Magnetic structure of the $(Tb_{1-x}Mn_y)MnO_{3-\delta}$ system

Hao Zhang,[1] Roxana Flacau,[2] Guobao Li[1]

[1] Beijing National Laboratory for Molecular Sciences (BNLMS), State Key Laboratory of Rare Earth Materials Chemistry and Applications, College of Chemistry and Molecular Engineering, Peking University, Beijing 100871, P. R. China
[2] Canadian Neutron Beam Centre, Chalk River Laboratories, Chalk River, ON, Canada

Six samples with the nominal formula $(Tb_{1-x}Mn_y)MnO_3$ (x=0.040, y=0.005 for S1; x=0.056, y=0.024 for S2; x=0.073, y=0.044 for S3; x=0.106, y=0.082 for S5; x=0.139, y=0.121 for S7; and x=0.155, y=0.140 for S8) have been characterized using neutron diffraction performed on the C2 High Resolution Powder Diffractometer at Canadian Neutron Beam Centre (Chalk River, Canada) and magnetic measurements.

Similar behaviors as $TbMnO_3$ have been found for S1 and S2. Figure 1 shows the temperature dependent neutron diffraction data of S1. It is found that the diffraction patterns collected at 43 to 290 K shown in Fig.1c are similar to each other. For the data collected at 10 K to 42K, new reflections are found, which are attributed to the sinusoidal antiferromagnetic ordering of Mn with a wave vector $\boldsymbol{q}$ = (~0.283, 0, 0) in the space group $Pna2_1$ setting after that reported for $TbMnO_3$[1,2] and similar to $(Tb_{1-x}Mn_y)MnO_{3-\delta}$ ($\delta\approx0$, x=0.089, y=0.063 noted as S4; or x=0.122, y=0.102 noted as S6) reported previously.[3] This magnetic structure is noted as magnetic phase A. And for the data collected at 3.5 to 8 K, round reflections are found, which can be attributed to the sinusoidal antiferromagnetic ordering of Tb with a wave vector $\boldsymbol{q}$ = (~0.415, 0, 0) in the space group $Pna2_1$ setting after that reported for $TbMnO_3$,[1,2] and noted as magnetic phase B. For S3, it is similar to S4. The magnetic diffraction peaks corresponding to the magnetic phase B are not observed. S5 is similar to S6. New magnetic diffraction peaks around 25° appear as shown in Figure 2, which are attributed to the antiferromagnetic ordering of Mn and Tb, and noted as magnetic phase C. In addition, the diffraction peaks corresponding to the magnetic phase A also appear in the neutron diffraction data collected at low temperature. As for S7 and S8, it is found that only magnetic diffraction peaks related to the magnetic phase C appear.

References

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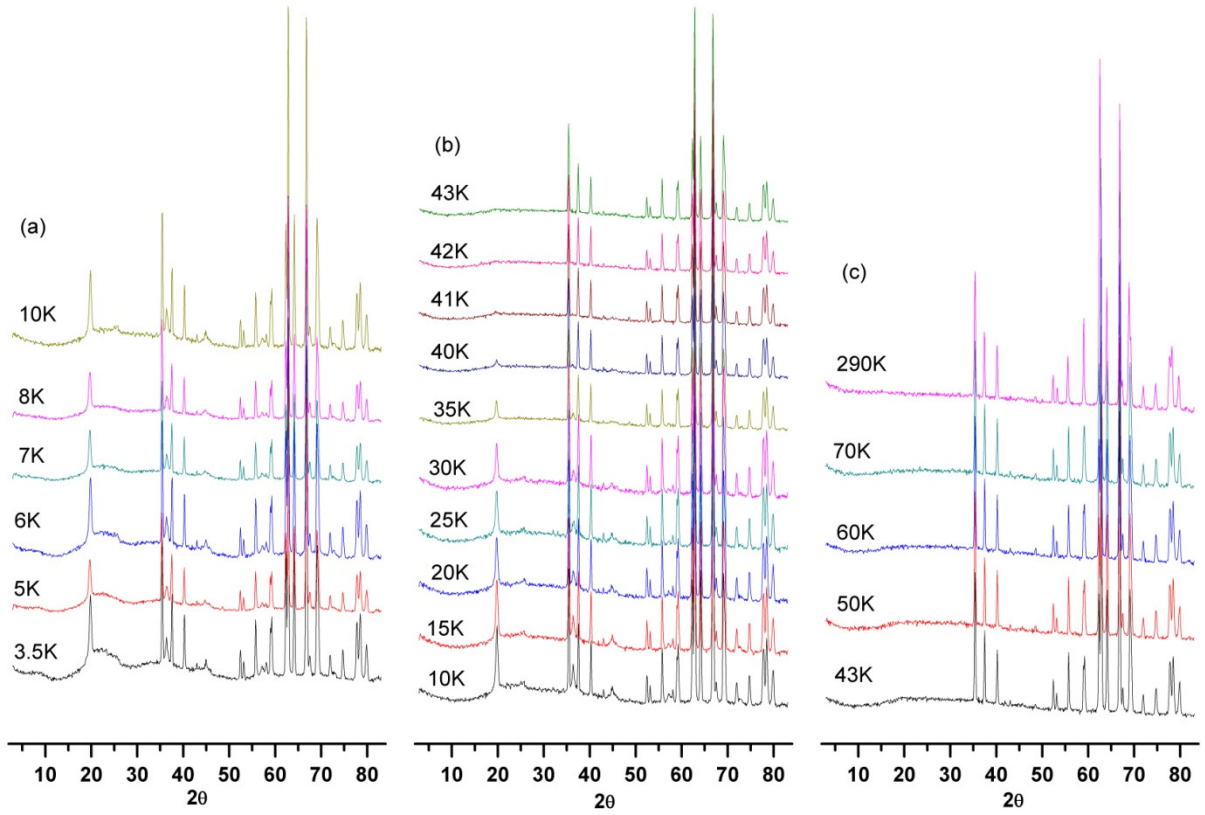

Figure 1 Neutron diffraction data collected for S1 at selected temperatures

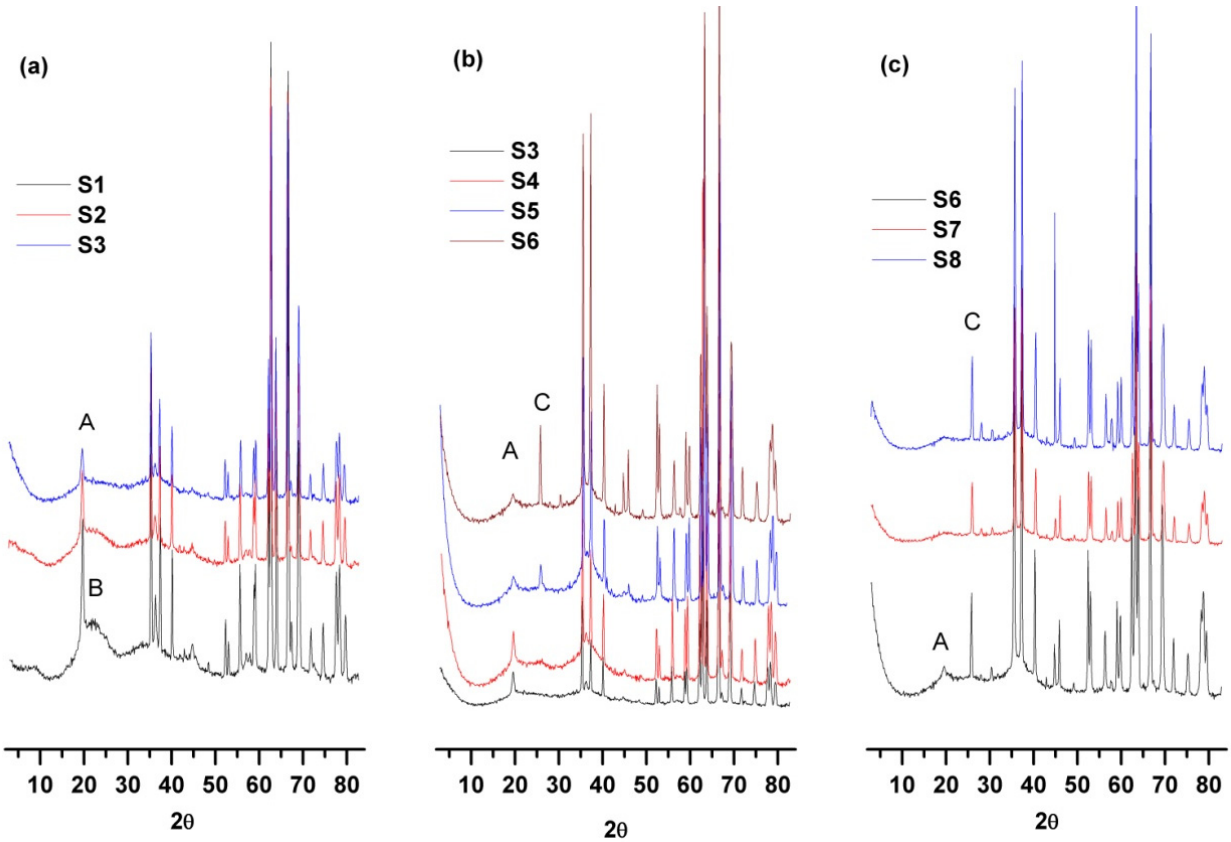

Figure 2 Neutron diffraction data collected for S1, S2, S4, S5, S6, S7, and S8 at 3.5K, and for S3 at 6K.