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Sheding light on the multiferroicity in Mn1-xCoxWO4 using superspace formalism

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The use of the superspace symmetry formalism allows to rationalize the physical properties induced by an incommensurate magnetic ordering [1]. The incommensurate magnetic structures (ICMS) in Mn1-xCoxWO4 have been studied in the light of this formalism. MnWO4 is a multiferroic material in which the magnetic order of one of its magnetic phases induces ferroelectricity. Like most multiferroic materials MnWO4 is extremely sensitive to small perturbations such as chemical substitution. It turned out that doping with Co^{2+} is particularly interesting since it strongly stabilizes the multiferroic phase at low temperatures, and moreover, by increasing the cobalt amount in the crystals the orientation of the electric polarization flops from the b axis to the ac plane [2]. This change of orientation is linked to a symmetry change. The ICMS of the $x = 0$ and $x = 0.10$ compounds, which exhibit completely different behavior, have been studied thoroughly using superspace formalism. We have found, not only the symmetry of the magnetic structures and their intrinsic restrictions, but also information about the tensor properties of each incommensurate phase, such as ferroelectric and magnetostructural properties [3]: in the paramagnetic state, there is a unique independent magnetic atom in the crystallographic unit cell in both cases, but when the system enters into the multiferroic phase, this is no-longer true. In the multiferroic phase of MnWO4, the two Mn atoms in the unit cell become symmetry independent, whereas in the $x = 0.10$ substituted compound, they are still symmetry-related. This difference is related to the change of the electric polarization.

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