system with the lattice vibrations. A theoretical analysis has shown that if a magnetic field which gives rise to spin-level splitting is applied and the splitting coincides with the frequency of the phonons participating in the light scattering being observed, then an appreciable shift in the Mandel'shtam-Brillouin component appears.

Especially interesting results may be obtained by combining the paramagnetic resonance and the Mandel' shtam-Brillouin effect. In particular, if a "narrow phonon bottleneck" is produced, i.e., if the rate of energy transfer from the spin system to the resonant phonons is higher than from these phonons to phonons of other frequencies, then at the saturation point of the paramagnetic resonance the effective temperature of the resonant phonons should increase by many factors and, correspondingly, the intensity of the scattered light should increase.

Tests were run on a cerium-magnesium nitrate single crystal, which has suitable paramagnetic and optical properties. Under the conditions of continuous saturation of the paramagnetic resonance, the effective temperature of the resonant phonons increased from 1.5°K to 250°K. If, however, intermittent saturation with frequency somewhat different from the frequency of the paramagnetic resonance was employed, then the effective temperature of the resonant phonons increased to 8000°K in the beginning over a short interval of time of the order of 0.1 μsec. The avalanche-like growth of the number of the resonant phonons is explained by the fact that the experiment was set up under conditions which ensured the population inversion of the spin levels, by virtue of which a phonon maser effect appeared.

In conclusion, the possibility of using the Mandel' shtam-Brillouin scattering to study the various mechanisms underlying spin-lattice relaxation, to observe single-phonon processes at high temperatures, and to detect acoustic paramagnetic resonance is discussed.

The contents of the following articles are discussed in the report:

[1] S. A. Al'tshuler and B. I. Kochelaev, Zh. Eksp. Teor. Fiz. 49, 862 (1965) [Sov. Phys.-JETP 22, 600 (1966)].

[2] B. I. Kochelaev, Dokl. Akad. Nauk SSSR 166, 833 (1966) [Sov. Phys.-Doklady 11, 130 (1966)].

[3] S. A. Al'tshuler and B. I. Kochelaev, Polarization, matiere et rayonnement (volume jubilaire en l'honneur d'Alfred Kastler). Presses Universitaires de France, Paris, 1969.

[4] S. A. Al'tshuler, R. M. Valishev, and A. Kh. Khasanov, Tezisy dokladov yubileĭnoĭ konferentsii po paramagnitnomu rezonansu (Theses of Reports of the Anniversary Conference on Paramagnetic Resonance), Kazan', 1969, p. 235.

[5] S. A. Al'tshuler, R. M. Valishev, and A. Kh. Khasanov, ZhETF Pis. Red. 10, 179 (1969) [JETP Lett. 10, 113 (1969)].

[6] S. A. Al'tshuler, R. M. Valishev, B. I. Kochelaev, and A. Kh. Khasanov, ZhETF Pis. Red. 13, 535 (1971) [JETP Lett. 13, 382 (1971)].

G. I. Distler. The Electrical Structure of Crystals

The electrical structure of crystals, which determines their many physical and chemical properties, is a set of different electrically active defects. The methods of decoration, based on selective crystallization of different substances on the elements of the electrical relief of the surfaces of solids, allows us to visualize at different levels of resolution this relief and its changes.

It is established that the active sites of a real crystal are, apart from isolated point defects, complex active centers—groups of point defects—which act in a number of processes as a unit, as well as micro- and macro-clusters of point defects. Between charged point defects of opposite charge in crystals, there appear polarized line bridges, since it is precisely at these places that the intensity of the electric field has its maximum value. Polarized line structures are often observed at complex active centers, in clusters of radiation defects and in electric double layers at the boundary between two solid phases, the lines being, as a rule, oriented along definite crystallographic directions. Thus, there appears in crystals a lattice structure whose lattice points are electrically active point defects and clusters of them, while the linear sections are micro- and macro-polarized structures.

During crystallization, the formation of nuclei occurs selectively on electrically active point defects, while the growth and coalescence of the nuclei and fairly large particles occur at different rates at localized regions of the surface, the electrical properties of which are determined in the first place by the micro- and macroclusters of point defects. At the negatively charged sections of the surface, physically adsorbed thin layers of water are formed which play the role of a "lubricant." Polarized line structures are also active places during crystallization. Crystallization is, consequently, a matrix replication process, programmed in the electrical structure of the surface of the crystal-substrates (and seedings). A far-reaching analogy between such heterogeneous processes as crystallization and biological processes suggests itself.

The establishment of the fact that the activity of surfaces, in particular, of cleavage and growth steps, manifests itself through their electrical characteristics, calls for a new approach to the dislocation theory of crystal growth. Indeed, the exit points of screw dislocations, which are responsible for the existence of undergrown steps, should be active during the growth
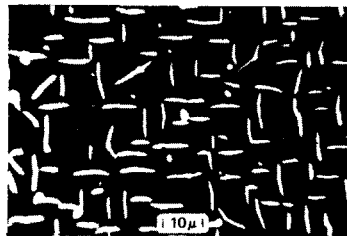

FIG. 1. Picture of oriented crystallization of anthraquinone on the outer surface of a plycrystalline layer of ZnO of thickness 150Å, deposited on the surface of a NaCl crystal.
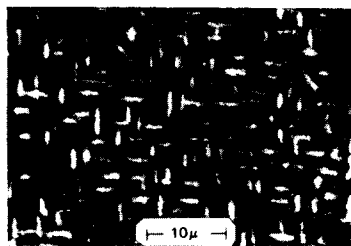
FIG. 2. Same as in Fig. 1, on the contact surface of the ZnO poly-crystalline layer, produced on the surface of a NaCl crystal and then detached from it.

of crystals only when these steps possess the requisite electrical characteristics. Only if the charge and potential of the steps, connected with the screw disloca-tions, are more favorable for crystallization than the other electrically active points of the surface, e.g., the point defects, will the growth of the crystals take place through the dislocation mechanism.

The electrical structure of crystals is responsible for the long-range processes, consisting in the trans-mission of structural information through the boundary layers, produced on the surfaces of crystals. Under the action of the electrically active points of the crystal surface, there appear localized induced polarized structures of the electret type, which reflect the elec-trical properties of the crystal surfaces. The possi-bility of transmission and storage of structural informa-tion through the thermoelectret and photoelectret mechanism by means of not only amorphous, but also polycrystalline boundary layers, was established. This means that the induced polarized structure appears and exists independently of the crystallographic directions of the boundary layer (Fig. 1). Induced polarized struc-

tures were also produced in monocrystalline epitaxial layers, which acquire in the boundary region contiguous to the substrate special electrical properties that dif-fer from the properties of the remaining monocrystal-line layer. The polarized structures, which are the information network, get "frozen" into different boundary layers so stably that these layers become unique electrical copies of the surface, which can exist independently of the crystals once they are detached from them. This uncovers a very promising possibility of production of "electrical copies" with one and the same matrix for carrying out appropriate heterogene-ous processes, in particular, crystallization.

[1]G. I. Distler, Izv. Akad. Nauk SSSR, ser. Fiz. 32, 1044 (1968).

[2]G. I. Distler and V. P. Vlasov, Fiz. Tverd. Tela 11, 2226 (1969) [Sov. Phys.-Solid State 11, 1798 (1970)].

[3]G. I. Distler and S. A. Kobzareva, Dokl. Akad. Nauk SSSR 188, 811 (1969) [Sov. Phys.-Doklady 14, 935 (1970)].

[4]G. I. Distler and V. G. Obronov, Dokl. Akad. Nauk SSSR 191, 584 (1970) [Sov. Phys.-Doklady 15, 213 (1970)].

[5]G. I. Distler and E. I. Tokmakova, Kristallografiya 16, 212 (1971) [Sov. Phys.-Crystallography 16, 171 (1971)].

[6]G. I. Distler and V. G. Obronov, Dokl. Akad. Nauk SSSR 197, 819 (1971) [Sov. Phys.-Doklady 16, 268 (1971)].

Translated by A. K. Agyei