with plane-parallel end faces (∿3")[6]. For convenience in comparing the data of Figs. 1 and 2, the numbering of the SE spectra is connected with the temperature scale of Fig. 2. The spectra 36 - 40 (Fig. 1) are shown on an enlarged scale (relative to λ), so as to illustrate the switching of the SE at T ≥ 600°K to the transition I (11533 cm^{-1} $^4F_{3/2} \rightarrow {}^4I_{11/2}$ 2271 cm^{-1}) with λ_g = 10796 Å. At these temperatures, λ_g(A) = 10801 Å (Fig. 2a and 2b). The flare-up of the high-temperature lines F, G, H, and I is due, on the one hand, to the change of the polarization properties of the crystal, and on the other to the temperature growth of the population of the upper level of the $^4F_{3/2}$ term, and also to the resonances (for certain lines).

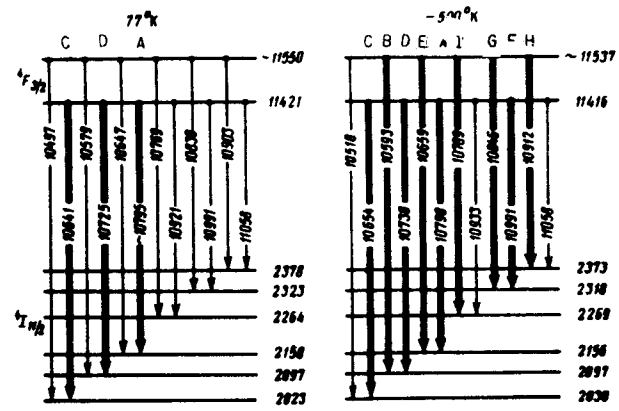

Fig. 3. Schemes of crystal splitting of the $^4F_{3/2}$ and $^4I_{11/2}$ terms of the Nd^{3+} ions in $YAlO_3$ for 77 and ∿500°K. The level positions are indicated in cm^{-1}, and the transitions between them in A. The heavy arrows denote inducing transitions (scheme for 77°K) registered below 300°K and (for 500°K) above 300°K. The SE on line B was obtained with a laser with ($YAlO_3:Nd^{3+}$ + $SrF_2:LaF_2:Nd^{3+}$) [1].

In conclusion, the author thanks Corresponding Member of the USSR Academy of Sciences B.K. Vainshtein and V.Ya. Khaimov-Mal'kov for a discussion of the results, G.A. Bogomolov, B.N. Grechushnikov, N.R. Ivanov, and Z.B. Perikalin for help, valuable advice, and critical remarks, and also Kh.S. Bagdasarov, under whose direction the $YAlO_3:Nd^{3+}$ crystals were synthesized.

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SUPERCONDUCTIVITY AND STRUCTURE OF COMPOUNDS BASED ON NIOBIUM AND VANADIUM

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The question of the connection between the temperature T_c of the transition to the superconducting state and different structural characteristics of

[6] Owing to the presence of boundaries between the disoriented sections of the given sample, the He-Ne laser radiation passing through it (6328 Å) forms a system of symmetrical beams with mutually perpendicular polarization and with sharply decreasing intensity, with divergence ∿1, ∿2°, etc., lying in one plane.

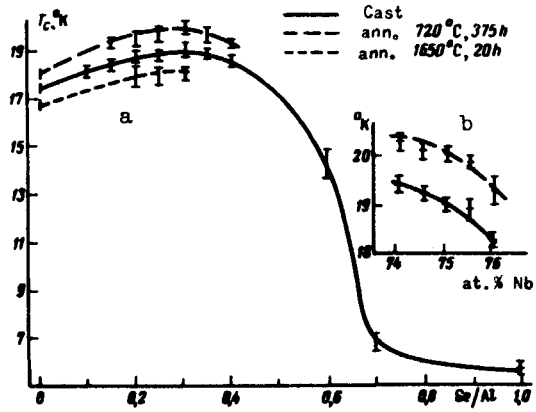

Fig. 1

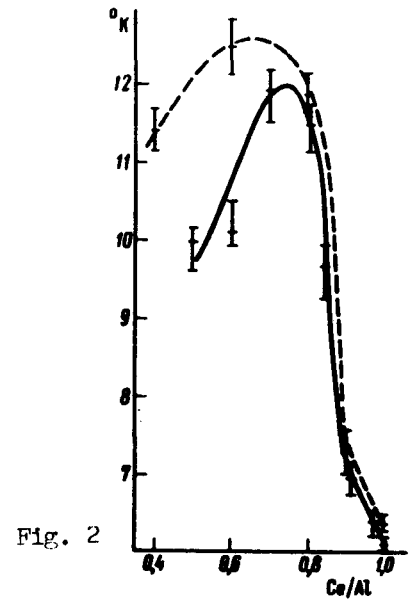

Fig. 2

Fig. 1. a - Dependence of T_c on the Al:Ge ratio, for alloys of the system Nb-Ge-Al. Nb content 75 at.%; b - dependence of T_c on the content for alloys with Al:Ge = 3:1.

Fig. 2. Dependence of T_c on the Al:Ge ratio for alloys of the V-Ge-Al system. Content 75 at.% V.

intermetallic compounds is presently extensively discussed in the literature. Compounds based on niobium and vanadium have relatively low T_c. In particular, the maximum T_c has been attained with the ternary compounds of the Nb-Ge-Al system. The reason for the appreciable rise of T_c when some of the Al atoms are replaced by Ge in the compound $Nb_3(Ge-Al)$ are still not clear. Further experiments are needed to make it possible to assess the influence of the variation of the composition of the phases, the structural transitions, ordering phenomena, etc. on the parameters of the superconducting transitions. In the present investigation we studied a number of alloys containing compounds with structure A-15 in the ternary systems niobium-germanium-aluminum and vanadium-germanium-aluminum.

The procedures used to prepare the samples and to measure their properties were described earlier [1].

Figure 1 shows the data obtained on the concentration dependence of T_c in the investigated alloys. The highest transition temperature (20.3°K) was obtained at Al:Ge = 3:1 for an annealed alloy containing 74 at.% Nb (Fig. 1b). It is interesting that a slight decrease of the Nb content at this ratio leads to a rise of T_c, whereas according to the data of [2] an increase of T_c corresponds to the region of excess of Nb relative to the $Nb_3(Ge-Al)$ composition. A composition change corresponding to isomorphic substitution of Al(Ge) leads to the appearance of a maximum on the concentration dependence of T_c (Figs. 1a and 2). We note that to attain a maximum for the V-Ge-Al system it is necessary to have the inverse ratio, Al:Ge = 1:3 (Fig. 2).

The noticeable dependence of T_c on the ratio of the aluminum to germanium and the rise of the transition point on approaching the value 3:1 were

previously observed for Nb-Ge-Al alloys in [2]. On the basis of these data, the authors of [2, 3] made the natural assumption that the ordering of the Ge and Al atoms possibly exerts an influence, but no definite experimental confirmation of this assumption was obtained. It was therefore of interest to carry out a neutron-diffraction analysis of the compound $V_3(Ge-Al)$, bearing in mind that the vanadium atoms have a small scattering amplitude and the diffraction pattern should be quite sensitive to the distribution of the germanium and aluminum. Neutron-diffraction patterns were obtained for a sample with composition $V_3(Ge_{0.75}Al_{0.25})$ in the cast state and after annealing at 850° for 375 hours. The line intensity was compared with the calculation. A typical section of the neutron-diffraction pattern is shown in Fig. 3. The low intensity of the (210) line indicates that the V atoms are almost entirely in the position 6(c). The absence of superstructure lines (see the positions (311), (222), (331) marked by the superior arrows) indicates that there is no ordering in accordance with the Fe_3Al scheme in the Ge and Al sublattice. Experiments were also performed for the purpose of establishing the connection between the characteristics of the annealing and the transition temperature. According to the data shown in Figs. 1 and 2, annealing at a given temperature and time exerts a similar influence on T_c in the entire concentration interval: after low-temperature annealing, T_c rises noticeably, and after high-temperature annealing a certain lowering of T_c takes place in comparison with the same samples in the cast state. We note that the ordering of the Al and Ge atoms should have led to a change of T_c in a definite interval of compositions.

Preliminary data on the influence of the annealing time were obtained for the alloy with composition $Nb_3(Al_{0.75}Ge_{0.25})$ (see the table). We see that a rise in the transition temperature corresponds to annealing at 950° for not more than 90 min, after which the effect of the annealing decreases appreciably, as was reported also for an annealing temperature 1000° in [4]. The debyegrams have shown that an annealing time that leads to a rise in the transition temperature is accompanied in many cases by smearing of the lines. The results do not permit us as yet to state with assurance that the initial stages of the decay (of the aging type) influence the transition temperature, but they indicate that further research in this direction is desirable.

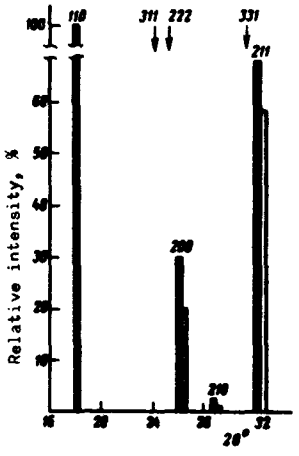

Fig. 3. Calculated (light bars) and experimental (dark bars) intensities of the alloy $V_3(Al_{0.25}Ge_{0.75})$ on the neutron-diffraction pattern.

It was also of interest to ascertain the existence of a martensitic transformation in the compounds of the investigated ternary systems. To this end, low-temperature x-ray investigations were made of the alloy $Nb_3(Ge_{0.3}Al_{0.7})$. At 20°K, we observed a change in the form of

Dependence of the change of T_c on the annealing time at 950°C

t, min	ΔT_c, °K
3	0.2
6	0.3
30	0.6
90	0.3
180	0.2
300	0.2

the diffraction lines, making it possible to assume, by analogy with [5 - 7], the existence of a structure transition with tetragonal strain $e \approx -(3.1 \pm 1.2) \times 10^{-3}$. We note that the value of e lies between the values e for V_3Si and Nb_3Sn. The sign of e coincides with that for Nb_3Sn [7]. It is interesting that the nuclear-resonance investigations at 24°K clearly point to a change in the symmetry of the lattice in the same samples, which also indicates the presence of a transition [8] not observed in Nb_3Al [9]. This circumstance confirms the important role of correlation between the superconducting and martensitic transitions in high-temperature superconductors of the A-15 type.

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CRITICAL TEMPERATURE OF AMORPHOUS SUPERCONDUCTING FILMS

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Naugle and Glover [1] observed a decrease of the critical temperature of the superconducting transitions of amorphous (i.e., having very high resistance) films of Bi and Ga, condensed on a low-temperature substrate, in inverse proportion to their thickness d. This means that ΔT_c is proportional to the value of the normal resistance. In the present paper we propose an explanation for this effect, based on the assumption that the lowering of T_c is due to fluctuations of the electromagnetic field in the film.

We define the point of transition into the superconducting phase as the point where the ordering parameter ψ exhibits perturbations that increase with time. According to the nonstationary Ginzburg-Landau equation [2] we have

$$\frac{\partial \psi}{\partial t} + \Gamma\psi - D\left(\nabla - \frac{2ie}{c}\mathbf{A}\right)^2\psi = 0, \qquad (1)$$

where

$$\Gamma = \frac{8}{\pi}(T - T_{c0}), \quad D = \frac{1}{3}v_F\ell,$$

and ℓ is the mean free path. At $\vec{A} = 0$, the transition point $T = T_{c0}$ is determined from the condition $\Gamma = 0$. When the fluctuation fields ($\vec{A}$) are taken into