spectrogram.

In estimating the plasma temperature, we assumed the so-called "corona model" of the plasma and used House's ionization and recombination cross sections [4], as well as the later data of I. L. Beigman and L. A. Vainshtein [5], who took into account photorecombination at excited levels (calculation shows that dielectric recombination does not take place at the given values of the electron density).

It should be noted that the use of the "corona model" in our case of a dense plasma may not be perfectly valid. No account is taken in the corona model of triple recombinations with electrons. Estimates show, however, that the role of such processes is apparently small, and their inclusion leads to higher values of T_e. On the other hand, no account is taken of photoionization processes due to the large optical thickness of the plasma in the lines; allowance for these processes yields a lower value of the temperature.

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CHANNELING OF ALPHA PARTICLES IN BERYLLIUM OXIDE

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1. Measurements of the ranges of fast charged particles in crystalline solids have led to the discovery of the phenomenon of deep penetration of fast particles in crystals along channels between the close-packed rows or planes of atoms with small indices [1-4]. The investigations of this phenomenon were made for the most part on crystals with metallic [5-8] or covalent [9-10] bonds. However, as shown analytically [11] and also in a mathematical experiment with an electronic computer, the channeling of charged particles can take place also ion ionic crystals, particularly in BeO [12].

We deemed it of interest to investigate experimentally the channeling of fast charged particles in a BeO crystal.

2. Beryllium oxide crystallizes in a hexagonal system and has a wurtzite structure. BeO forms ionic crystals in the form of prisms with a = 2.69 Å, c = 4.37 Å, c/a = 1.63, and with cleavage in the $\{10\bar{1}0\}$ plane. Their structure consists of close-packed hexagonal formation of oxygen atoms, in which half the tetrahedral voids is occupied by beryllium atoms.

The character of the forces of interaction between the atoms in the BeO lattice differs from the interaction in the crystals with metallic and covalent bonds. The lattice potential is negative in the places where the positive Be ions are located, and is positive at the location of the negative O ions. Therefore the distribution of the potentials in the geometric channels in the BeO lattice is very complicated and cannot be regarded with the aid of simple quantitative calculations; they require, in all probability, the use of electronic computers.

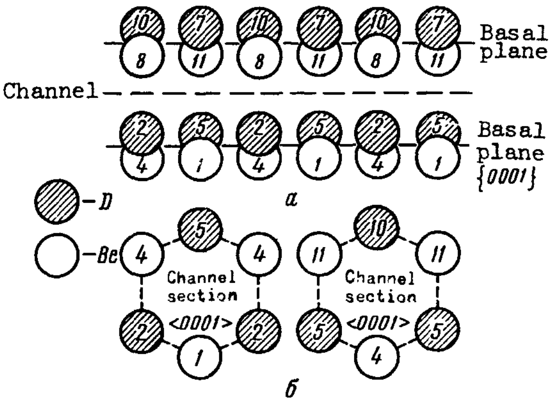

Fig. 1. Structure of BeO crystal and geometry of channels. a - channel between basal planes, b - section of channels that are normal to the basal planes.

There are two most effective types of channels in the BeO crystal structure: in the ⟨0001⟩ direction normal to the basal plane (Fig. 1b), and between the atomic layers made up of the basal planes (Fig. 1a).

3. The fast-particle source used in the experiment was Pu-239, which emits 5.15-MeV α particles. One square centimeter of the radioactive source emitted 1.83 x 10^6 α particles per minute into a 2π solid angle. The targets for the study of α-particle penetration were made of amorphous or polycrystalline BeO in the form of plates 0.5 mm thick (the range of 5-MeV α particles in amorphous BeO is 0.025 mm [13]).

One side of the target was placed on the Pu-239 source, and the other was pressed against a scintillation counter (ZnS crystal phosphor and FEU-29 photomultiplier). The entire source-plus-target system was placed in a vacuum chamber (~10^{-5} mm Hg).

Bombardment of the amorphous-BeO target revealed no penetration of the α particles through the entire target thickness. In the bombardment of a single-crystal target cut parallel to the basal plane {0001} of the BeO crystal, ~8% of the total number of α particles incident on the crystal surface passed through the target. The transmission through a single-crystal target cut parallel to the {01$\bar{1}$0} face of the BeO crystal was ~13%.

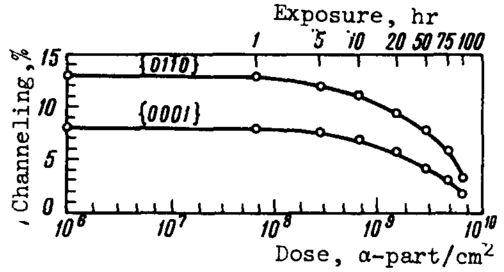

Fig. 2. α-particle channeling in BeO vs. integral α-particle flux.

In the first case, the passage of α particles was due to their capture and subsequent propagation through channels along the ⟨0001⟩ direction, which is normal to the basal plane and passes through the center of the basal hexahedron, and in the second case the passage is due to channeling in the two-dimensional voids between neighboring close-packed basal planes.

When the integral dose of bombarding particles was increased from 10^6 to 10^{10} cm^{-2}, the channeling efficiency dropped to 2 - 3% respectively for the two investigated target orientations {0001} and {01$\bar{1}$0} (Fig. 2). In all probability, the α particles that did not enter the channel or that crossed it cause displacements of the atoms of the BeO lattice and lose their energy to this process, and are therefore decelerated and remain in the crystal. The displaced lattice atoms and the penetrating helium atoms distort the structure of the channels in the BeO crystal. When a channeled particle encounters such distortions, it is deflected through a large angle and is also decelerated. In final analysis, this leads to an over-all decrease of the transparency of the crystal to fast particles, as is indeed observed in the experiments.

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LOSS OF DISSIPATIVE EFFECTS IN INELASTIC SCATTERING IN MANY-VALLEY SEMICONDUCTORS

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It was shown in [1] that scattering of electrons by optical phonons of energy $\hbar\omega_0$ at low temperatures ($kT \ll \hbar\omega_0$) can be regarded in a certain interval of electric fields $\vec{E}$ as absolutely inelastic. This means that when the electron energy ϵ, which increases under the influence of the field $\vec{E}$, reaches a value $\epsilon = \hbar\omega_0$, an optical photon is emitted instantaneously, and the electron is stopped. If the acceleration of the stopped electron is in a magnetic field $\vec{H}$ (crossed with $\vec{E}$), then its maximum energy is $\epsilon_{max} = 2mc^2(E/H)^2$. Therefore, when $H > H_c \equiv 2(c/v_0)E$ (where v_0 is the velocity of an electron of energy $\hbar\omega_0$) we have $\epsilon_{max} < \hbar\omega_0$, and the electron loses its ability to emit optical photons after the first scattering. This means that dissipative effects disappear completely when $H > H_c$. As a result, the gauss-ampere characteristic (dependence of the current $\vec{j}$ on $\vec{H}$ at fixed $\vec{E}$) has singularities at $H = H_c$, namely a jump in the dissipative current $j_{\parallel}$ and an asymmetric sharp peak of the Hall current $j_{\perp}$ [1].

We indicate in this note effects of similar nature, which can occur in many-valley semiconductors. For simplicity we confine ourselves to the case of two valleys (Fig. 1) and assume $T = 0$. The latter means that when $E = 0$ the electrons are at the centers of the valleys, and that absorption of optical phonons is impossible. We neglect also other elastic scattering mechanisms (impurities and acoustic phonons). The effects in the many-valley