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Direct correlation between magnetic field and cycloidal rotation on CoCr2O4 and Ge doped CoCr2O4

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The large interest from the scientist community on the magnetoelectric multiferroics comes, mostly, from the technological prospects on those [1,2]. Especially, the type II multiferroics, where the magnetic order drives the electric polarization, being both order parameters strongly correlated. The strong correlation gives the possibility of switching the magnetization by electric field or vice versa. This can be understood as low energy consumption, more energetically efficient and faster-switching devices.

CoCr2O4 (CCO), type II multiferroic, is one of the few magnetoelectric multiferroics which exhibits a transversal conical magnetic structure, giving as a result of a net polarization and magnetization [3]. Here, we present a study using soft x-ray scattering under high and low magnetic fields, to characterize a Ge doped CCO compound, to compare with pure CCO and follow their conical order of the multiferroic phase under high magnetic fields. We report the unexpected control of the spin spiral direction, and as a consequence the polarization direction, via the field cooling process. This effect is observed in Ge-CCO as in CCO. In addition, the (qq0) magnetic modulation vector of Ge-CCO presents a double feature with opposite sign, which may describe a scenario of multiple spiral sublattices.

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[1] N. A. Spaldin et al., "The Renaissance of Magnetoelectric Multiferroics, Science", vol. 309, 391-392 (2005).
[2] M. Fiebig, et al., "The evolution of multiferroics", Nature Reviews Materials, vol.1, p. 16046, 2016.
[3] Y. Yamasaki et al., Magnetic Reversal of the Ferroelectric Polarization in a Multiferroic Spinel Oxide. Phys.Rev. Lett. 96, 207204 (2006).

Position

Phd

Author: ORTIZ, Nazaret (PSI)

Co-authors: Dr PARCHENKO, Sergii; Dr LINARES MARDEGAN, José Renato; PORER, Michael; Dr SCHIERLE, E (Helmholtz-Zentrum Berlin fur Materialien und Energie GmbH); Dr WESCHKE, E (Helmholtz-Zentrum Berlin fur Materialien und Energie GmbH); RADOVIC, Milan (Paul Scherrer Institut); STAUB, Urs (Paul Scherrer Institut)

Presenters: ORTIZ, Nazaret (PSI); Dr PARCHENKO, Sergii

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