

Study on the spin flop transition of $s = 1$ one dimensional ferromagnetic spin chain in NiTe_2O_5

Oh, Y.S., Lee, J.H.; Park, D.; Lee, S.; Lee, J. (Physics, UNIST, South Korea)

Introduction

In a recent study of multiferroics in polar antiferromagnet Ni_3TeO_6 , under high magnetic field up to 100 Tesla, it has been reported that an unexpected additional metamagnetic transition exists ~ 52 T and magnetic-field-induced polarization at the transition is 4 times larger than at low field spin-flop transition at 9 T. The authors have insisted that the successive metamagnetic transition and colossal magnetoelectric effect are attributed to complex multiple exchange interaction between neighboring Ni^{2+} ions in face-sharing NiO_6 octahedra with zig-zag chain configuration [1].

One-dimensional chain compound NiTe_2O_5 has archetypical antiferromagnetic long-range order at 30.5 K and low field spin-flop transition at 8.3 T, as similarly observed in multiferroic Ni_3TeO_6 . The long-range order indicates that complex three-dimensional exchange interactions are dominant in NiTe_2O_5 even though edge-sharing NiO_6 octahedra form one-dimensional chain structure. The similarity of magnetic properties of NiTe_2O_5 and Ni_3TeO_6 motivates to investigate additional high-field metamagnetic transition in NiTe_2O_5 .

Experimental

Two pieces of NiTe_2O_5 single crystal are prepared as needle shape, where the long axis is parallel or perpendicular to the c -axis. The needle-shaped single crystals are loaded in a capsule for magnetization measurement using 65 T short-pulse magnet in NHMFL-LANL.

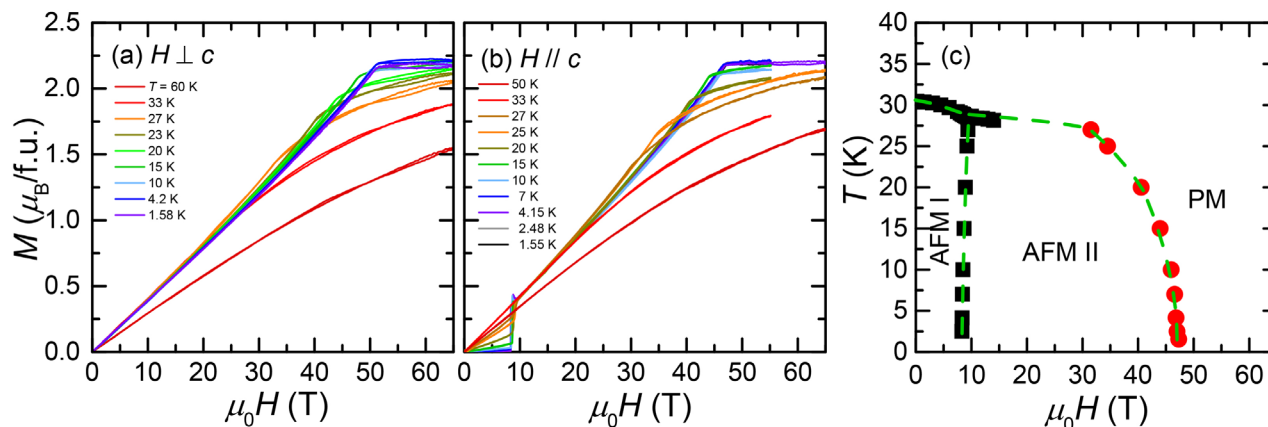


Fig.1 Magnetic field dependent magnetization $M(H)$ (a) perpendicular and (b) parallel to the c -axis at various constant temperatures. (c) Magnetic phase diagram of NiTe_2O_5 . The phase boundary is determined by $M(H)$ using 65 T pulse magnet and temperature dependence of magnetization using PPMS.

Results and Discussion

Figure 1(a) and (b) show the magnetic field dependent magnetization perpendicular and parallel to the c -axis, respectively. The magnetic moment of Ni^{2+} ions is fully polarized at 51.4 T and 47.3 K with a value of $2.19 \mu_B/\text{f.u.}$, which is close to of $2.17 \mu_B/\text{f.u.}$ of Neutron scattering experiment [2].

Conclusions

Using 65 T pulse magnet, the magnetic field induced phase transition and magnetic properties of NiTe_2O_5 have been studied. In contrast with Ni_3TeO_6 , NiTe_2O_5 has a single spin-flop transition.

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References

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