density changes. This can be attributed to the fact that plasma conductivity begins to prevail.

We thus have two clear-cut limits. The first corresponds to the change of the temperature coefficient of resistivity of mercury at a density near 9 g/cm^3 [3]. It can be called the "close-packing" limit. This limit can be traced also in the case of a system of spheres (see Fig. 1). The second limit can be called the "limit of metallic conductivity." Starting with this limit, a rise in temperature produces no chains through which metallic conductivity can be effected. The arbitrary transition boundary shifts on approaching the limit. Near the critical density, a shift towards lower densities and a rise in temperature are observed. The transition line crosses the critical isobar of the metal-dielectric transition only at the critical point, and does not go along the isobar as stated in [13]. The foregoing results lead to important conclusions concerning the characteristic dimension of the atom and the limiting possibilities of chemical bonds.

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INFLUENCE OF REACTOR IRRADIATION AT HELIUM TEMPERATURE ON THE PINNING OF ABRIKOSOV FLUXOIDS IN SINGLE-CRYSTAL NIOBIUM

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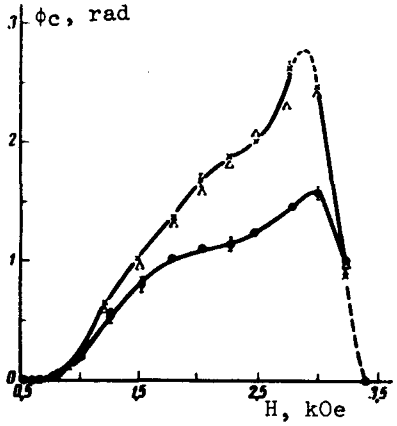
It is known that Abrikosov fluxoids are pinned on different crystal-lattice defects. An important role in this pinning is played by dislocation. The pinning force is estimated in [1 - 3]. The influence of the dislocation density on the pinning was estimated in a theoretical paper by Baramidze and Saralidze [4], and the influence of surface defects of the crystal on the pinning of magnetic vortices was estimated in an experimental study by the present authors jointly with D.G. Chigvinadze and a group from Oxford [5, 6]. The influence of low-temperature neutron irradiation on dissipative phenomena in the mixed state was investigated by Andronikashvili et al. [7].

Using the currentless procedure developed at the Physics Institute of the Georgian Academy of Sciences (described in detail in [5, 6]), we investigated



Dependence of the critical angle ϕ_c on the external magnetic field H at T = 4.2°K: ● - prior to irradiation, × - after irradiation at T = 4.2°K by fast neutrons at a dose of 3.5×10^{12} cm^{-2}, Δ - after letting the sample recuperate for 80 hours at T = 100°K.

the influence of neutron irradiation on the pinning force in single-crystal niobium. The irradiation was at 4.2°K. Cylindrical samples with diameter 6 mm and ℓ = 5 mm were cut by the electric-spark method from a single crystal obtained from the Institute of Metal Physics and Pure Metals (Dresden, E. Germany). A radioactive analysis has revealed the presence of $\sim 10^{-3}$ at.% Ta, and also of Na, Cu, Ag, Zn, As, and Sb in an amount not exceeding $\sim 10^{-6}$ at.%.

Measurements of the magnetic moment at 4.2°K yielded H_{c1} = 650 Oe and $H_{c2} \simeq 3200$ Oe.

The sample, suspended from a thin elastic filament connected to a rotary head, was placed in a transverse magnetic field. The angle ϕ_1 of rotation of the rotating head was measured with accuracy $\Delta\phi_1 = \pm 4.6 \times 10^{-3}$ rad, and the rotation ϕ_2 of the sample was measured with accuracy $\Delta\phi_2 = \pm 4 \times 10^{-4}$ rad. The rate of rotation of the head was 7×10^{-3} rad/sec.

If the sample temperature is $T > T_c$ and the head is rotated and ϕ_2 is measured as a function of ϕ_1, then the sample rotates uniformly with the head, but lagging the latter by a certain angle, regardless of the applied magnetic field.

For $T < T_c$ and fields $0 < H < H_{c1}$, the picture is analogous to that of the normal state. On the other hand, if $H_{c1} < H < H_{c2}$, then the sample does not follow the rotating head, up to a definite critical angle ϕ_c [5, 6]. The immobility of a mixed-state sample situated in the magnetic field is due to the force F_p that pins the Abrikosov fluxoids to the inhomogeneities of the crystal lattice. Only if $\phi_1 > \phi_c$ is the torque applied to the sample capable of rotating it relative to vortices oriented along the magnetic field. The angle ϕ_c is thus a measure of the pinning force.

The critical angle ϕ_c depends at a given temperature on the external magnetic field H. The points in Fig. 1, which shows the results of measurements at 4.2°K, represent the experimentally observed values of ϕ_c prior to the irradiation. Starting with H_{c1}, the value of ϕ_c increases, reaches a maximum, and then drops sharply to zero at $\sim H_{c2}$.

Irradiation at T = 4.2°K with a fast-neutron dose of 3.5×10^{12} cm^{-2} increases the maximum value of ϕ_c by almost 75%, as marked by the crosses in the figure.

When evaluating these results, it must be borne in mind that such a small irradiation dose does not lead to the formation of clusters of point defects capable of serving as independent pinning centers. Indeed, in [8], in which the influence of neutron irradiation at 50°C on single-crystal niobium was investigated, it was shown that even a dose of 2×10^{18} cm^{-2} does not lead to formation of defects with dimensions comparable with the dimensions of the vortices. The main type of defects is represented in this case by dislocation loops of small dimensions, on the order of 30 - 170 Å. On the other hand, it is known [9, 10] that the maximum pinning force is expected under conditions when the dimension of the pinning centers is $\ell \sim \xi$, where ξ is the coherence length.

In our case, obviously, as a result of low-temperature neutron irradiation at a dose 4.5×10^{12} cm^{-2}, the growth of ϕ_c is due to the pinning of the dislocations already present in the sample by the newly produced point defects. The dislocations, in turn, are pinning centers for the vortices.

Storing the sample for 80 hours at T = 100°K (the corresponding values are designated by triangles) does not eliminate the irradiation effect.

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EXCITATION ENERGY TRANSFER BETWEEN TRIVALENT RARE-EARTH IONS, STIMULATED BY A RADIATION FIELD

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We have observed the transfer of excitation energy from Yb^{3+} ions to Tb^{3+} ions in silicate glass; this transfer was stimulated by radiation from a neodymium laser with wavelength 1.06 μ. The energy transfer was effected by the interaction of the Yb^{3+} ion in the excited state, the Tb^{3+} ion in the ground state, and a photon of energy equal to the difference between the excited energy states of the ions Yb^{3+} ($^2F_{5/2}$) and Tb^{3+} ($^5D_4$). In our experiments, the radiation of the neodymium laser not only excited the Tb^{3+} ions, but also produced a photon field at a difference frequency. A theoretical analysis of the transfer of excitation energy between active ions with photon participation is given in [1].

The investigations were performed on silicate-glass samples activated with 8 mol.% Tb^{3+} and 7 mol.% Yb^{3+} (the content of the initial batch). Irradiation of such glass by a neodymium laser operating either in the free-running mode or Q-switched, at T = 300°K, produced luminescence of the Tb^{3+} ions in the region 0.48 - 0.53 μ; this luminescence was connected with transitions from the $^5D_4$ level to the $^7F_{6-0}$ levels. The energy level scheme of the Yb^{3+} and Tb^{3+} ions