11th International Conference on Advanced Materials

Rio de Janeiro Brazil
September 20 - 25

ICAM 2009

Weak ferromagnetism at room temperature in the novel cobaltite $YBaCo_4O_{7+\delta}$

J. L. Izquierdo(1), J. F. Montoya(1) , A. Gomez(2), C. Paucar(1), and O. Morán(1)*

(1) Laboratorio de Materiales Cerámicos y Vítreos, Departamento de Física, Universidad Nacional de Colombia, Sede Medellín, A.A. 568, Medellín, Colombia
(2) Departamento de Ingeniería de Materiales, Universidad Nacional de Colombia, sede Medellín, A.A. 568, Medellín, Colombia
* Corresponding author: e-mail: omoranc@unalmed.edu.co

Abstract – Polycrystalline samples of the new cobaltite $YBaCo_4O_{7+\delta}$ were obtained through standard solid state reaction und their structural, electrical and magnetic properties carefully studied. X-ray powder diffraction pattern showed reflexes corresponding to a pure hexagonal structure. Careful SQUID measurements showed weak ferromagnetic ordering at room temperature with a magnetic saturation of $5x10^{-3}$ μ_B/Co ($2x10^{-2}$ μ_B/Co at 5 K). Weak ferromagnetic ordering at RT was also observed by measuring the dependence of Magnetization on the temperature. Thus, the magnetic behavior may be interpreted as a spin glass-like state with a weak ferromagnetic component.

Cobalt-containing oxide phases attract a considerable attention due to their valuable properties, including a high level of oxygen ionic and electronic conductivity [1], high catalytic and electrocatalytic activity [2], magnetic ordering [3] and superconductivity phenomenon [4]. Therefore, a search for new cobaltite-based materials with improved functional characteristics is a very important challenge. Recently, the new type of ceramic compound $YBaCo_4O_7$, denoted 114, was reported to exhibit an unusual magnetic behavior, which resembled that of a spin-glass phase [5]. In spite of the predominantly antiferromagnetic character of the exchange interactions between cobalt ions, the ferromagnetic component seems to be strong enough as to be detected still at room temperature. In this way, it is interesting to study how the magnetic correlation grows in this geometrically frustrated system with decreasing temperature. In this work, powders of $YBaCo_4O_{7+\delta}$ were obtained from stoichiometric mixtures of Y_2O_3, $BaCO_3$ and Co_3O_4 reactants. After mixing the constituents thoroughly in an agate mortar, the resulting powder was slowly heated in air (5 ℃/mi n) up to 1200 ℃ and calcined for 48 h. The sample was then cooled inside the furnace at an ambient rate. Some reaction occurred between Co and the alumina crucible, partly coloring it blue. The black single phase $YBaCo_4O_{7+\delta}$ powder was grounded and then pressed into pellets (~3 cm in diameter and thickness ~3 mm) which were finally sintered at 1100 ℃ for 11 h in air. The so fabricated samples were characterized after their structural, morphological, electrical and magnetic properties. Carefully magnetic measurements were carried out in the temperature range 2-400 K using a Quantum Design SQUID magnetometer.

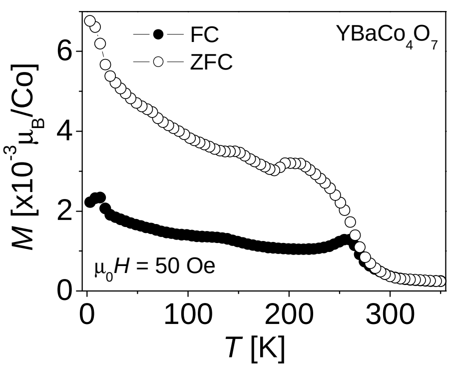

Figure 1: Temperature dependence of the ZFC and FC magnetization of polycrystalline $YBaCo_4O_{7+\delta}$ measured in a 50 Oe magnetic field.

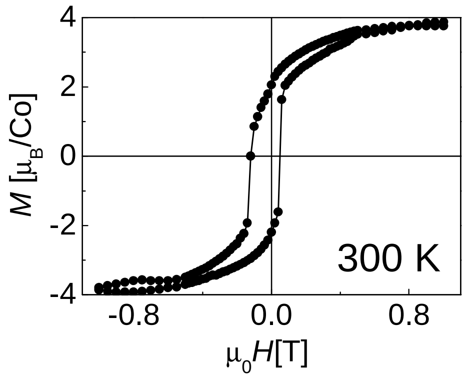

Figure 2: *M-H* hysteresis loops of polycrystalline $YBaCo_4O_{7+\delta}$ recorded at 300 K
.

[1] T.J. Mazanec, Solid State Ionics 70/71 (1994) 11.
[2] V.V. Kharton, A.A. Yaremchenko, E.N. Naumovich, J. Solid State Electrochem. 3 (1999) 303.
[3] M.A. Senaris-Rodrigues, J.B. Goodenough, J. Solid State Chem. 118 (1995) 323.
[4] K. Takada, H. Sakurai, E. Takayama-Muromachi, F. Izumi, R.A. Dilanian, T. Sasaki, Nature 422 (2003) 53.
[5] M. Valldor, Solid State Sci. **6** (2004) 251.