemical and magnetic properties of these compounds, the conditions under which these oxides can be oxidized or reduced to obtain a different phase or the influence of thickness on their magnetic properties (e.g. spin re-orientation transitions), need to be studied in order to obtain the knowledge required for these materials to be used in the above-mentioned applications.

In this talk we will review some of the recent studies on the applications of Conversion Electron Mössbauer Spectroscopy to this kind of systems and will show how the use of complementary surface imaging and spectroscopic techniques can help to understand the growth of the various oxides on Ru (0001) as well as to follow the transformations occurring among them when the thin layers deposited are exposed to NO_2-controlled atmospheres. We will also discuss briefly on our recent activity in building an Integral Low Energy Electron Spectrometer (ILEEMS) and its ability to study thin layers of iron-containing materials.

[1] B. Quiao, A. Wang, X. Yang, L.F. Allard, Z. Jiang, Y. Cui, J. Liu, J. Li and T. Zhang, Nature Chemistry **3**, 634-641 (2011).
[2] M. Bibes, J.E. Villegas and A. Barthélémy, *Advances in Physics* **60**, 5-84 (2011).