It is known that at room temperature the electron mean free path in bismuth, δ, at 10^{10} Hz ($\ell \sim 3\mu k$ [5]). However, this does not affect the value of the surface impedance of bismuth. The value of R_{11} measured by us likewise does not differ from the static value. Nonetheless, authors of papers on magnetoresistance [6, 7] note the presence of a strong dispersion in the microwave band.

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CRITICAL THICKNESS OF IRON FILMS

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In one of our earlier investigations [1] we observed the existence of a new allotropic modification in iron films obtained by low-temperature condensation. This modification is transformed jumpwise into α - Fe when the films are heated to 40°K (Fig. 1). It was shown recently by electron diffraction [2] that the new allotropic modification observed in extremely non-equilibrium iron films is amorphous iron. A very sharp drop of resistance is observed also when films of the rare-earth element ytterbium, obtained by condensation on a substrate cooled with liquid helium [3], is annealed to 14°K. This drop of the electric resistance is also connected with the transition of the ytterbium from new non-equilibrium phase into the usual modification. It was shown further that ytterbium retains the new phase when annealed to 14°K in films of thickness below critical ($\sim$ 3000 Å). When the ytterbium films reach the thickness 3000 A during the course of condensation, they change jumpwise into the usual

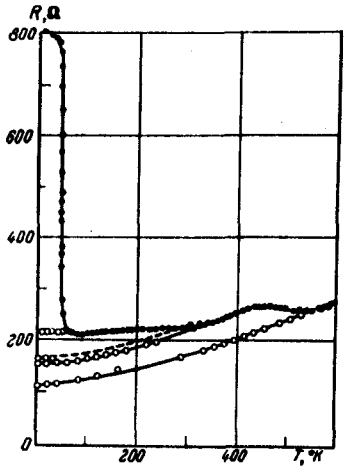

Fig. 1. Resistance vs. temperature for iron film ~50 Å thick; ● - irreversible variation of resistance upon annealing, o - reversible variation of resistance of annealed film.

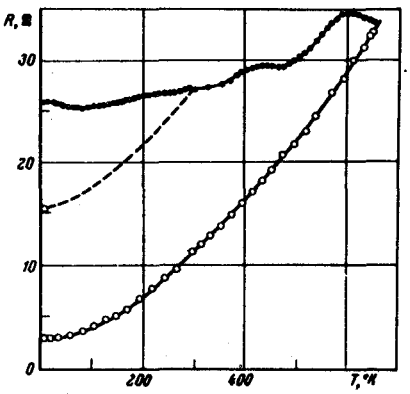

Fig. 2. The same as Fig. 1, but for ~600 Å film.

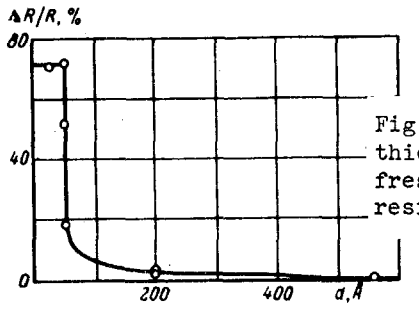

Fig. 3. Drop of resistance during the phase transition at 40°K vs. thickness of iron film; ΔR - difference between resistance of freshly condensed film and resistance after phase transition. $R_{4.2}$ - resistance directly before condensation

modification at liquid-helium temperature.

In this paper we report the results of an investigation of the critical thickness of iron films. The initial iron was 99.99% pure. The procedure of obtaining the films was similar to that described earlier [1]. The film thickness was estimated from the temperature-dependent part of the electric resistance [4].

The results have shown that, like the ytterbium layers, the iron films have a critical thickness. Films of thickness smaller than critical go over from the amorphous to the crystalline state at a temperature 40°K (Fig. 1), which agrees with the previously published data [1].

On the other hand, if the thickness of the iron layer during the time of condensation exceeds the critical value, the transition takes place at the temperature of liquid helium.

Figure 2 shows the R(T) plot of an iron film with thickness larger than critical; the resistance jump characterizing the phase transition did not occur during the heating process, because the transition took place during the time of condensation. The critical thickness was estimated by us to be 50 Å. This is shown in Fig. 3, which shows the dependence of the drop of the electric resistance at 40°K on the film thickness. This amounts to 71 - 72% of the resistance of freshly-condensed films of thickness than critical. The existence at 40°K of a small drop of resistance in the case of layers of thickness larger than critical can be attributed to the presence of the wedge-like edges of the film, which are thinner than critical.

It should be noted that Suits [5] also observed a jump of the resistance in iron films during the time of condensation at a temperature ∿ 3°K, when the layer thickness reached 50 Å. However, he erroneously attributed the higher transition temperature (∿ 40°K) obtained in our investigation [1] to a possible contamination of the films by the residual gases, and not to the existence of a critical thickness.

The existence of a critical thickness of iron layers can obviously be attributed to a change in the thermodynamic conditions in thin films, as was demonstrated by Bublik and Pines [6] for a large number of metals. It seems that, in analogy with iron and ytterbium, a critical thickness is apparently possessed by all metallic films obtained by low-temperature condensations and having unstable phases different from the phases in the bulky state.

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SECOND HARMONIC GENERATION IN THE CRYSTAL $BeSO_4.H_2O$

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Among the piezoelectric crystals used for second-harmonic generation, the number of substances having relatively large components of the non-linear polarizability tensor and simultaneously satisfying the synchronism condition is very limited. One such substance is the crystal $BeSO_4.4H_2O$ [1]. The crystal belongs to the tetragonal system and has a symmetry space group I $\bar{4}2c$ [2].

$BeSO_4.4H_2O$ is colorless and transparent in the ultraviolet down to 1700 Å. The crystal was grown from an aqueous solution on an oriented primer by the method of lowering the temperature. The growth rate along {101} faces was 1.5 mm in a day. The linear dimensions reached several cm. The crystals can be worked with a filamentary saw [3] and polished on resin with the aid of chromium oxide.

The refractive index of beryllium sulfate in ultraviolet are still unknown, but the crystal symmetry and extrapolation of the dispersion on curves give grounds for assuming that a second-harmonic extraordinary wave can be generated with the aid of the ordinary wave of laser radiation.

The sample was 12 mm thick and was cut in such a way that a laser beam normally incident on its front face made an angle $\theta = 60°$ with the optical axis and an azimuth angle $\phi = 45°$. The second harmonic was observed in the lights of a helium-neon laser with $\lambda = 6328$ Å. The signal was registered with a photomultiplier or photographed on a film placed in the focus of a quartz lens with f = 150 mm. The experimentally measured synchronism angle was $\theta_0 = 60 \pm 1°$ The conversion coefficient compared with a KDP crystal of the same thickness and $\theta = 57°$ is 1/3. The parameters of the angular structure are practically the same as for KDP, indicating that the birefringence coefficients of these two crystals are close, and consequently it can be assumed that the component of the nonlinear polarizability tensor d_{36} of $BeSO_4.4H_2O$ is 1/3 the corresponding component of KDP. The high sharpness of the spatial-structure picture was evidence that the crystal was optically perfect and there were no polysynthetic twins in the investigated sample.

It should be noted that beryllium sulfate, being harder than KDP and ADP, is easier to work mechanically.

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