# Experimental report

13/03/2019

**Proposal:** **5-31-2543**

**Council:** 4/2017

**Title:** Investigation of crystal and magnetic structure of a new manganese tellurate

**Research area:** Materials

**This proposal is a new proposal**

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**Samples:** Mn2TeO6
BiMnTeO6

| Instrument | Requested days | Allocated days | From | To |
|---|---|---|---|---|
| D2B | 2 | 2 | 19/03/2018 | 21/03/2018 |

**Abstract:**

First studied by Fruchart et.al, Mn2TeO6 was synthesized using solid state reaction and was reported as inverse trirutile structure. During the development and optimization of the solid state synthesis process, we discovered a new phase as an intermediate state in the phase mixture. Now finally it is possible to obtain it as a single phase using the spray drying method. Laboratory X-ray diffraction performed at room temperature indicateds that the new compound is single phase and may be indexed as trigonal cell using DICVOL software. Those structure paramters are similar to the ones reported for layered honeycomb tellurates, like BiFeTeO6. Magnetic susceptibility of the new trigonal Mn2TeO6 shows an antiferromagnetic transition around 11K in both ZFC and FC; while there is a subtle divergence at around 60K. To go further, we would like to perform a neutron powder diffraction study of the new trigonal Mn2TEO6 to investigate the crystal structure including oxygen positions, Mn and Te distribution on the cationic sites due to their strong contrast in NPD. In addition, we are also interested to perform a NPD on one member of the layer honeycomb of manganese based tellurates.

**Experimental report on experiment 5-31-2543, " Investigation of crystal and magnetic structure of a new manganese tellurate", at ILL beam lineD2B, from 19/03/2018 to 21/03/2019.**

The aim of the proposal was to shed light upon the structural temperature dependence of new manganese tellurates, mainly $Mn_2TeO_6$, in connection with their potential magneto-electric properties.
This investigation was carried out on new polymorph $Mn_2TeO_6$ powders inside vanadium can, in a cryostat. The beamline was set up with the high resolution, the wavelength of 1.594 and 2.398 Å.

The diffractograms were recorded, from 1.5 K and 293 K. The quality of the diffractogram was excellent (see Figure 1 up) and analysis (through Rietveld refinements) is currently being performed to identify the different phases observed depending on the Mn concentration (Mn rich, stoichiometric and Mn poor). It shows that only slight difference between three samples. Figure 1 down shows the Rietveld analysis of the 300 K $Mn_2TeO_6$ diffractogram, refined with *P*312 space group (*a* = 5.010Å, *c* = 4.659 Å, $\gamma = 120^{\circ}$). Crystal structure refinement indicates possible Mn-Te disordering within the honey comb layer (Figure 1 right). Nevertheless, the incommensurate magnetic peaks were observed at 1.5K for all samples. Further investigation is currently in progress.

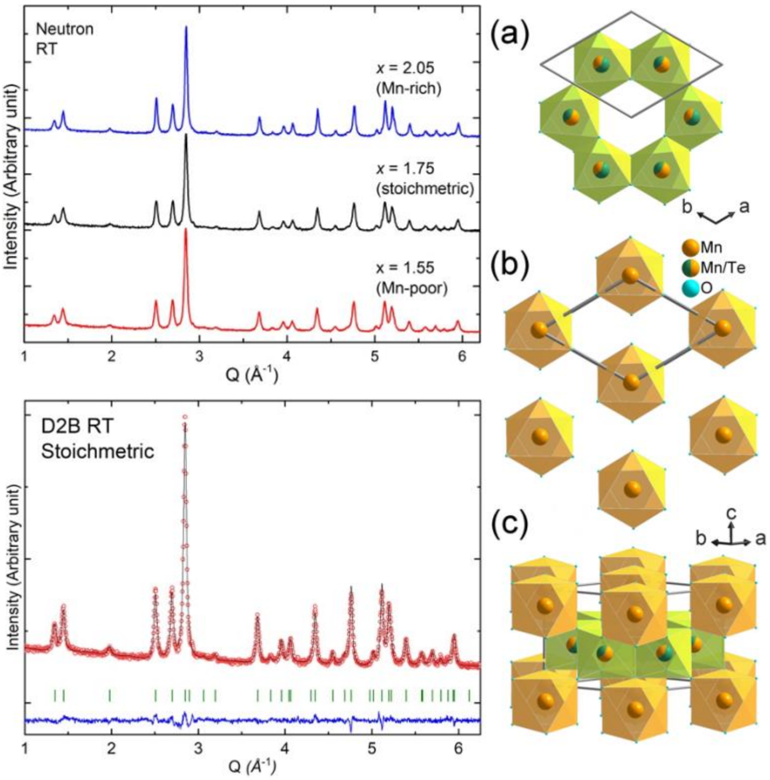


Figure 1 (up) Three diffractograms recorded for honey comb $Mn_2TeO_6$ different Mn concentration. (down) Rietveld refinement of honeycomb $Mn_2TeO_6$ (stoichmetric) using P312 space group. (right) Crystal structure of disorder $Mn_2TeO_6$ in honeycomb

Moreover, $BiMnTeO_6$ was measured at RT and refined crystal structure is in excellent agreement with synchrotron diffraction study. A first manuscript is being prepared, describing the room temperature crystal structure (N. Matsubara et al, in preparation (2019)).