MS46-O3 Towards to control the Dzyaloshinkii-Moriya interaction in chiral magnets with $P2_13$ crystal structure

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The sense of chiral magnetic ordering, observed in compounds with chiral crystal structure, depends on the sign of the Dzyaloshinskii-Moriya interaction (DMI). We have probed structural and magnetic chiralities for a series of monogermanides and monosilicides of 3d-metals as well as for Cu_2OSeO_3 single crystals. Scattering of polarized neutrons on chiral magnetic structures was used to determine the absolute magnetic configuration. The absolute crystal structure was established by the X-ray single crystal diffraction data providing that resonant contribution enables to observe violation of the Friedel law.

We show that the chiral magneto-lattice coupling mapped phenomenologically as the DMI could be applied to control magnetic chirality as needed for spintronics applications. The sign of the Dzyaloshinskii constant D defines the chirality of magnetic helix γ_m relative the structural chirality Γ_c. The product $\mathrm{sgn}(D) \times \Gamma_c \times \gamma_m$ is an invariant with respect to inversion and time-reversal operations ensuring that left-handed and right-handed polymorphs have the same energy. For monosilicides and monogermanides the sign of D depends on 3d-element that results in a number of interesting phenomena for the solid solutions.

Keywords: chirality, absolute structure, Dzyaloshinskii-Moriya interaction

MS46-O4 The use of resonant X-ray diffraction to tune destructive interference as a highly sensitive probe for structural distortions

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Resonant X-ray diffraction was used to study site-specific deviations from the ideal perovskite-type structure of strontium titanate ($SrTiO_3$). Varying the X-ray wavelength close to the absorption edge of a resonant atom allows to precisely tune its scattering amplitude. For an ideal crystal structure and Bragg reflections where atoms scatter out of phase, this effect can be used to nullify the structure factor due to destructive interference. Tiny deviations of the atom positions from the average structure and the resulting change of scattering phase can, after averaging, be expressed as an extra factor to the scattering amplitude. In the case where the displacement is due to temperature, this parameter is well known as the Debye-Waller factor. In general, this factor is different for each atom which results in a change of the conditions for destructive interference and has a strong effect on the resonant diffraction spectra of the above mentioned reflections. The choice of reflection within this set defines the resolution and the direction probed by the method. We used this effect to characterize the displacement of atoms in $SrTiO_3$ caused by temperature, defects and external electric field. The measurements were performed in the region of the Sr-K absorption edge on {00l, l=2n+1} reflections. In the focus of our investigations was the strained phase of $SrTiO_3$ which forms during application of a 1 MV/m DC electric field as reported in literature [1]. It could be validated that the new phase is polar which is expressed as a displacement of titanium from the center position in field direction. The method has proven a high sensitivity already for displacements in the 0.001 Å regime.

[1] J. Hanzig, M. Zschornak, et al., Phys. Rev. B 88, 024104 (2013), doi:10.1103/PhysRevB.88.024104

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