SOVIET PHYSICS JETP VOLUME 16, NUMBER 6 JUNE, 1963

MnAu2

EFFECT OF PRESSURE ON THE MAGNITUDE OF THE THRESHOLD FIELD AND TEMPERATURE OF THE ANTIFERROMAGNETIC TRANSFORMATION OF $MnAu_2$

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Submitted to JETP editor July 9, 1962

J. Exptl. Theoret. Phys. (U.S.S.R.) 43, 2024-2027 (December, 1962)

The electric resistance and galvanomagnetic effect of the helicoidal antiferromagnetic $MnAu_2$ are measured at an hydrostatic pressure up to 10,000 kg/cm^2 in the region of the magnetic transformation temperature. The shift of the Neel point T_N and threshold field H_{th} in $MnAu_2$ under the influence of uniform compression is determined. It is found that pressure appreciably lowers the threshold field: $dH_{th}/dp = -0.67 \pm 0.07$ Oe-cm^2/kg, whereas the antiferromagnetic transformation temperature increases: $dT_{th}/dp = (0.68 \pm 0.05) \times 10^{-3}$ deg-cm^2/kg. Possible explanations of the observed variation of T_{th} and H_{th} are considered.

INTRODUCTION

THE magnetic properties of the compound $MnAu_2$ have many specific features [1] due to the complicated magnetic structure of this compound. Neutron-diffraction investigations [2] have established that in the tetragonal lattice of $MnAu_2$ the magnetic moments lying in the neighboring basal planes are turned through an angle $\varphi = 51°$ relative to each other, forming a helix-like spin configuration. The magnetic moments lying in one and the same basal plane are parallel to one another. It was established recently that a similar magnetic structure is possessed also by a large group of rare-earth metals, some compounds of the rutile type, and compounds with general chemical formula $Mn_{2-x}Cr_xSb$.

An investigation of the magnetic structure of $MnAu_2$ has made it possible to explain one of the main features of the magnetic behavior of helicoidal antiferromagnets, consisting in a destruction of the antiferromagnetic order by relatively weak fields, when $\mu H_{th} \ll kT_N$ (in $MnAu_2$ the threshold field is $H_{th} = 8000$ Oe, and the Neel temperature is $T_N = 365°$). However, the nature of the forces that lead to the occurrence of the helicoidal structure itself is not yet completely clear at present. In the theoretical investigations [3,4], and the analysis of general problems of helicoidal antiferromagnetism, the hypothesis is made that the main forces responsible for the establishment of a helicoidal order of the spin magnetic moments are exchange forces. In one and the same crystal there exist simultaneously various types of exchange interactions, which differ from one another both in magnitude and in sign.

From this point of view it seems to us of interest to carry out an all-inclusive investigation of the electric and magnetic properties of helicoidal antiferromagnets under hydrostatic compression, for one can expect in this case large changes in their magnetic properties which in turn yields information on the variation of the exchange interactions as a function of the volume of the crystal elementary cell.

We present here the results of an investigation of the influence of high hydrostatic pressure on the Neel temperature and on the threshold field in the $MnAu_2$ compound.

RESULTS OF MEASUREMENTS AND THEIR DISCUSSION

Isotropic hydrostatic compression was produced in a high-pressure chamber; the medium transmitting the pressure was a 50 per cent mixture of transformer oil and pentane. The procedure for measuring the galvanomagnetic effect $\Delta R/R$, the electric resistance, the temperature, and the pressure was analogous to that described by us previously [5].

1. The influence of the hydrostatic compression on the temperature of the magnetic transformation of $MnAu_2$ was determined by measuring the temperature dependence of the electric resistance $R(T)$ at pressures $P_1 = 1$ kg/cm^2, $P_2 = 4600$ kg/cm^2, and $P_3 = 8850$ kg/cm^2. In all cases the value of T_N was determined from the kink on the $R(T)$ curve.

The results of the measurements of the influence of the pressure on the electric resistance of