whereas at the realized excitation, in the transition state ~1.5 MeV, appreciable deviations from (1) might be expected. On the other hand, it is well known [9, 16] that the use of (1) in the analysis of the differential cross sections of the reactions (d, pf) and (t, pf) leads to reasonable agreement with experiment both for the form of $W(\theta)$ and for the values of K_0^2 (see the insert of Fig. 2) even within the energy gap of even-even fissioning nuclei, down to the lowest transition state $K^\pi = 0^+$. This fact is surprising, but it is difficult to assess its significance to the theory of fission, since, as shown in [9], the existing experimental data can also be described by assuming a reasonable discrete state of intermediate states $K^\pi(J > K)$. Obviously, this alternative deserves a special study.

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CONNECTION BETWEEN THE SUPERCONDUCTING PROPERTIES OF THE Ti-Nb-Fe ALLOY AND THE PARAMETERS OF THE NGR SPECTRA

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An investigation of the phase decay of superconducting alloys during its initial stages, when the greatest changes of the superconducting properties takes place, is of considerable interest. The use for this purpose of methods such as x-ray and electron microscopy is frequently ineffective, owing to the large number of segregations and their finely dispersed character [1]. New possibilities of investigating this process are offered by the method of nuclear γ-resonance spectroscopy (NGRS), which has high sensitivity to the change of the local surrounding of the resonant atoms [2]. The purpose of the present study was to establish a connection between the critical current density J_c (the macroscopic parameter most sensitive to the change of the microstructure of the alloy) and the NGR spectrum parameters, which reflect this change directly.

We chose for the investigation an alloy based on Ti, containing 38 at.% Nb and 5 at.% Fe. The choice of the composition is dictated by the assumption that during the course of decay of a single-phase solid solution, that exists according to [3] in the Ti-Nb-Fe system at temperatures above 1000°C, the Fe atoms will become redistributed among the phases, and this exerts a strong influence on the critical current density. The initial materials for the alloy were Ti iodide, electron-beam melted Nb, and Fe of high purity, enriched to 8% with the resonant isotope Fe^{57}. An ingot weighing 40 grams was remelted 5 times in a crater furnace with an inert electrode in an argon atmosphere and was rolled down at a temperature close to 1000°C in vacuum to a thickness of 3 mm. Further rolling to 70 μ was at room temperature. We investigated the samples after cold deformation and annealing in a vacuum of 10^{-5} Torr for 10 hours at temperatures from 350 to 800°C.

The NGR spectra were obtained at room temperature with the MS-10K spectrometer (Carl Zeiss, Jena) operating at constant velocity. The source was Co^{57} in Pt. The thickness of the absorbers, in terms of the resonant isotope, was about 0.1 mg/cm^2. The spectra were processed with the Minsk-22 electronic computer. The critical current density was measured at T = 4.2°K in a setup with a superconducting solenoid [4]. The samples for the measurement of J_c, measuring 10 × 1 × 0.07 mm, were cut from the central parts of the absorbers after performing the Mossbauer-effect investigations. The magnetic field in the measurements of J_c was perpendicular to the plane of rolling of the ribbon and to the direction of the transport current.

Plots of J_c vs. the magnetic field intensity H following annealing at different temperatures are shown in Fig. 1. The sharp rise of J_c and the appreciable change in the shape of the $J_c(H)$ curve compared with the curve obtained after cold deformation (curve 1) and annealing at 350°C (the curve is not shown, since it hardly differs from curve 1) is observed for a sample annealed at 450°C (the sample anneared at 400°C was damaged during the measurements and it was impossible to determine the $J_c(H)$ dependence for it). Annealing at 500°C has a much smaller effect on J_c than annealing at 450°, namely the peak of J_c is retained at strong fields, and the value of J_c in medium fields is approximately one-tenth the corresponding value of J_c after annealing at 450°C. The influence of annealing at 600 and 700°C is approximately the same as annealing at 450°, but annealing at 700° lowers the critical field to 70 kOe. Annealing at 800° influences J_c less than annealing at 500°.

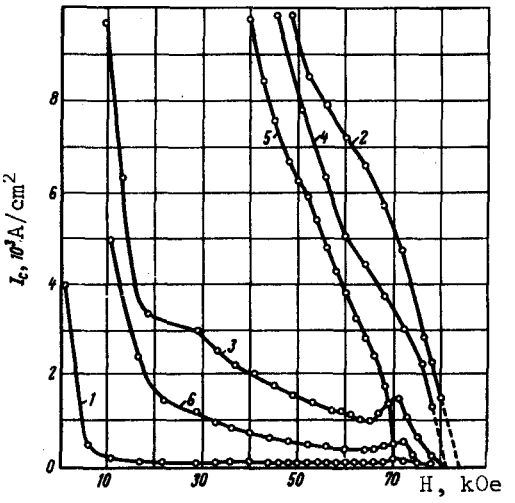

Fig. 1. Dependence of the criticial current density on the magnetic field intensity following cold deformation (curve 1) and following annealing at 450° (curve 2), 500° (curve 3), 600° (curve 4), 700° (curve 5), and 800° (curve 6).

Figure 2 shows the NGR spectra for samples subjected to cold deformation (a) and annealed at 450°C (b), 500° (c), 600° (d), and 800° (e). The spectra of the samples annealed at 350 and 700°C are not shown, and are close in form to spectra a and e, respectively. In the analysis of the NGR spectra, we started out from the following phase-decay scheme: The samples have a metastable single-phase structure after the cold defromation, with a large density of defects that stimulate the decay in the

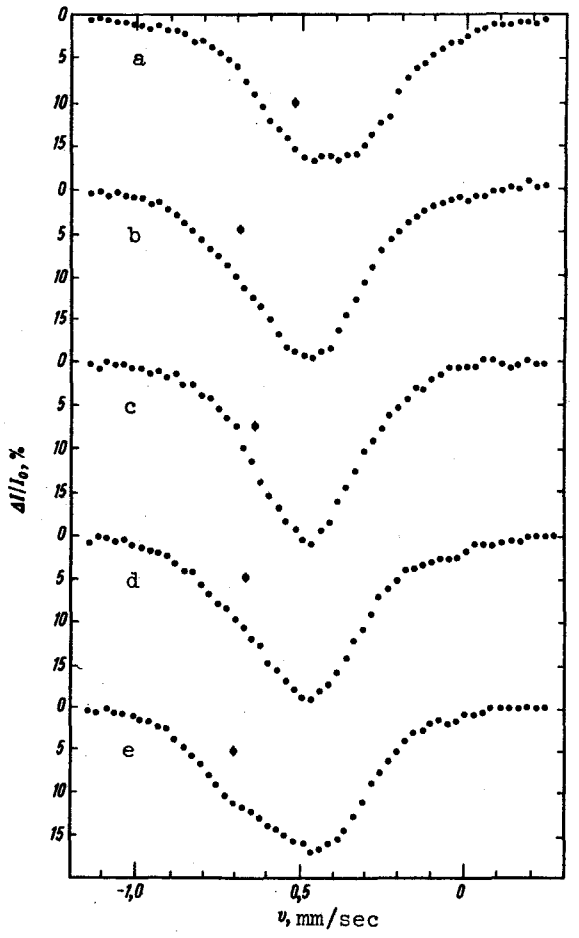

Fig. 2. NGR spectra for samples following cold deformation (a), following annealing at 450° (b), 500° (c), 600° (d), and 800°C (e).

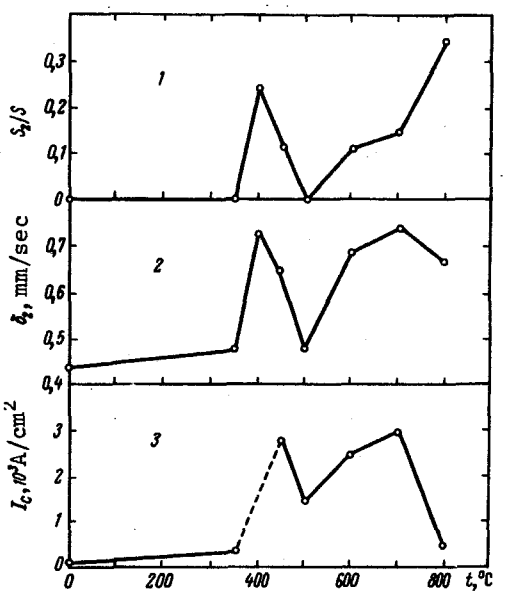

Fig. 3. Relative area under the second line of the NGR spectrum (curve 1), chemical shift of the second line (curve 2), and critical current density in a field $H = 0.9H_{c2}$ (3) as functions of the annealing temperature.

regions close to them at relatively low annealing temperatures. The temperature of the start of such a defect-stimulated decay is in our case close to 400°C. However, the density of defects decreases upon annealing, and there exists an annealing temperature at which the decay in the entire volume of the sample is still impossible, and the number of defect regions is reduced to a minimum. In our case this temperature is close to 500°C. At higher annealing temperature, decay in the entire volume of the sample becomes possible. We have assumed that the iron atoms are distributed during the decay between the solid solution based on titanium and a second phase of unknown composition, and in the resolution we approximated the spectra by two lines of Lorentz shape. It turned out that the chemical shift of the fundamental line, in the case of samples annealed at 400, 450, 600, and 700°C, does not depend on the annealing temperature and amounts to $\delta_1 = -0.48 \pm 0.01$ mm/sec (all the shifts are relative to Co^{57} in Pt). This value coincides with the chemical shift of the single line with which the spectrum of the sample annealed at 500°C can be approximated. The value of δ_1 for the sample annealed at 800° is -0.43 ± 0.02 mm/sec. The position of the line centers in the case of a cold-deformed sample and one annealed at 350° is shifted relative to Co^{57} in Pt by -0.44 ± 0.01 mm/sec and -0.48 ± 0.01 mm/sec, respectively. The large line width (0.45 ± 0.03) and their shape allow us to assume that quadrupole splitting takes place in this case.

Figure 3 shows plots of the relative area under the second line, S_2/S, of the chemical shift δ_2 of the second line against the annealing temperature. It is assumed that in the case of cold-deformed samples and samples annealed at

350 and 500°C the value of S_2/S is zero, and the values of δ_2 coincide with the positions of the centers of these spectra. As seen from Fig. 3, the area under the second line is maximal after annealing at 400° and 800°, and the values of the chemical shift are maximal after annealing at 400 and 700°. The relative value of the area under the second line is proportional to the fraction of the iron atoms leaving the solution, and the character of its dependence on the annealing temperature obviously corresponds to the proposed decay scheme. The value of the chemical shift δ_2 apparently changes in accordance with the change of the composition, structure, and dimension of the segregations. The same Fig. 3 shows a plot of the critical current density in a field $H = 0.9H_{c2}$ (i.e., in a field corresponding to ahe peak of J_c for curves 1, 3, and 6 of Fig. 1) against the annealing temperature. We see that this dependence is in full correlation with the $\delta_2(t)$ dependence. It can be proposed that the value of the chemical shift for the iron atoms in the segregations and the value of the critical current density are determined by the same factors. A more detailed evaluation of the results will be published by us later.

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PLASMA HEATING BY OPPOSING BEAMS OF COHERENT RADIATION

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The possibility of plasma heating by coherent radiation was noted immediately after the development of lasers. It is customary to consider heating and absorption of radiation resulting from the interaction between electrons and nuclei at temperatures such that full ionization is already reached, i.e., free-free absorption is considered (cf., e.g., [1, 2]). Kovrizhnykh [3] proposed a method of heating nuclei in a plasma, based on stimulated nonlinear scattering by nuclei of narrow-spectrum opposing radiation beams ($\Delta\nu \ll \nu_0$, ν_0 is the Langmuir frequency). Peyraud [4] considered heating of electrons by stimulated Compton scattering of light in a focused laser beam with spectrally-narrow radiation, $\Delta\nu/\nu \sim 10^{-4}$.

The possibility of observing the effect of stimulated Compton scattering in the presence of crossed beams was first pointed out by Dreicer [5].

In this paper we propose the use of opposing beams, one or both of which are spectrally broad ($\Delta\nu/\nu \geq v/c$, where v is the thermal velocity of the electrons). Strictly speaking, light with this $\Delta\nu$ cannot be called coherent, but the required intensity can be attained only by somehow broadening the coherent radiation (by a method not considered here).

Only with such a spectrum do the electrons have a Maxwellian distribution with respect to the longitudinal velocity as a result of interaction with light without collisions [6].