switching, where $t_{pulse} \approx 10^{-3}$ sec.

The measurement results lead to the following conclusions:

1. The emf tends to saturate with increasing light intensity. This tendency begins with intensities of the order of 1 W/cm^2 in the "stationary" case (curve 2b). This is to be expected, since the condition $(\Delta n)_p \ll p_p$ is violated. Indeed, a rough estimate under the assumption that the electron lifetime in the p region is $\tau_n \approx 10^{-6}$ sec yields $\Delta n = g\tau_n \approx 10^{16}$ cm^{-3} (here $g \approx 10^{22}$ cm^{-3} cm^{-1}).

2. The saturation of the photo-emf extends over several orders of magnitude of the radiation power. The decrease in the emf in the region of highest light intensities is due apparently to the occurrence of a Dember emf of opposite sign, since no drop in the photo-emf was observed when the p-n junction was irradiated from the end.

3. In no case did the limiting photo-emf's coincide with the calculated values of the c.p.d., being always smaller. Apparently part of the potential barrier of the p-n junction is not lifted even at maximum photogeneration. This question is presently under study, but it is clear that the c.p.d. in silicon p-n junctions can not be determined by measuring the saturation photo-emf.

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1) n_n and p_p are the equilibrium densities of the electrons in the n region and of the holes in the p region; Δn and Δp are the density increments due to the nonequilibrium carriers.

2) An increase of the light intensity to 5×10^7 W/cm^2 by focusing damaged the sample surfaces.

ANOMALOUS BEHAVIOR OF $j_c(H, T)$ OF HEAT-TREATED Nb - 75% Zr ALLOYS

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In spite of the tremendous number of investigations devoted to hard superconductors, the temperature dependence of the critical density has barely been studied. Kim et al. [1] measured at various temperatures the magnetization of cylinders of Nb and of Nb - 25% Zr alloy annealed at 1125°C, and obtained on this basis a linear dependence of the critical current density $j_c(T)$ in a transverse magnetic field. $j_c(H)$ of wires made of Nb - (25 - 33)% Zr alloy was measured quite recently at temperatures above 4.2°K, and the linearity of $j_c(T)$ was confirmed. This is precisely the dependence that follows from Anderson's phenomenological model [3], which presently affords the most complete description of the behavior of hard superconductors. The main parameter $\alpha_c = j_c H$ of this model should not depend strongly on H in a wide range of fields, as was indeed observed experimentally by Kim et al. [1-4], and is also well satisfied, as a rule, in the case of Nb_3Sn [5].

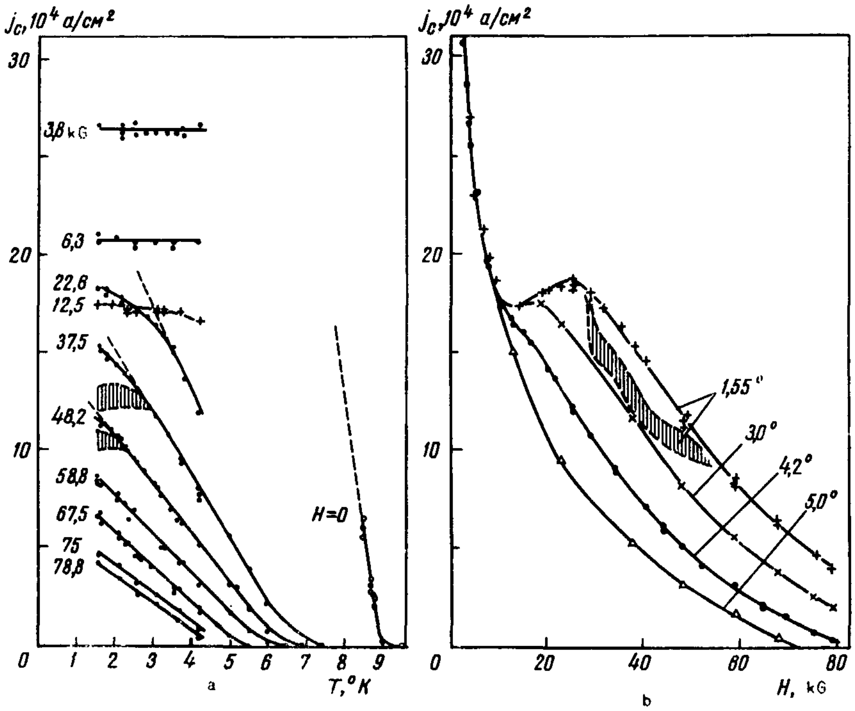

Fig. 1. Critical current density vs. T and H for samples annealed for one hour at 500°C: a -- $j_c(T)$ at fixed values of H; b -- $j_c(H)$ at fixed values of T.

We have investigated $j_c(H, T)$ of wires of 0.18 - 0.29 mm diameter made of Nb - 75% Zr alloy annealed for one hour at 400 - 500°C [6,7] and observed marked deviations in their behavior from the predictions of the model. The measurements were made in the temperature interval from 1.5°K to T_c in a transverse magnetic field up to 80 kG [1]. Figure 1a shows the measured values of $j_c(T)$ at fixed field values for samples annealed for one hour at 500°C. Linearity of $j_c(T)$ was observed for large H down to the lowest temperature, with $dj_c/dt \sim 1/H$. However, in fields weaker than 40 - 45 kG the character of $j_c(T)$ changed: starting with some temperature, a deviation from linearity was observed, and at a still lower value of T saturation set in; the lower H, the higher these temperatures. The anomalous variation of the critical current density with temperature exerted a characteristic influence on the plots of $j_c(H)$ at constant T (see Fig. 1b). With decreasing T, the $j_c(H)$ curves were altered even in a way as to exhibit a maximum at the lowest temperature. Unlike the previously observed "peak effect" [8], this maximum is located not near the upper critical field, but at much lower values of H. The results described above were obtained for a large number of samples. It has been established that the shape of the curves does not change when the wire diameter is decreased with emery paper (the samples measured had cross sections 6.6, 4.4, and 2 x 10^{-4} cm^2). Similar results were obtained also for samples annealed at 550°C. The curves had a somewhat different character in the case of annealing at 400°C: although deviation of $j_c(T)$ from linearity took place here, too, the saturation was not complete even in weak fields.

Comparison of the experimental data with Anderson's theoretical model shows that α_c depends strongly on the external magnetic field, going in medium fields through a maximum that becomes sharper with decreasing temperature (Fig. 2b). A similar variation of $\alpha_c(H)$ is obtained also on the basis of the results of [2] and a few others (e.g., [8]). It follows from all this that in the case of alloys with high j_c the model calls for considerable modification. It is interesting to note that the deviation of $\alpha_c(T)$ from linearity is observed only in fields located to the left of the maximum of $\alpha_c(H)|_T$, the maximum values of this parameter falling on a straight line, although they pertain to different H (see Fig. 2).

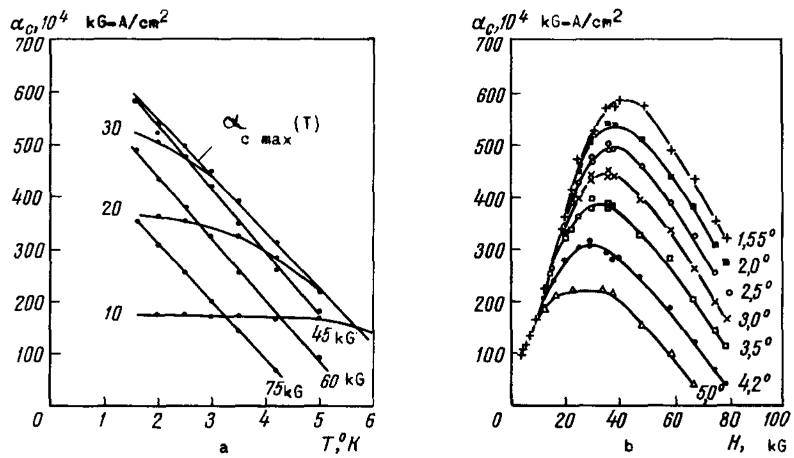

Fig. 2. $\alpha_c = j_c H$ as a function of the temperature and of the magnetic field. a -- $\alpha_c(T)$ for fixed values of H; b -- $\alpha_c(H)$ for fixed T.

In the investigation of sufficiently thick samples (0.25 - 0.29 mm in diameter) we observed still another unusual feature in the behavior of $j_c(H, T)$, viz., instabilities of j_c occurred, principally in medium fields close to those at which the maximum of $\alpha_c(H)$ is observed, and at temperatures lower than a fixed value that depends on the field and on the wire diameter. These instabilities were manifest in a large irregular scatter of j_c for fixed values of H and T (shaded areas in Fig. 1). In some cases even the largest among the unstable values of j_c decreased rapidly with decreasing temperature. The observed instabilities disappeared completely when the wire diameter was decreased below a certain limit (0.19 - 0.22 mm) which is characteristic for the given series of samples. We assume that this behavior is connected with an interaction between the magnetic field of the transport current and the magnetic flux lines of the external field (for example, on one side of the wire, where the field of the current is directed opposite the external field, a process similar to "annihilation instability" takes place [9]).

Work is now continuing and its detailed results will be published later.

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1) The measurement at temperatures from 4.2°K to T_c were made in collaboration with M. Litomiski and I. Ruzicka of the Czechoslovak Institute for Nuclear Research [10].

CONCERNING ONE POSSIBLE MECHANISM OF INSTABILITY OF AN ELECTRON PLASMA IN A CRYSTAL

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It has been pointed out in [1] that cyclotron resonance in crystals can be used for frequency conversion in the microwave band. The method proposed for such a conversion is based on the anharmonicity of motion of the carriers (electrons and holes) in the crystal under the influence of a high-frequency electric field, due to deviation of the dispersion - the dependence of the energy on the quasimomentum - from quadratic for these carriers. A similar idea was advanced later by Lax [2], who noted that in the quantum interpretation the frequency conversion mechanism at resonance is connected with the unequal spacing of the Landau levels for particles with nonquadratic dispersion.

In both cited papers, the crystal was regarded as a passive nonlinear ac frequency converter. Yet a crystal with nonquadratic dispersion of the quasiparticles can possess the