Poster Presentation

MS90.P03

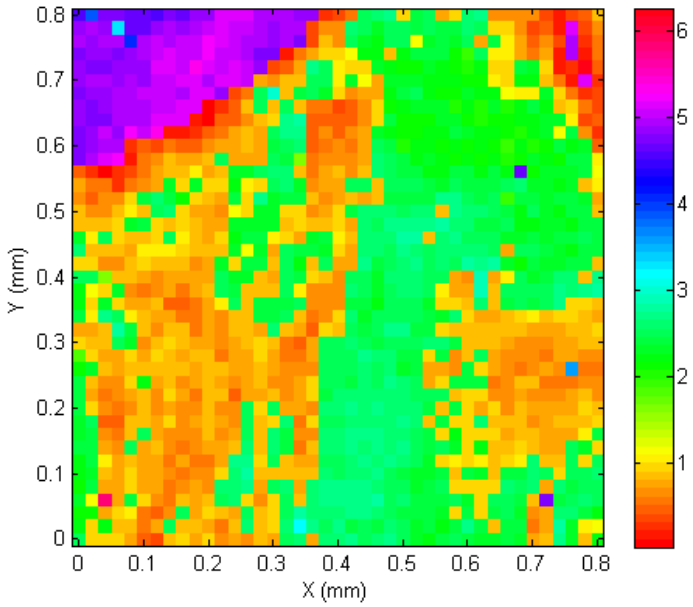
Mapping domains in the weak ferromagnet CoCO3

G. Beutier[1], S. Collins[2], G. Nisbet[2], E. Ovchinnikova[3], V. Dmitrienko[4]

[1]SIMaP, CNRS & Grenoble INP & Grenoble Alpes University, Grenoble, France, [2]Diamond Light Source, Harwell, United Kingdom, [3]Faculty of Physics, Lomonosov Moscow State University, Moscow, Russia, [4]Shubnikov Institute of Crystallography, Moscow, Russia

The Dzyaloshinskii-Moriya (DM) interaction [1,2] produces a perpendicular component in the coupling of neighbouring spins when the symmetry between the spins is low, or can drive a distortion of intervening atoms to create a spontaneous electric polarization in some magnetoelectrics. In weak ferromagnets, the canting of the atomic moments due to the DM interaction leads to a small parasitic ferromagnetic polarization in an otherwise antiferromagnetic structure. Recently, we determined the sign of the Dzyaloshinskii–Moriya interaction in the weak ferromagnet FeBO3 by measuring the interference between resonant x-ray scattering and non-resonant magnetic scattering at a forbidden reflection [3]. Using the same method, we determine its sign in the carbonates MnCO3 and CoCO3. These isostructural materials turn out to show opposite interference effect: further analysis is underway to confirm or not that they actually have Dzyaloshinskii–Moriya interactions of opposite signs. We go one step further and apply the same principle to map the absolute orientation (direction and sense) of the magnetisation in a crystal of CoCO3: by mapping the 009 forbidden reflection at 3 azimuthal angles, we obtain 3 projections of the local magnetisation allowing its unambiguous determination. The reconstructed magnetisation map, whose spacial resolution is about 20 µm x 20 µm (the size of the focused x-ray beam), was measured after zero-field cooling to 9 K, well below the Neel temperature. It confirms the strong in-plane anisotropy of the material, with magnetisation domains essentially along 6 orientations separated by 60°. Two of them, with orientation at 60° to each other (green and orange in the figure), are largely dominant on the part of the sample that was imaged. To our knowledge it is the first experimental determination of the absolute orientation of the magnetic moments in a weak ferromagnet. The figure shows the reconstructed map of magnetisation, with the direction of the local in-plane magnetisation encoded (in radians) on a periodic colour map.

[1] *Dzyaloshinsky, J.Phys.Chem. Solids 4, 241 (1958),* ***[2]*** *Moriya, Phys. Rev. Lett. 4 228 (1960),* ***[3]*** *Dmitrienko et al, Nature Physics (2014) http://dx.doi.org/10.1038/nphys2859*



Keywords: Dzyaloshinskii–Moriya interaction, Resonant X-ray Diffraction, Cobalt carbonate