School on *Nanomaterials for magnetism and spintronics*

Ecole Franco - Coréenne

IPCMS Université Louis Pasteur - Strasbourg
LPM Université Henri Poincaré - Nancy
Ewha University - Séoul

18-23 FÉVRIER 2008

PROGRAMM

MONDAY FEBRUARY 18, 2008

9h15-9h30 - Welcome B. Doudin (Strasbourg)
9h30-10h15 - Introduction W. Weber (Strasbourg)
10h15-11h00 - Thin films and nanostructures, fabrication and properties (1) P. Panissod (Strasbourg)
11h30-12h15 - Thin films and nanostructures, fabrication and properties (2) P. Panissod (Strasbourg)
12h-13h00 - Materials for Spintronics T.H. Kim (Seoul)

15h00-15h45 - Transport through magnetic domain walls D. Weinmann (Strasbourg)
15h45-16h30 - Nanoparticles (1) G. Pourroy (Strasbourg)
17h00-17h45 - Nanoparticles (2) G. Pourroy (Strasbourg)

TUESDAY FEBRUARY 19, 2008

9h30-10h15 - Magnetic oxides A. Maignan (Caen)
10h15-11h00 - Ferroelectric materials A. Maignan (Caen)
11h30-12h15 - Multiferroics A. Maignan (Caen)
12h15-13h00 - New switching molecular systems (1) J.F. Letard (Bordeaux)

15h00-15h45 - New switching molecular systems (2) J.F. Letard (Bordeaux)
15h45-16h30 - Carbon-based spintronics (1) J. Trbovic (Basel)
17h00-17h45 - Carbon-based spintronics (2) J. Trbovic (Basel)

WEDNESDAY FEBRUARY 20, 2008

9h30-11h00 - Spin electronics devices and design (1+2) M. Hehn (Nancy)
11h30-12h15 - Current-induced switching : spin transfert torque S. Mangin (Nancy)
12h15-13h00 - Magnetoelectric interfaces and ferroelectric tunnel junctions (1) E. Tsymbal (U. of Nebraska)

15h00-15h45 - Magnetoelectric interfaces and ferroelectric tunnel junctions (2) E. Tsymbal (U. of Nebraska)
16h15-17h00 - Exchange coupling Y. Henry (Strasbourg)
17h00-18h30 - Laboratory visits (1) nanofabrication rooms or (2) physical measurements

THURSDAY FEBRUARY 21, 2008

9h30-11h00 - Scanning probe microscopies and magnetism (1+2) J.P. Bucher (Strasbourg)
11h30-12h15 - Low-dimensionality magnetism M. Drillon (Strasbourg)
12h15-13h00 - Talks of participants (1)

15h00 -16h00 - Talks of participants (2)
16h30-18h30 - Poster session

FRIDAY FEBRUARY 22, 2008

9h30-10h15 - Correlation effects in transport D. Weinmann (Strasbourg)
10h15-11h00 - New quantum transport phenomena in magnetic nanojunctions E. Tsymbal (U. of Nebraska)
11h30-13h00 - Laboratory visits (2) physical measurements or (1) nanofabrication rooms

15h00-16h30 - Microwave magnetism (1+2) M. Bailleul (Strasbourg)
17h00-17h45 - Femtosecond spin dynamics in semiconductors P. Gilliot (Strasbourg)
17h45-18h30 - Femtosecond magnetization dynamics of nanoparticles V. Halté (Strasbourg)

THE STUDY OF RELAXATION BEHAVIOR ON CO-DOPED IN $LIFEPO_4$ BY MOESSBAUER SPECTROSCOPY

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Since the magnetoelectric (ME) effect was observed in Lithium-orthophosphates $LiMPO_4$ (M=Fe^{+2}, Mn^{+2}, Co^{+2}, Ni^{+2}), have been extensively investigated for information storage and electronic, magnetic and optical switches [1]. Especially, $LiFePO_4$ compound is very charming for application rechargeable Li batteries because of high theoretical energy density, low cost, remarkable thermal stability and environmental friendliness. And, recently, the observation of ferrotoroidic (FTO) domains in $LiCoPO_4$ was reported by Bas. Van Aken et al [2]. From these complex magnetic structures, $LiMPO_4$ show the various anomaly effects. Therefore, it is essential to determine the unusual magnetic properties of $LiMPO_4$ in low temperatures for properly understand the mechanism. We present crystallographic and magnetic properties of $LiFe_{1-x}Co_xPO_4$ using the Mössbauer spectroscopy and the x-ray diffraction (XRD).

The polycrystalline sample of $LiFe_{1-x}Co_xPO_4$ was made by using a direct reaction. Lithium carbonate (Li_2CO_3), iron(II) oxalate dehydrate ($FeC_2O_4 \cdot 2H_2O$), ammonium dihydrogen phosphate ($(NH_4)H_2PO_4$), and cobalt oxide (CoO), were mixed in stoichiometric ratios and sealed in evacuated quartz tubes. The X-ray (Cu-Kα radiation) diffraction patterns exhibited a orthorhombic phase for $LiFePO_4$.The crystal structure was determined to be a orthorhombic with space group *Pnma* by using a Rietveld refinement. The lattice constant a_0 = 10.329 and 10.241, b_0 = 6.006 and 5.924, and c_o = 4.698 and 4.698 at x = 0, 1, respectively. The Mössbauer spectrum shows a large asymmetric and distorted line broadening at 4.2 K. We have analyzed the Mössbauer spectra by using the full Hamiltonian for the ^{57}Fe nucleus and by considering both the magnetic dipole and the electric quadrupole interactions. The magnetic hyperfine field (H_{hf}) and the quadrupole splitting (ΔE_Q) at 4.2 K were fitted and yielded the following results: H_{hf} = 135 and 127 kOe , θ = 22.5 and 16°, φ = 12.5 and 0°, η = 1.0 and 0.95, $\Delta E_Q = (1/2)e^2qQ[1+(1/3)\eta^2]^{1/2}$ = 2.85 and 0.36 mm/s, and R = 2.7 and 3.0 at x = 0 and 1, respectively.

References

[1] I. Kornev, physical Revi. B, **62**, 12247 (2000).
[2] B. B. V. Aken, Nature, **449**, 702 (2007).