are close to the parameters of the considered A component of the hyperstructure of $Fe_{0.88}S$ [5, 9].

The results of detailed investigations of this phenomenon in single-crystal Fe_7S_8 absorbers are being readied for publication.

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INFLUENCE OF TWINS ON THE MAGNETORESISTANCE OF Sb

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As is well known, in many crystals subjected to an external force, the lattice is shifted to a new position prior to the occurrence of the failure, and a mechanical twin is produced. The twin part of the crystal is a reflection of the crystal lattice relative to a certain plane called the twinning plane.

In this paper we attempt to clarify the influence of the twinning planes[1)] on the magnetoresistance of Sb at low temperatures. The measurements were made on a single crystal with a structure of high perfection (the dislocation density on the (111) plane, determined with the aid of etch pits, did not exceed 10^2 cm^{-2}), grown by drawing from the melt [1].

To produce mechanical twins, the sample was immersed in liquid nitrogen and its edge was broken off. As a result, the part of the sample adjacent to the fracture, was pierced by twins, the average distance between which was 1 mm. The width of each twin was $\lesssim 10^{-2}$ mm, and the system of twinning planes had Miller indices (110).

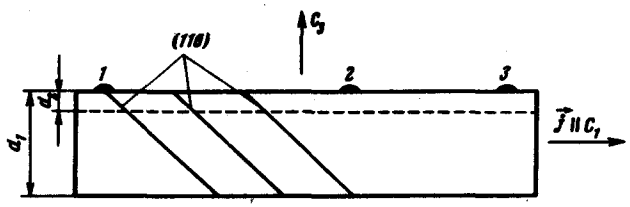

Fig. 1. Geometry of experiment: d_1 and d_2 - initial and final thickness of the sample; 1, 2, 3 - potential contacts; (110) - twinning plane (the thickness of the lines representing the twinning planes includes the twinning layers); $\vec{j}$ - electric-current vector.

The magnetoresistance of the "ideal" part of the crystal and the part containing the twins (we shall henceforth designate them

[1)] Here and throughout, when speaking of the influence of the twinning planes on the kinetic properties of Sb, we have in mind the real boundaries of the twins, and not ideal mathematical surfaces that have no thickness.

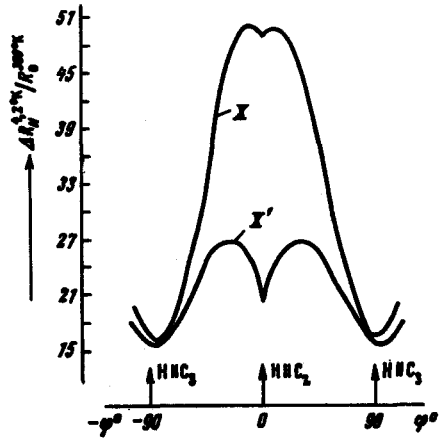

Fig. 2

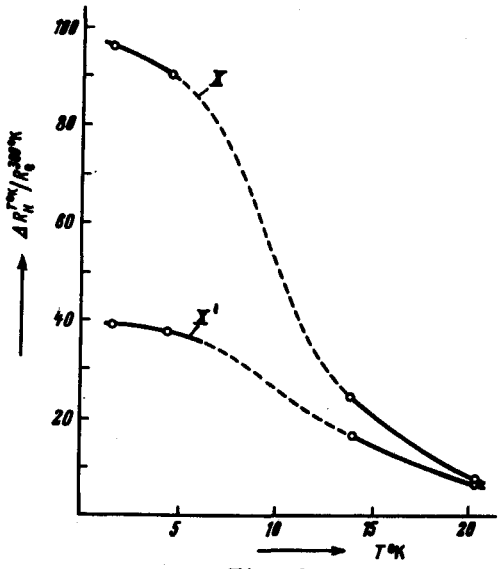

Fig. 3

Fig. 2. Rotation diagrams of Sb X and Sb X' in a magnetic field, H = 15 kOe, T = 4.2°K.

Fig. 3. Temperature dependence of magnetoresistance, $H \| C_2$, H = 20 kOe.

for convenience as Sb X and Sb X') were measured with three potential contacts. The geometry of the experiment is shown in Fig. 1.

The measurements were performed in several stages: first we investigated the initial Sb X-Sb X' sample (its cross section was nearly elliptic, with extremal dimensions 3.9 × 2.9 mm), after which the sample was etched twice in aqua regia and investigated after each etching. The temperature and magnetic-field ranges were 1.6 - 20°K and 5 - 20 kOe.

The experiments have shown that the ratio of the electric resistances at room temperature and at helium temperatures $R_0(300°K)/R_0(4.2°K)$, and also the magnetoresistance

$$\Delta R_H^{4,2°K}/R_0^{300°K} = \frac{R_H^{4,2°K} - R_0^{4,2°K}}{R_0^{300°K}} \approx R_H^{4,2°K}/R_0^{300°K}$$

of Sb X and Sb X' differ at $\vec{H} \| C_3$ by only several per cent, whereas for $\vec{H} \| C_2$ the difference between the magnetoresistances at helium temperature (in the initial state of the sample) is more than 100% (Fig. 2, table). Since this difference is quite insignificant at T = 20°K, it is obvious that the temperature dependence of $R_H^{T°K}$ is Sb samples with structure defects is greatly distorted (Fig. 3).

As the crystal thickness was being decreased by the chemical etching, the electric conductivity and the magnetoresistance of Sb X also decreased, this being the consequence of the size effect [2]. The behavior of the electric conductivity of Sb X', and also of the magnetoresistance at $\vec{H} \| C_3$, was similar. However, at field directions near C_2, the magnetoresistance of Sb X' no longer

Sample[1]	Transverse dimensions mm[2]	$R_o^{300°K}/R_o^{4.2°K}$		$\Delta R_H^{4.2°K}/R_o^{300°K}$; $H = 20$ kOe			
				Sb X		Sb X′	
		Sb X	Sb X′	$H \parallel C_2$	$H \parallel C_3$	$H \parallel C_2$	$H \parallel C_3$
Sb X – Sb X′	3.9 (C_2) × 2.9 (C_3)	2100	1940	90.5	30.17	37.82	28.53
Sb X*a* – Sb X′*a*	1.15 (C_2) × 1.45 (C_3)	1910	1650	77.5	27.8	44.5	26.8
Sb X*б* – Sb X′*б*	0.7 (C_2) × 1.2 (C_3)	1750	1500	74.3	24.0	47.7	22.2

[1] The indices a and b correspond to the sample after the first and second etching, respectively.

[2] The parentheses contain the directions of the crystallographic axes - binary (C_2) and trigonal (C_3).

decreased, but increased with increasing sample thickness[2], tending to the corresponding value for the "ideal" part of the crystal (table).

It follows therefore that the thinner the sample, the smaller the influence of the structure defects of a given type on the resistance of antimony in a magnetic field.

We note first that the change of the electric resistance and magnetoresistance due to disorientation of the twins relative to the original part of the crystal, without allowance for scattering by the twin boundaries, should be of the same order as the ratio of the length of the twin to the adjacent part of the crystal, and cannot exceed several per cent in these experiments. We therefore assume that the influence of the structure defects introduced in Sb X' on the transverse magnetoresistance is due mainly to the interaction of the twinning planes with the carriers drifting in the perpendicular crossed fields $\vec{E}$ and $\vec{H}$ ($\vec{E}$ - electric field vector). It is obvious that the interaction should be minimal when $\vec{H} \parallel C_3$ and maximal when $\vec{H} \parallel C_2$, for in the former case the drift-velocity vector is parallel to the (110) plane, and in the latter, at a given free path, the twinning plane "senses" the largest number of carriers (Fig. 1). Further, if the change of the magnetoresistance at $\vec{H} \parallel C_2$ exceeds 100%, then it is natural to assume that the interaction with the twin boundaries is the fundamental momentum relaxation mechanism in the volume of Sb X' for the majority of the carriers. Then the observed phenomenon is none other than the size effect on the boundaries of the twins, with the characteristic free path length L on the order of the thickness of the sample. If this is so, then the smaller the transverse dimension of the sample along the C_3 axis, the smaller (see Fig. 1) the relative number of carriers that interact with the twinning planes, and consequently, the closer the value of the magnetoresistance in the part of the sample containing the twins to the value for the "ideal" part of the crystal; this is in full agreement with the experimental data (see the table).

To realize the size effect on the twin boundaries it is necessary that the carrier reflection from the boundary be sufficiently large. If it is assumed that the thickness D of the boundary layer, in which the lattice cannot be regarded as ideal (the so-called accomodation region), is much smaller than the de Broglie wavelength λ_B, then the reflection coefficient is $K \sim (D/\lambda_B)^2$

[2] The effect was duplicated in samples having approximately the same twin density of given orientation as in Sb X', and approximately the same initial cross section.

[3]. For Sb, however, the accommodation region can reach 10 μ [4][3], so that an estimate of the reflection coefficient is difficult. Furthermore, K may greatly increase because of the appearance of bound charges on the twin boundaries, in analogy with what occurs in semiconductors [5].

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CW CHEMICAL LASER USING DF-CO_2

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We report here realization of continuous laser emission in subsonic gas streams. The generation was produced by CO_2 molecules excited by energy transfer from vibrationally-excited DF* molecules obtained by a purely chemically initiated chain reaction between deuterium and fluorine.

These processes correspond to the scheme:

$$F + D_2 \rightarrow DF^* + D, \quad \Delta H = -31{,}7 \text{ kcal/mole}, \tag{1}$$

$$D + F_2 \rightarrow DF^* + F, \quad \Delta H = -98 \text{ kcal/mole} \tag{2}$$

$$DF^* + CO_2(00^0 0) \rightarrow CO_2(00^0 1) + DF. \tag{3}$$

In our experiment, as in [1, 2], the source of the "priming" active centers needed to realize the chain reaction (1) - (2) was the auxiliary chemical reaction

$$F_2 + NO \rightarrow FNO + F, \quad \Delta H = -18 \text{ kcal/mole}. \tag{4}$$

The observed continuous generation corresponded to the state of molecular transition $CO_2[00^0 1] \rightarrow CO_2[10^0 0]$ with radiation wavelength 10.6 μ.

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[3] According to [4], in individual cases the accommodation region may reach several hundred microns. At such dimensions, its contribution to the change of the magnetoresistance is comparable with the changes observed in the present investigation. However, if the influence of the accommodation band reduces simply to a decrease of the carrier mobilities, then one cannot understand, without making additional particular assumptions, the cause of the anisotropic (relative to the magnetic-field direction) change of the magnetoresistance in the part of the sample containing the twins, and also the cause of the small change of $R_0(300°K)/R_0(4.2°K)$ of this part of the crystal.