results in a higher refractive index than that provided by electrostatic or magnetic lenses.

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SUPERCONDUCTIVITY OF ALLOYS OF THE SYSTEM Nb_3Al-Nb_3Ge

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We have reported earlier [1 - 4] that an investigation of the Nb_3Al-Nb_3Ge system revealed a maximum on the plot of T_c against the composition; this maximum was located near the composition $(Nb_3Al)_4Nb_3Ge_2$, and its magnitude was greatly increased by heat treatment.

We performed additional investigations of the properties of these alloys and of the influence of heat treatment on T_c.

For the heat treatment, the samples were placed in a quartz tube which was evacuated, filled with helium gas, and sealed. A quartz ampoule with the samples was placed in an oven, and was rapidly immersed in water at T = 0°C after the end of the annealing. To determine the optimal heat-treatment regime, the annealing was performed at different temperatures and at different lengths of time (Figs. 1 and 2).

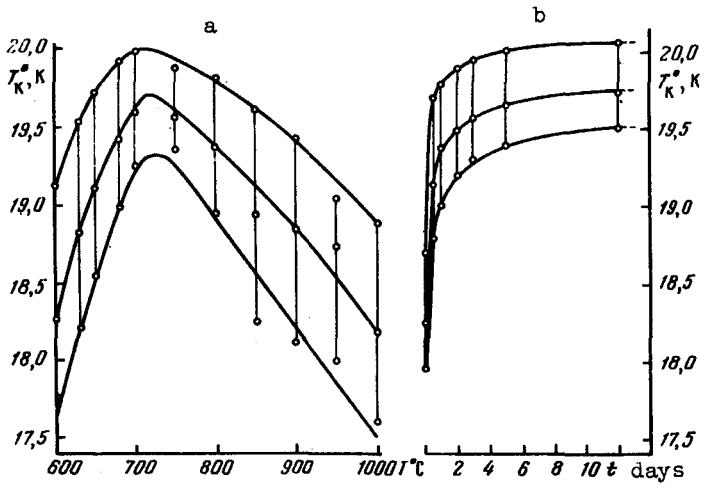

Fig. 1 a - Dependence of T_c on the heat-treatment temperature. The vertical lines characterize the width of the transition. b - Dependence of T_c on the heat-treatment time at T = 700°C. The vertical lines charectarize the width of the transition.

Figure 2 shows the change of the resistance in the transition region, for one of the metal-ceramic samples subjected to optimal heat treatment.

By measuring the resistance of the sample as a function of the magnetic field at different temperatures it is possible to plot the temperature dependence of the critical field. The value of $\partial H_c/\partial T$ for values of T close to T_c turns out to be in this case 30 kOe/°K. If we estimate H_c at T = 0°K assuming that $H_c = H_{c_0}[1 - (T/T_c)^{3/2}]$, then H_{c_0} should amount to 380 kOe.

An investigation of the transition curve obtained for a bulky sample (in the form of an irregular cylinder of height usually 7 mm and diameter 4 - 5 mm) and for powder prepared from this cylinder has shown that the transition curve of the powder is shifted towards lower temperatures and is strongly elongated compared with the curve of the bulky sample, and when the

sample is more disperse this shift and smearing of the curve increase. X-ray investigations of the powdered alloy, after annealing at various temperatures, revealed an increase of the lattice parameter with increasing annealing temperature. The obtained data are listed in the table.

Sample	Lattice constant of phase with structure A
Initial powder prepared by grinding a bulky sample subjected to optimal heat treatment	5.1744 ± 0.0004
The same powder after a day's annealing at 700°C	5.1754 ± 0.0004
The same powder after a day's annealing at 800°C	5.1760 ± 0.0004
The same powder after a day's annealing at 900°C	5.1767 ± 0.0004

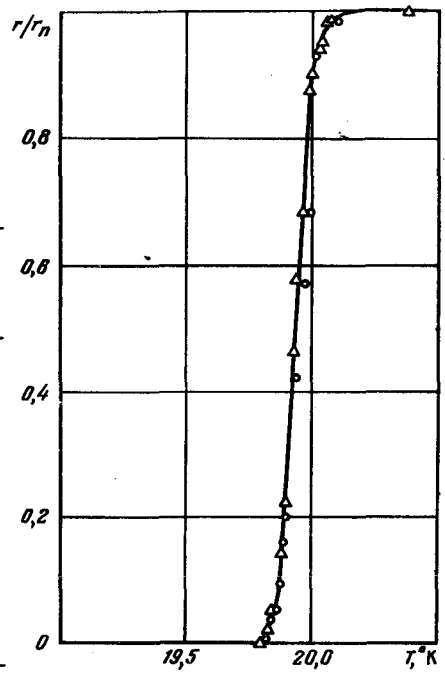

Fig. 2. Change of resistance of one of the heat-treated samples at the transition point. The circles correspond to measurements repeated 7 days later.

An investigation of the transition curves of a sample subjected to annealing at various temperatures, and a parallel determination of the shape of the (622) line, have shown that in addition to the shift in the low-temperature region and the smearing of the transition curve with increasing annealing temperature, a strong smearing of the x-ray line is observed; this can be regarded as the consequence of the decomposition of the alloy with increasing annealing temperature (see Fig. 3).

The obtained data show that in the system Nb_3Al-Nb_3Ge there exists a region of alloys, close to the composition $(Nb_3Al)_4Nb_3Ge$, whose critical temperatures reach 20°K. High critical temperatures are obtained in the case when the samples of the alloys are subjected to a special treatment, as a result of which ordering may take place in the alloy having a β-W lattice. The optimal heat-treatment temperature is 700 - 750°C. Raising the heat-treatment temperature to 1000°C leads to a lowering of T_c. The lowering of T_c may be due to a partial decomposition of the composition close to $(Nb_3Al)_4Nb_3Ge$, which is formed at the optimal heat-treatment temperature.

If ordering occurs at the same time among the Al and the Ge atoms, then it should be accompanied by appearance of superstructure lines on the x-ray patterns. The large period of the superstructure, equal to several periods of the initial lattice, can lead to the occurrence of an additional oscillation branch, with an end-point frequency much lower than the main end-point frequency of the alloy. The occurrence of an additional low-frequency branch can contribute to an increase of the effective attraction between the electrons, owing to exchange of excitations of this branch. An experimental proof of the existence of such a branch might explain the reason why T_c increases not only in this alloy, but in other multicomponent alloys.

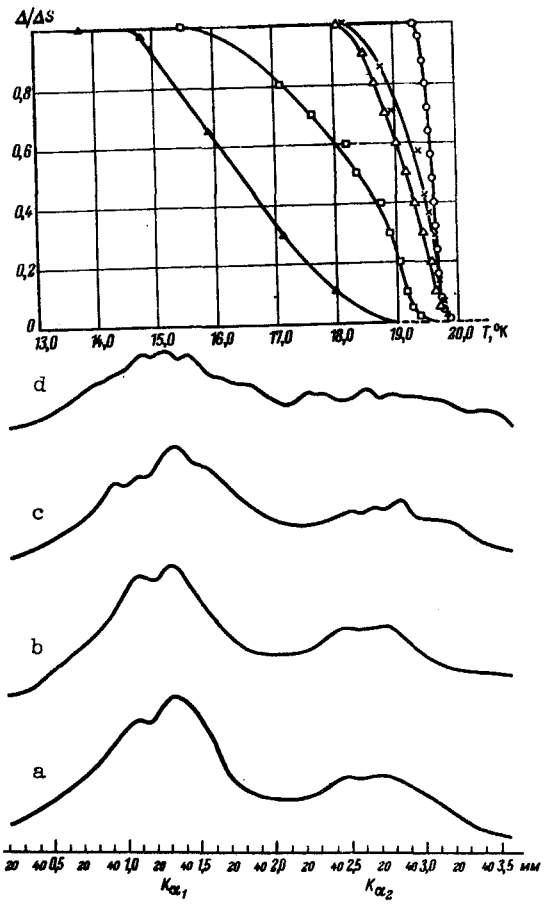

Fig. 3. Transition curves and shape of the (622) x-ray line of samples heat treated at various temperatures. The x-ray pictures were taken at room temperature: o - bulky sample after optimal heat treatment; ×, a - powder obtained from this bulky sample; Δ, b - the same powder after annealing at 700°C for a day; □, c - the same powder after annealing at 800°C; ∇, d - the same powder after annealing at 900°C.

Nor can we exclude the fact that the addition of small amounts of germanium increases the density of the electron states on the Fermi surface, N(0), and this is precisely why T_c increases, since N(0) comes closer to the maximum of the dependence of N(0) on the number of electrons per atom [5].

If we use for T_c the formula $T_c = 1.14\theta e^{-1/\rho}$ from the microscopic theory of superconductivity, and assume $\theta \approx 180°K$, then we can estimate the value of ρ, which turns out to equal 0.42.

According to the theory [5], ρ cannot exceed 0.5; at larger ρ the lattice becomes unstable. The value of ρ obtained by us is close to the limit, so that such an alloy can easily decompose. This is perhaps why a powder made of a heat-treated alloy sample has a transition curve that is shifted towards lower temperatures, and the shift increases with increasing degree of dispersion of the powder.

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