# High Temperature Magnetic Susceptibility of MnO

J. A. POULIS, C. H. MASSEN AND
P. VAN DER LEEDEN

*Physical Department of the Technological University of Eindhoven, The Netherlands*

1. The plot of $1/\chi$ versus $T$ of MnO shows a deviation from a straight line. 2. This plot is not influenced by the preparation temperature when the MnO is prepared from dissociation of $MnCO_3$. 3. This plot is not influenced by the size of the MnO crystals. 4. The number of magnetons of MnO equals the theoretical value derived from $S=5/2$ near the Néel temperature.

The magnetic susceptibility of MnO has previously been reported by several authors[1-4]. The results may be compared with the results concerning MnS[5)6)], MnSe[6)] and MnTe[6)7)]. The measurements indicated that at high temperatures deviations appeared from the Curie-Weiss law. To determine the magnitude of these deviations more accurate susceptibility measurements have to be performed. We had at our disposal a susceptibility balance designed for research on diamagnetic substances. When MnO was measured, the error made could completely be ascribed to the error of the temperature measurement being of the order of 0.5°C.

A schematic view of the apparatus may be seen in Fig. 1. The balance is suspended from a Pt-Ni strip 1. To one of the bars 2 of the balance the sample 3 is attached, moving inside a furnace 4, which was mounted between the pole pieces 5 of an electromagnet. The sensitivity was enlarged by using an electronic displacement meter.

We started with a sample of $MnCO_3$ in the initially evacuated vessel 6. The $MnCO_3$ was found to follow the Curie-Weiss law up to about 370°C, where dissociation started. The $CO_2$ resulting from the dissociation was stored in the vessel 6. At room temperature the MnO and $CO_2$ recombined. Successive dissociations and recombinations enabled us to perform measurements with mixtures of variable MnO ratio. The recombination rate at room temperatures was very small, so that it was possible to measure the temperature dependence of the susceptibility of each dissociation or recombination product in the temperature interval between room temperature and 370°C.

The pure MnO, resulting from complete dissociation was studied in a larger temperature range. A quadratic polynomial was constructed through the points in the plot of $1/\chi$ versus $T$ of MnO. The discrepancy between this curve and the measured points could be described by a standard error of less than 0.1%.

The plot of $1/\chi$ versus $T$ of $MnCO_3$ proved

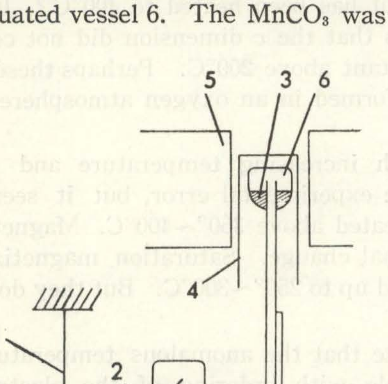


Fig. 1. View of the apparatus (schematically). For the meaning of the symbols see text.

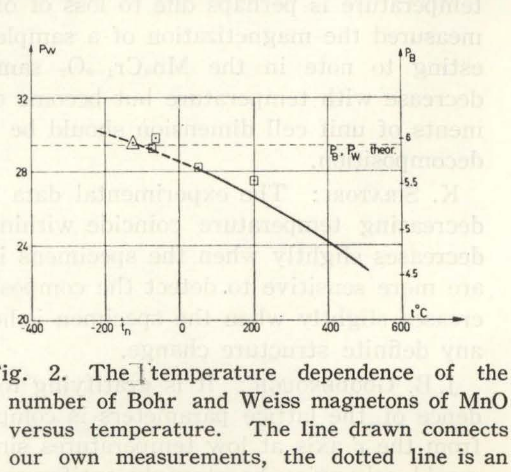


Fig. 2. The temperature dependence of the number of Bohr and Weiss magnetons of MnO versus temperature. The line drawn connects our own measurements, the dotted line is an extrapolation. The other points were measured by ⊡ Birckel[1)], △ Bizette[3)].

to be a straight line, whilst the standard deviation of the measured points amounted to 0.05%. All plots of $\chi$ versus $T$ after various dissociation and recombination periods proved to be linear combinations of the curves of pure $MnCO_3$ and MnO. As the temperature of dissociation did not disturb this linear additivity (uncertainty 0.5%), it can be concluded that the plot of $1/\chi$ versus $T$ is not influenced by the crystal size of the MnO, this size being dependent on the dissociation temperature, as was proved by X-ray analysis.

From our quadratic polynomial we derived the number of magnetons of MnO in dependence of temperature. Extrapolating the polynomial below room temperature gave information about the number of magnetons between the Néel point and room temperature. This showed the quite remarkable fact that near the Néel temperature the number of magnetons of MnO is equal to the theoretical number corresponding with $S=5/2$.

## References


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## DISCUSSION

L. F. Bates: I hesitate to ask this question; but how did the authors deal with the problem of accidental ferromagnetic impurity with this type of magnetic balance?

J. A. Poulis: We made measurements at different field strength and we did not find any indication of ferromagnetic impurity.