Magnetic behaviour in copper doped $YMnO_3$ and $LuMnO_3$ multiferroic materials

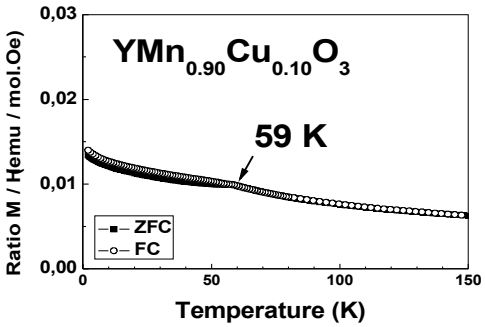
L. Jeuvrey, O. Peña

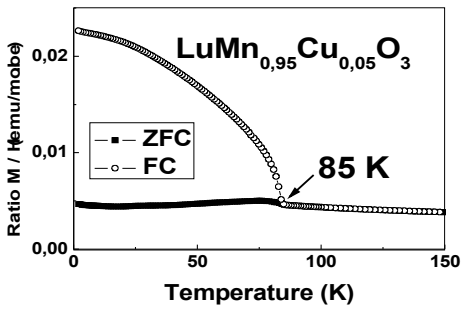
Sciences Chimiques de Rennes. UMR 6226. Université de Rennes 1, France

One of the main goals in our research is the description of the main interaction mechanisms in functional materials, in particular magnetic oxides. We have been studying $REMnO_3$ perovskites where RE^{3+} or Mn^{3+} are partially substituted by divalent ions. As a result, part of Mn^{3+} transforms into Mn^{4+} and creates ferromagnetic Mn^{3+}-Mn^{4+} interactions [1]. Our group has been studying the Y-based and Lu-based manganites for which, due to the empty *d* shells of yttrium and lutetium, the magnetic measurements allow a direct study of the interactions between Mn-site ions. However, only a few papers report on substituted $YMnO_3$ with hexagonal structure, which is a multiferroic material [2]. We present therefore our work on the substitution of Mn^{3+} by Cu^{2+}, in $YMnO_3$ and $LuMnO_3$ compounds which retain the multiferroic hexagonal structure.

We present herein our work on $YMn_{1-x}Cu_xO_3$ and $LuMn_{1-x}Cu_xO_3$ ($0 \leq x \leq 0.15$) synthesized by a modified Pechini process using metal oxides dissolved in nitric acid. The ratio metal-nitrates/citric-acid/ethylene-glycol was 1:2:4 at pH = 1. The resulting powders, after elimination of organic elements, were synthesized at 1150 °C-1250 °C, pelletized and sintered at 1300 °C. X-Ray diffraction data showed pure samples crystallized in the noncentrosymetric hexagonal structure, with monotonous variation of the lattice parameters with increasing Cu content. An enhanced grain growth when increasing the copper content was observed by SEM pictures, probably due to the presence of a liquid copper-oxide phase playing the role of a precursor in the formation of the pseudo-ternary phase.

Magnetic measurements were performed on a Quantum Design MPMS-XL5 SQUID susceptometer between 2 K and 300 K. For $YMn_{1-x}Cu_xO_3$ samples, ZFC/FC cycles showed AFM behaviour with a slight irreversibility at a temperature T_N, which ranges from 70 K to 49 K with increasing Cu content. No apparent ferromagnetic (FM) component was observed, but a slight hysteresis is visible on M(H) measurements. On the other hand, ZFC/FC cycles of $LuMn_{1-x}Cu_xO_3$ samples showed a definite FM behaviour while the M(H) measurements showed only slight hysteresis effects. These different magnetic behaviours can be explained in terms of structural differences between the two compounds. The $Lu_{1-x}Y_xMn_{0.9}Cu_{0.1}O_3$ solid solution presents FM behaviour for $x \leq 0.2$. In this compound the average A^{3+}-site ionic radius is equivalent to $r(Yb^{3+})$.





[1] O. Peña, A.B. Antunes, G. Martinez, V. Gil, C. Moure, J. Magn. Magn. Mater., 310 (2007) 159-168.

[2] E. Bertaut, R. Pauthenet, M. Mercier, Physics Letters 7 (1963) 110-111.