Spin Waves in MnP

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Manganese phosphide MnP is a ferromagnetic intermetallic compound below TC = 291K, and it transforms into a proper screw state at T* = 47K.
The crystal structure is a slightly distorted NiAs structure with the lattice parameters of a = 5.916 , b = 5.260 , c = 3.173 at room temperature. In the ferromagnetic state, the easy-axis of the magnetization is the c-axis. In the proper screw state, the spin rotates in the b-c plane with a propagation vector δ = 0.117a* along the a-axis.
One of our interests of MnP is the mechanism of transition from ferromagnetism to helimagnetism which had not been explained by theoretical viewpoint. In order to elucidate the mechanism, the information of spin wave in the whole Brillouin zone is crucially important.
The ferromagnetic spin-waves along the three principal axes had been measured by Todate et al[1]. They reported that the dispersion relation along the a-axis exhibits anomalous wave vector and temperature dependence, and also the quadratic q dependence was observed both along the b- and c-axes. In the proper screw state, spin-waves along the a- and b-axes had been measured by Tajima et al[2]. They reported the anomalous jump around T* along the a-axis which may be related to 3 δ.
In order to obtain the spin wave dispersion relations, we performed the neutron inelastic scattering experiments at triple-axis spectrometer PONTA (5G), JRR-3M reactor in JAERI (Tokai).

The single crystal of MnP, whose size is 9mm $\phi \times$ 40mm, was grown by the Bridgman method.
The spin wave dispersions have been mearsured along the a-axis at 12 K and 50K, as shown in Fig1. We could observe the spin wave dispersions along the a-axis, however, anomalous jump around T* which Tajima et al reported was not found. It is probably broadened dispersion due to itinerant magnetism.
In order to obtain the spin waves in the whole Brillouin zone, further measurements of spin waves at higher energy (~ 100meV) and lower energy (0 ~ 2 meV) are now in progress.

References

[1] Y Todate et al.: Jou Phys Soc Jpn. 56 36 (1987).
[2] K Tajima et al.: Jou Mag Mag Mat. 15-18 373-374 (1980).

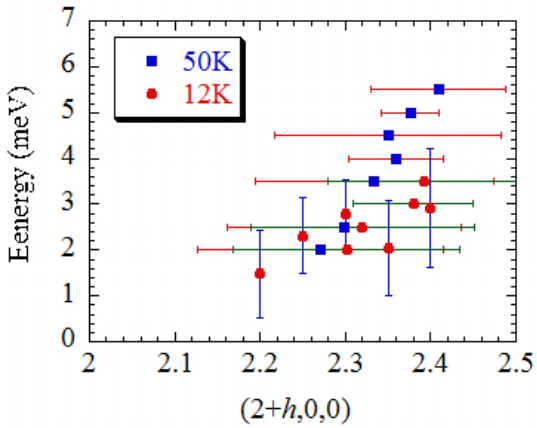

Fig. 1. Spin wave relations along the a-axis