SOME PECULIARITIES IN THE MAGNETIC BEHAVIOUR OF UCoGA[1])

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The paper presents new results of magnetic measurements that demonstrate interesting magnetic properties of UCoGa.

I. INTRODUCTION

The influence of Ga on the magnetic properties of different compounds containing rare earth, uranium and/or 3*d* elements was studied in numerous works [1—6] and a spin-glass and/or reentrant magnetic behaviour was found in many cases [7]. Some results of the magnetic measurements of UCoGa have already been reported in [3, 4]. We present here several new results obtained on UCoGa that demonstrate distinct peculiarities in its magnetic behaviour.

II. RESULTS AND DISCUSSION

The single phase state of our UCoGa samples was proved by means of X-ray analysis. Fig. 1 shows the magnetization vs temperature curves of a polycrystalline sample of UCoGa in dependence on a zero- and a non- zero field cooling of the sample. A similar form of the curves was also found, e.g., in UNiGa [5, 7], where it was attributed to the existence of a reentrant magnetic state. It is also of interest that Co_xGa_{1-x} alloys with $0.5 < x \leqslant 0.6$ yield a spin glass state as well [2]. It is supposed that the magnetic properties of the system are due to substitutional antistructure Co atoms on the Ga sublattice [8]. Similar magnetic effects were also found in some amorphous compounds containing Co and Ga elements, for instance in $Gd_{72-x}Co_xGa_{18}B_{10}$ with $0 < x \leqslant 4$ [9].

[1]) Contribution presented at the 8th Conference on Magnetism, KOŠICE 29. 8.—2. 9. 1988
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The influence of magnetic fields on the $\chi_{AC}(T)$ dependence (at $f = 230$ Hz) is shown in Fig. 2. As can be seen, the thermal variations of the magnetic susceptibility reveal a specific behaviour in the region above the ordering temperature. The existence of a secondary maximum that increases with the decreasing field strength is quite evident. A similar phenomenon has also been observed in $U_{0.6}Th_{0.4}As$ [10]. It was shown that this effect may have its origin in a character change of the exchange forces at a given composition. It was also deduced that the results could provide an argument for a strong p-f hybridisation in such

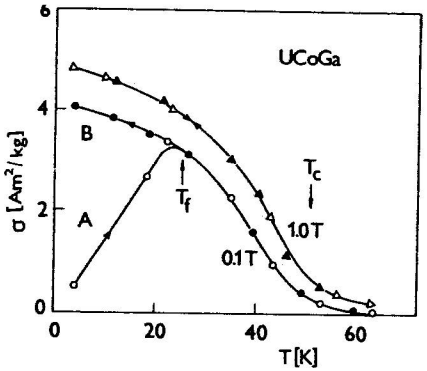

Fig. 1. O, Δ ... the magnetization of a zero field cooled sample of UCoCa in dependence on increasing temperature in the field 0.1 and 1.0 T, respectively;
●, ▲ ... the magnetization of the sample in dependence on decreasing temperature in the same fields.

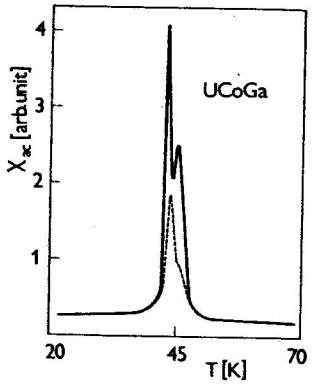

Fig. 2. The $\chi_{AC}(T)$ dependence of the sample UCoGa in the field 0.05 T (broken line) and in the field < 3 mT (full line)

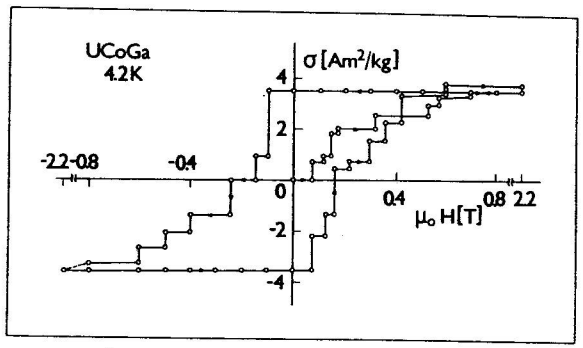

Fig. 3. The initial magnetic curve and hysteresis loop of a polycrystalline sample of UCoGa at 4.2 K.

compounds. Additional experiments are needed, in particular to know if the valency of the uranium atoms in the compounds is conserved.

The hysteresis loop of a polycrystalline sample of UCoGa is shown in Fig. 3. Sharp discontinuities are evident at 4.2 K, where a large number of apparent domain walls moving in cascade leads to the magnetization reversals observed.

The same magnetic behaviour as in UCoGa was also reported for $(Tb_{80}Ga_{20})_{100-y}Fe_y$ compounds with $y = 20$, and 30 [11]; i.e. i) field cooling effects seen in Fig. 1, ii) sharp peaks and secondary maxima in susceptibility vs temperature curves, respectively, and iii) discontinuities in hysteresis loops at low temperatures. The phenomena were classified in [11] as speromagnetic transitions into a spin-glass-like structure in a system with significant chemical short-range clusters, and a smeared magnetic transition.

III. CONCLUSION

As well as UNiGa, the UCoGa compound yields substantially more complex magnetic properties than it was supposed by Sechovský et al. [12] in their model of the UTX (T — transition metal, X — Al, Ga, Sn) system.

ACKNOWLEDGEMENTS

The hysteresis loop of UCoGa was measured by A. V. Andreev who prepared the samples.

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Received September 16th, 1988
Accepted for publication February 2nd, 1989

НЕКОТОРЫЕ ОСОБЕННОСТИ МАГНИТНОГО ПОВЕДЕНИЯ UCoGa

В работе представлены новые результаты магнитных измерений, которые свидетельствуют об интересных магнитных свойствах UCoGa.