11th International Conference
on Advanced Materials
Rio de Janeiro Brazil
September 20 - 25
ICAM2009

Structural Refinement in the Sol-Gel Processed Magnetoelectric Compounds

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Abstract – Multiferroics are materials in which two or all three of the properties, ferroelectricity, ferromagnetism, and ferroelasticity occur in the same phase. Specifically the bismuth ferrite ($BiFeO_3$) is a very promising candidate for technological applications and the $FeAlO_3$ compound emerges as an extremely attractive lead-free multiferroic material. In this way, a detailed structural study was conducted through X-ray diffraction (XRD) in $BiFeO_3$ and $FeAlO_3$ samples synthesized by the sol-gel technique. Crystallographic parameters were refined by carrying out a Rietveld analysis (FULLPROF program).

Multiferroics are materials in which two or all three of the properties, ferroelectricity, ferromagnetism, and ferroelasticity occur in the same phase. In particular, multiferroic magnetoelectrics represent the materials that are simultaneously ferromagnetic and ferroelectric, with or without ferroelasticity. These materials have been attracted much academic and technological attention in the last years. This is because they present potential applications in those areas where (anti)ferroelectric and (anti)ferromagnetic materials are extensively employed. In this way, the electric and magnetic order parameter coupling opens the possibility of the integration between the ferroelectromagnetics physical properties through the magnoelectric effects, and can promote interesting technological advances in many electro-electronic technologies (this include multiple-state memory elements, electric field controlled ferromagnetic resonance devices, and variable transducers with either magnetically-modulated piezoelectricity or electrically-modulated piezomagnetism), in spite of the open issues concerning the origin of the ferroelectromagnetism. Specifically the bismuth ferrite ($BiFeO_3$) is a very promising candidate for technological applications and the $FeAlO_3$ compound emerges as an extremely attractive lead-free multiferroic material. In this way, a detailed structural study was conducted through X-ray diffraction (XRD) in $BiFeO_3$ and $FeAlO_3$ samples synthesized by the sol-gel technique. Crystallographic parameters were refined by carrying out a Rietveld analysis (FULLPROF program). In this work new space groups are proposed to the crystal structure of BiFeO3 compound. The authors would like to thank CAPES, CNPq and Fundação Araucária de Apoio ao Desenvolvimento Científico e Tecnológico do Paraná (prot. 10797) Brazilian agencies for financial support.

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