It should be noted that, as in the case of application of an electrostatic charge [12], in the Al-Sn system simultaneously with an increase of T_c there was observed upon condensation of Sn on films of a mixture an anomalous rise in the electric resistance of a multiple-layer film. The effect was observed at Sn film thickness not higher than 30 - 40 Å, and its value was up to 14% of the resistance of the initial layer, and remained unchanged when the films were annealed to 40°K, whereas the film resistance connected with the crystal structure defects were greatly decreased in this temperature interval.

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ANTIFERROMAGNETISM OF INVAR ALLOYS

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Kondorskii and the author [1, 2] have reached the conclusion that the anomalies of the physical properties of invar alloys are connected with the antiferromagnetism of the γ phase of iron [3 - 5] (cubic face-centered modification of iron). This point of view was subsequently used in a number of papers [6]. However, the concrete mechanism of the origin of the invar anomalies is still under discussion in the literature. Interest in this question has recently increased in connection with neutron-diffraction investigations of invar alloys [7 - 9]. It follows from these investigations that an invar alloy constitutes a magnetically-inhomogeneous medium in which, according to [8, 10], there can exist in addition to the ferromagnetic regions also regions that are antiferromagnetic at low temperatures.

If such regions actually exist, then one should expect the character of the temperature dependence of the susceptibility of the para-process and of the galvanomagnetic properties of the invar alloys should reflect the transition of these regions.into the antiferromagnetic state. The present article presents therefore experimental data on those invar-alloy properties which point to the existence of an antiferromagnetic transformation. These experimental data were published in part in [11], but no interpretation was offered for them.

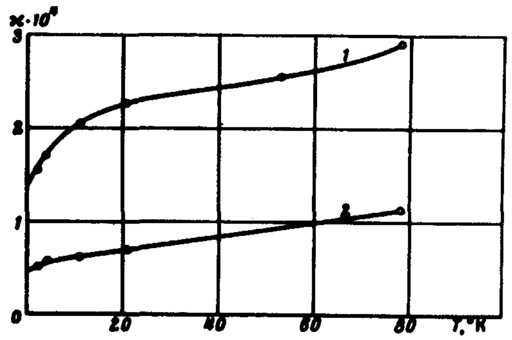

Fig. 1. Differential magnetic susceptibility of iron-nickel alloys vs. the temperature in the region of the para-process. Nickel content: 1 - 37.95 wt.%, 2 - 44.85 wt.%.

The figure shows the temperature dependence of the differential susceptibility κ for two samples of Fe-Ni alloys with invar composition, containing 37.95 (curve 1) and 44.85 (curve 2) wt.% of Ni, measured in a magnetic field of 8.2 kOe.

Curve 1 at a temperature below T ≈ 15°K shows a steeper κ(T) dependence. This effect can be quite naturally attributed to a transition of the invar-alloy regions containing an excess of iron into an antiferromagnetic state. As expected, for the sample containing 44.85% Ni this effect is much more weakly pronounced, since the invar anomalies are weak at these Ni concentrations. The curves of the figure do not show the characteristic κ(T) peak corresponding to the Neel point. This circumstance can be due to the following causes: first, the temperature of the transition into the antiferromagnetic state may be "smeared out" as a result of the inhomogeneities of the composition; second, the Curie-Weiss law may not hold at all for alloys based on γ iron. The last statement is based on the results of investigations of the magnetic properties of iron-manganese alloys [4]. The transitions of these alloys into the antiferromagnetic state are described by κ(T) curves that likewise have no maxima at the Neel point.

For invar alloys, the electric and magnetic properties at low temperatures are closely connected with each other [11]. Attention should therefore be called to the data published in [11] on the temperature dependence of the quantity $\beta(T) = (-1/R_0)(\Delta R/\Delta H)$ (R_0 is the electric resistance at 4.2°K, ΔH and H are parallel to the current), measured on samples having the same compositions and at the same value of the magnetic field as the data for the susceptibility. The quantity β(T), as a function of the temperature, behaves like κ(T) and when the temperature drops below 15°K it also increases much more rapidly. This effect confirms the existence in invar alloys of a magnetic transformation at ~15°K.

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