High-pressure structural and magnetic phase diagram of NiFe2O4

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Abstract

NiFe2O4 is known to crystallize in the cubic Fd-3m spinel structure with general formula AB2O4. In this compound, the Fe3+ ions are occupying the tetrahedral A-site and both Fe3+ and Ni2+ ions locate on the octahedral B-site. This system ferrimagnetically orders below 870 K and the Ni2+ and Fe3+ on the octahedral B-site are antiferromagnetically coupled to the Fe3+ on the tetrahedral A-site [1]. The importance of this compound was recently reconsidered following the discovery of its possible multiferroic properties by Dey et al [2]. Indeed, this study, combining macroscopic characterization and X-ray diffraction on powder, revealed the presence of a structural distortion from Fd3 ?m to the P4_1 22 occurring below 98K, concomitant to the appearance of an electric polarization that could be explained by a Fe3+ and Ni2+ cationic order on the octahedral site [2]. To further characterize this structural distortion and possible cationic order, we recently performed X-ray diffraction, Resonant X-ray diffraction (RXD), X-ray Magnetic Circular Dichroism (XMCD) and X-ray Absorption Spectroscopy (XAS) measurements on our NiFe2O4 single-crystals and none of these experiments confirmed the structural distortion reported in the literature. However, while our attempt to confirm the structural distortion at low temperature failed so far, our recent XAS and XMCD measurements on the ODE beamline at SOLEIL and single crystal diffraction on ID15b at ESRF under pressure surprisingly revealed the presence of a complex magnetic and structural phase diagram.

[1] N. S. S. Murthy et al., Phys. Rev. 181, 969–977 (1969), [2] J. K. Dey et al., Phys. Rev. B 99, 144412 (2019)