

Fig. 2. Plots of voltages in coil (a) and on piezoelectric plate (b) vs. the frequency of additional modulating signal, at which total suppression of the HF oscillations occurs (longit. pumping)

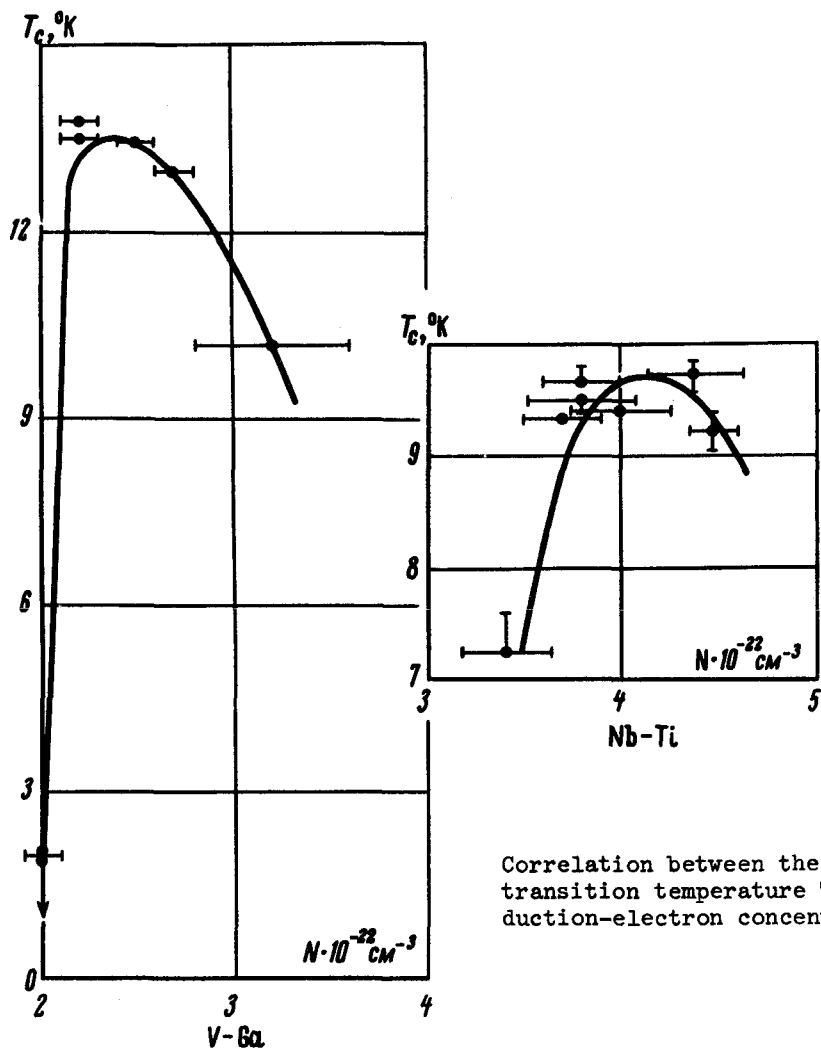
- [1] Ya. A. Monosov and V. V. Surin, *ZhETF Pis. Red.* 9, 664 (1969) [*JETP Lett.* 9, 412(1969)].
 [2] I. E. Dikshtein, Ya. A. Monosov, and V. V. Surin, *Fiz. Tverd. Tela* 10, 1907 (1968) [*Sov. Phys.-Solid State* 10, 1506 (1968)].

CORRELATION OF THE CRITICAL SUPERCONDUCTING-TRANSITION TEMPERATURE WITH THE CONDUCTION-ELECTRON CONCENTRATION IN V-Ga AND Nb-Ti ALLOYS

A. I. Golovashkin, I. S. Levchenko, I. E. Leksina, G. P. Motulevich, and A. A. Shubin
 P. N. Lebedev Physics Institute, USSR Academy of Sciences
 Submitted 20 October 1969
ZhETF Pis. Red. 10, No. 11, 515 - 517 (5 December 1969)

We have investigated the superconducting and optical properties of alloys of vanadium with gallium and of niobium with titanium. The vanadium-gallium alloys were obtained by simultaneous evaporation of the vanadium and gallium from different evaporators. The method of producing such alloys has been described earlier [1]. The alloys of niobium with titanium were produced in an arc furnace in an atmosphere of purified argon. The method of producing these alloys is described in [2]. Samples of the following compositions were prepared: V-Ga

The characteristics (including the suppression) of the HF oscillations observed in AF hematite crystals are analogous to the characteristics of automodulation of nonlinear ferromagnetic resonance [2]. The investigated AF crystals did not possess a ferrite base. This fact was established by simultaneously observing the HF oscillations in hematite and in yttrium ferrite and varying the temperature. It turned out that at a temperature close to 250°K (when the hematite goes over into the antiferromagnetic state), the HF oscillations in the AF crystal vanished abruptly, whereas in the yttrium ferrite they did not change noticeably. It can therefore be assumed that the HF oscillations in the AF hematite crystal are the consequence of parametric excitation of spin waves and of their instability. It is perfectly probable, however, that the domain structure of the antiferromagnet can also become manifest in the described phenomena, inasmuch as in the constant fields in which they are observed the sample may not be completely saturated. In this connection, great interest attaches to analogous experiments in the region of shorter wavelengths.



Correlation between the superconducting-transition temperature T_c and the conduction-electron concentration N .

with 70, 74, 85, 92, 93, 96, and 97 at. % V, and Nb-Ti with 25, 40, 52, 75, 85, and 100 at.% Nb. The Va-Ga alloys have the lattice of β -W, while the Nb-Ti alloys have a bcc lattice.

The superconducting-transition temperature T_c was measured by a resistance method. T_c was taken to be the temperature corresponding to half the residual resistance. The conduction-electron density N and the effective electron-phonon collision frequency ν were determined by an optical method [1, 3].

The measurements revealed a correlation between T_c and N , as shown in the figure. It is seen from the figure that the plot of T_c vs. N goes through a maximum for both alloys. The values of N corresponding to the maximum T_c are 2.2×10^{22} and $4.1 \times 10^{22} \text{ cm}^{-3}$ for V-Ga and Nb-Ti, respectively. We note that a similar nonmonotonic dependence of T_c on N was observed in [4] for the superconducting SrTiO_3 alloys, for which the maximum value $T_c \approx 0.5^\circ\text{K}$ corresponded to $N \approx 10^{20} \text{ cm}^{-3}$.

The measurements have also made it possible to establish a correlation between T_c and ν . It was found that T_c increases with increasing ν .

- [1] A. I. Golovashkin, I. S. Levchenko, and G. P. Motulevich, Zh. Eksp. Teor. Fiz. 57, 74 (1969) [Sov. Phys.-JETP 30, No. 1 (1970)]; FIAN Preprint No. 44, 1969. Tezisy dokladov VI Vsesoyuznogo soveshchaniya po probleme sverkhprovodyashchikh materialov (Abstracts of Papers at 6th All-union Conf. on Superconducting Materials), M., 1969, p. 8; Tezisy dokladov sovetsko-yaponskoi konferentsii po fizike nizkikh temperatur (Abstracts of Papers at Soviet-Japanese Conf. on Low-temperature Physics), Novosibirsk, 1969, p. 12.
- [2] FIAN Preprint No. 77, 1969; Tezisy dokladov VI Vsesoyuznogo soveshchaniya po probleme sverkhprovodyashchikh materialov (Abstracts of Papers at 6th All-union Conf. on Supercond. Materials), M., 1969, p. 16.
- [3] G. P. Motulevich, Zh. Eksp. Teor. Fiz. 46, 287 (1964) [Sov. Phys.-JETP 19, 199 (1964)]; A. I. Golovashkin, I. S. Levchenko, G. P. Motulevich, and A. A. Shubin, *ibid.* 51, 1622 (1966) [24, 1093 (1967)]; A. I. Golovashkin and G. P. Motulevich, *ibid.* 53, 1526 (1967) [26, 881 (1968)]; G. P. Motulevich, Usp. Fiz. Nauk 97, 211 (1969) [Sov. Phys.-Usp. 12, No. 1 (1969)].
- [4] J. F. Schooley, W. R. Hosler, E. Ambler, J. H. Becker, M. L. Cohen, C. S. Koonce, Phys. Rev. Lett. 14, 305 (1965).

CHANGE OF POPULATION OF ZEEMAN SUBLEVELS OF THE EXCITED STATE OF $\text{CaF}_2:\text{Eu}^{2+}$ PUMPED WITH POLARIZED LIGHT

B. P. Zakharchenya, A. Ya. Ryskin, and Yu. A. Stepanov
 A. F. Ioffe Physico-technical Institute, USSR Academy of Sciences
 Submitted 22 October 1969
 ZhETF Pis. Red. 10, No. 11, 517 - 520 (5 December 1969)

It is known that the intense phononless line $\lambda 4130 \text{ \AA}$ observed in the $\text{CaF}_2:\text{Eu}^{2+}$ absorption and emission spectra is connected with the electric dipole transition $^8\text{S}_{7/2}(f^7) \rightarrow ^4\text{F}_8(f^6d)$. The absorption spectrum reveals also strong band extending into the ultraviolet region from $\lambda 4130 \text{ \AA}$ and having a complicated electron-vibrational structure. Luminescence, just as in ruby and in many other activated crystals, is excited in $\text{CaF}_2:\text{Eu}^{2+}$ as a result of a two-step process that is made up of transitions to broad energy bands and subsequent non-radiative relaxation, which causes population of the lowest excited level $^4\text{F}_8(f^6d)$. This is followed by the aforementioned radiative transition with $\tau = 7 \times 10^{-7}$ sec.

The Zeeman effect at $\lambda 4130 \text{ \AA}$ has been adequately interpreted [1]. It is therefore possible to estimate the relative populations of the different sublevels of the excited state from the intensities of the individual Zeeman components. It was already indicated in [1] and [2] that when the crystal is cooled to 1.7°K a change takes place in the populations of the Zeeman sublevels, in spite of the relatively short lifetime τ . This change has an anomalous character and does not correspond to Boltzmann thermalization. We have observed even greater anomalies by using a two-step pumping of $^4\text{F}_8$ with polarized light. A $\text{CaF}_2:\text{Eu}^{2+}$ crystal with an Eu^{2+} ion concentration less than 0.1 molar per cent was placed in a magnetic field ($H = 28 \text{ kOe}$) in such a way that the $\langle 100 \rangle$ direction was parallel to H . The exciting light, containing wavelengths shorter than 4130 \AA , was incident on the crystal perpendicularly to the field and parallel to the $\langle 100 \rangle$ direction. The electric vector of the exciting light was either perpendicular to the field (σ light) or parallel to it (π light). The Zeeman components of $\lambda 4130 \text{ \AA}$ were observed in the radiation in a direction perpendicular to the field and photographed in σ and π polarizations with a high-resolution spectrograph.

Figure 1 demonstrates the appreciable increase of the intensities of the components coming from the Zeeman sublevels $^1\text{F}_5^+$ and $^1\text{F}_7^+$ (see Fig. 2) following excitation with π light.