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Magnetic Properties of Manganese Phosphide under Hydrostatic Pressure

Naoto KAWAI, Akira SAWAOKA and Gentaro KAJI

Department of Physics, Faculty of Engineering
Science, Osaka University, Toyonaka, Osaka

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It has been reported by Herber *et al.*¹⁾ that MnP is metamagnetic at temperature below 50°K above which, however, it becomes ferromagnetic with the Curie point 291°K.

Present authors have made the magnetic torque observations of the crystal and found that both the Curie point and the magnetic anisotropy energy decrease with increasing hydrostatic pressure.

For the present experiments were used a non-magnetic high pressure vessel made of hardened Be-Cu alloy and an air-jet bearing torque magnetometer. The specimen was put into and fixed firmly to the vessel and pressurized therein. The vessel was connected to the magnetometer. The torque moment of the sample was carefully detected by means of unbonded strain-gauge detector attached to the magnetometer. The details of the apparatus will soon be published elsewhere.²⁾

Single crystal MnP was prepared by the use of Bridgman method and it was cut into a form of disc whose plane was perpendicular to the crystallographic *b*-axis. In Fig. 1 are shown some typical torque curves of the crystal at 77°K under high pressure.

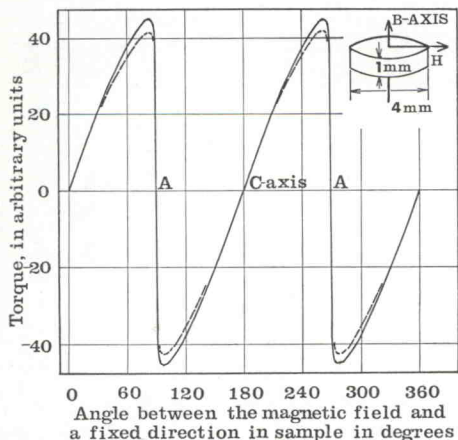


Fig. 1. Torque curves of a MnP single crystal in the (ac) plane, taken at 77°K with an applied field of 6800 oersted. The thick and broken lines show the curves observed under atmospheric pressure and 4900 bar, respectively.

The magnetic anisotropy energy E_a could easily be calculated from each curve, when the torque moment

measured was integrated with respect to the angle between the magnetic field and a fixed direction in sample.

In Fig. 2 is shown the change of E_a at 77°K with increasing hydrostatic pressure. The pressure dependence, $E_a^{-1}dE_a/dP$, was estimated to be -17×10^{-6} bar⁻¹.

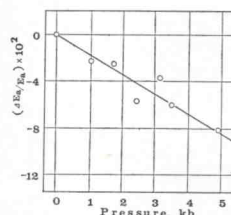


Fig. 2. Pressure dependence of magnetic anisotropy energy E_a of MnP at 77°K.

Next, the magnetic field was fixed in a particular direction along which the torque moment was maximum and temperature of the vessel including specimen was elevated at a rate approximately one degree per minute. Some typical examples of the observations are shown in Fig. 3. Since anisotropy energy as well as magnetization disappears at the Curie temperature, one can estimate the temperature exactly from the disappearing of the torque moment.

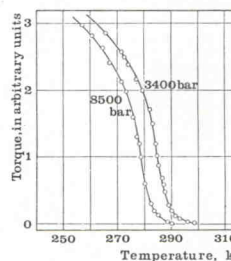


Fig. 3. Curves of torque vs. temperature of MnP observed under 3400 bar and 8500 bar respectively.

Comparing the four torque moment vs. temperature curves, dT_c/dP was assumed as -1.3×10^{-3} deg. bar⁻¹. Okamoto *et al.*³⁾ has deduced dT_c/dP from their measurement of electrical resistance anomaly using a polycrystalline MnP as specimen. Their estimated value was reported to be -1.6×10^{-3} deg. bar⁻¹.

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References

- 1) E. E. Huber, Jr., and D. H. Ridgley: Phys. Rev. **135** (1964) A1033.
- 2) To be submitted to the Rev. sci. Instrum.
- 3) private communication