Considerable attention is currently focused on metal-organic polymers combining two or more functionalities, e.g., conductivity and magnetism, magnetic and optical properties, porosity and magnetism. The inclusion of two different metallic atoms into the niccolite-like structure framework have led to the formation of isostructural compounds of formulae \([\text{NH}_2(\text{CH}_3)_2]_n[\text{M(II)Fe(III)}(\text{HCOO})_6]_n\) with \(\text{M(II)} = \text{Fe(1), Co(2) and Mn(3).}\)

The nuclear characterization of these compounds has been done combining high resolution neutron diffraction together with synchrotron X-ray diffraction at 45K. In compound 1 neutron studies show a sequence of phase transition involving nuclear transformation as well as a long range magnetic order. The nuclear phase transition involves an ordering of the \(\text{NH}_2(\text{CH}_3)_2\) countercation within the cavities framework which is related with a change in the electric behaviour from paraelectric to antiferroelectric.\[1\] However, in compounds 2 and 3, multipattern refinements combining X-rays and neutron radiation, permit the localization of the hydrogen atoms of the \([\text{NH}_2(\text{CH}_3)_2]\) counter ions, and discards the occurrence of a structural phase transition.\[2\]

Below TN, the magnetic order in these compounds vary from an antiferromagnetic behaviour with a weak spin canting for compound 3 to a ferrimagnetic behaviour for 1 and 2 compounds, due to the competition of the different magnetic moments present in each sublattices (the different spin state involved in those complexes are \(S = 5/2\), for \(\text{Fe(III)}\) and \(\text{Mn(II)}\) while it is 3/2 and 2 for \(\text{Co(II)}\) and \(\text{Fe(II)}\), respectively).

Neutron studies using single crystal and powder diffraction techniques have been carried out at Institut Laue Langevin (Grenoble, France) to elucidate the different magnetic behaviour present in these compounds.


Keywords: Neutron diffraction, multiferroic molecular compounds, formate compounds