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THE STUDY OF ELECTRICAL AND MAGNETIC PROPERTIES OF THE SYSTEM UFe_2—UNi_2[1]

ИССЛЕДОВАНИЕ ЭЛЕКТРИЧЕСКИХ И МАГНИТНЫХ СВОЙСТВ СИСТЕМЫ UFe_2—UNi_2

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The temperature dependence of electrical resistivity of $U(Fe_{1-x}Ni_x)_2$ for $x = 0, 0.25, 0.50, 0.75$ and 1.00 was studied in the temperature range 4.2—300 K. For the compound UFeNi a negative temperature coefficient of the electrical resistivity was observed nearly in the whole temperature region. The possibility of describing this compound in terms of a Kondo-like system is discussed.

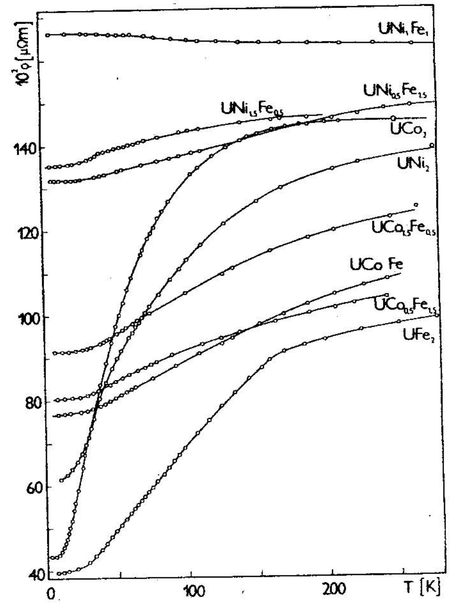

Fig. 1. Dependence of electrical resistivity upon temperature for the UFe_2—UNi_2 system.

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The intermetallic cubic Laves compound UFe_2 (C 15 type) is known to be ferromagnetic at low temperatures. The magnetic phase transition of the intermetallic compound UNi_2 belonging to the hexagonal Laves phase structure (C 14 type) has been described in [1]. The structural changes between cubic and hexagonal phases in the pseudobinary UFe_2—UNi_2 system are known from literature [2]. In the present contribution the electrical and magnetic properties of this system are studied to find the dependence on the Ni and the Fe content.

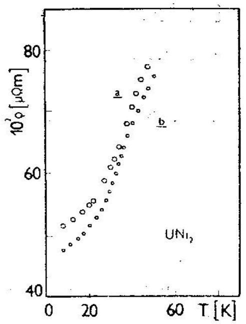

Fig. 2. Dependence of electrical resistivity upon T for UNi_2; a — not annealed, b — annealed.

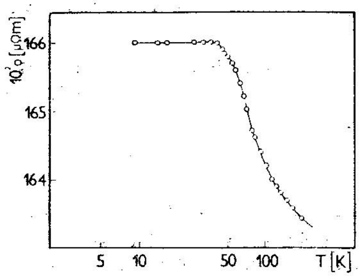

Fig. 3. Electrical resistivity of UFeNi vs ln T.

The specimes were arc-melted from high-purity metals under an argon atmosphere, and the quoted compositions are based on the weights used. The specimens were examined by roentgenographic and metallographic methods. The single-phase character was found to be better than 3 %. The final form of the specimens used for measurements was that of cylinders of an about 2 mm diameter and a 15 mm length. The resistivity was measured by the conventional four probe AC method, the magnetic moments by means of the ballistic method in magnetic fields up to 4.2 T.

Figure 1 shows the dependence of resistivity ϱ vs temperature T for all compositions. On the dependence for UFe_2 a kink approximately at 165 K is seen in good agreement with $T_C = 158$ K from measurements of the AC susceptibility [3]. The magnetic order in UFe_2 corresponds to the linear character of the dependence $\varrho(T) \sim T^2$ in the low temperature range [4]. The compound UNi_2 has an anomaly in the $\varrho(T)$ dependence at $T = 20$ K [1]. This anomaly is connected with a transition into a magnetically ordered state below this temperature, which corresponds to the behaviour of the Arrott plots [1] and of the AC susceptibility as a function of T [5]. The influence of annealing (Fig. 2) upon the $\varrho(T)$ dependence of UNi_2 is found to be negligible under the conditions used (840 °C, 100 hours).

In Fig. 1 no anomaly is observed on the $\varrho(T)$ dependence of $UFe_{1.5}Ni_{0.5}$, which probably points to no magnetic ordering in this compound. On the contrary, the compound $UFe_{0.5}Ni_{1.5}$ has a peak in the $\varrho(T)$ dependence at 38 K, which may indicate a transition into a magnetically order state at this temperature. For the UFeNi compound a decrease of resistivity with increasing temperature and a high value of residual resistivity are found, which can be explained by the model of strong scattering. If we study the dependence of resistivity vs ln T (Fig. 3), we observe a similar behaviour such as in a Kondo-system. For a curve like in Fig. 3 the exchange integral J in the Kondo-model is negative so that we can conclude that $J < 0$ in our case.

Magnetic measurements for pseudobinary alloys are in course and will be published elsewhere.

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