Poster Presentations

[MS20-P03] Low temperature and high diffraction of multiferrioc $MnWO_4$

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MnWO4 is a multiferroic - type II material in which specific long-range magnetic order induces a ferroelectric phase transition [1]. This so called spindriven magneto-electrics possesses high magnetoelectric coupling that allows switching of the ferroelectric polarization by an external magnetic field. Additionally, $MnWO_4$ is a rare, one of a very few crystals in which the electric-field induced switching of the chiral magnetism at constant temperature was observed [2]. $MnWO_4$ belongs to the wolframite type crystal structure. It crystalizes in the monoclinic *P*2/*c* space group with two formula units per unit cell. Distorted MnO6 octahedra and WO6 octahedra form the edge sharing zigzag-like (MnO6) and (WO6) chains along the [001] direction. Complex magnetic structures emerge as a consequence of competing inter- and intrachain exchange interactions.

$MnWO_4$ undergoes three successive magnetic phase transitions at T_{M1}=7.5 K, T_{M2}=12.3 K and T_N=13.5 K which separate different magnetic structures termed AF1, AF2 and AF3 [3]. In the AF2 phase an incommensurate elliptical spin configuration induces the spontaneous electric polarization along the [010] axis. A detailed experimental study of the mechanisms associated with the coupling between magnetic order and crystal lattice in $MnWO_4$ is missing even though the ferroelectric AF2 phase reveals incommensurately modulated x-ray diffraction peaks [4]. Here, we report the results of diffraction experiment performed at low temperatures and at high pressures for $MnWO_4$.

HASYLAB. The sample was kept in cryostat, at temperatures ranging from 2 up to 70 K. We recorded additional diffraction effects that clearly indicate that the crystal structure changes across magnetic phase transitions, i.e. (1) commensurate, superstructure peaks that indicate lattice doubling in antiferromagnetic AF1 phase, (2) very weak incommensurate diffraction peaks in ferroelectric phase AF2, pointing to modulation of the crystal structure in multiferroic phase, (3) several moderately strong diffraction peaks in AF1, AF2 and AF3 phases and in paramagnetic phase that are forbidden for the *c* glide plane. It indicates that the real symmetry of the $MnWO_4$ is different from *P*2/*c* at low temperatures. The results indicate magneto-elasting coupling through the magnetic phase transitions as well as may explain an unusual downturn of phonon shifts below 100 K encountered in Raman scattering.

High-pressure single-crystal X-ray diffraction was performed in Merrill-Bassett diamond anvil cell at Kuma KM4-CCD diffractometer (Mo K_α) at room temperature. It was found that similar diffraction phenomena that come from the low temperature structure appear also at moderate pressures (2.4(2)GPa).

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