Neutron Diffraction Study of the $Ga_xFe_{2-x}O_3$ Compounds

Christophe Lefevre[1,2]*, Francois Roulland[1],Alexandre Thomasson[1], Christian Meny[1], Florence Porcher[3], Gilles André[3] and Nathalie Viart[1]

[1]Institut de Physique et Chimie des Matériaux de Strasbourg (UMR 7504 CNRS-UDS), BP 43, 23, rue du Loess, 67034 Strasbourg Cedex 2, France

[2]Department of Physics, Ewha Womans University, Seoul, 120-750, Korea

[3]Laboratoire Léon Brillouin (UMR12 CEA-CNRS), Bât 563 CEA Saclay, 91191 Gif sur Yvette, France

Neutron scattering methods are indispensable in studying structure-property relationships. The determination of magnetic structure in magnetically ordered materials makes neutron diffraction among the major tools in the research on magnetoelectrics because to understand why a given compound displays or does not display the expected properties calls for detailed information on microscopic level. We present here a thermal study by neutron diffraction of both $GaFeO_3$ and $Ga_{0.6}Fe_{1.4}O_3$ samples which have been proved to be magnetoelectric at room temperature making them then extremely interesting in new potential electronic device. These compounds crystallize in an orthorhombic structure (S.G: $Pc2_1n$) with a~8.7 Å, b~9.4 Å and c~5.1 Å. The compounds have been prepared as polycrystalline powders by solid state reaction route. Neutron experiments were carried out at the LLB (Saclay, France). The powder diffraction patterns in the paramagnetic state have been registered at 300K for $GaFeO_3$ and at 400K for $Ga_{0.6}Fe_{1.4}O_3$ on the 3T2 (λ=1.225Å) diffractometer and thermal evolution from 1.8 to 290 K of the diffraction pattern have been recorded on the G4.1 (λ=2.423Å) multidetector diffractometer. The nuclear refinements indicate a preferential cationic distribution within the structure. Moreover, astonishing results about the magnetic structures have been obtained. Indeed, the magnetic moments of $GaFeO_3$ are oriented along the *c* axis whereas a tilt is observed for $Ga_{0.6}Fe_{1.4}O_3$.These structures as well as the different magnetic parameters will be introduced.