temperature. This indeed made it possible to make use of this phenomenon for the observation of long-range excitation migration in DNA. The only circumstance that hinders the migration of the triplet excitation through the DNA is the difference between the energies of the triplet levels for different basis. This difference, however, amounts at most to 1600 cm^{-1} (0.2 eV) [6], thus reducing the probability of excitation jumps between bases by at most three orders of magnitude. Consequently, the experimentally observed diffusion displacement of the excitation (on the order of 10^4 - 10^5 Å), can occur fully within the lifetime of the triplet state in the DNA.

The notion that the photodimer is produced via a triplet excited state agrees with the results of quantum-mechanical calculations [12].

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MODEL OF FROZEN-IN (RESIDUAL) CONDUCTIVITY

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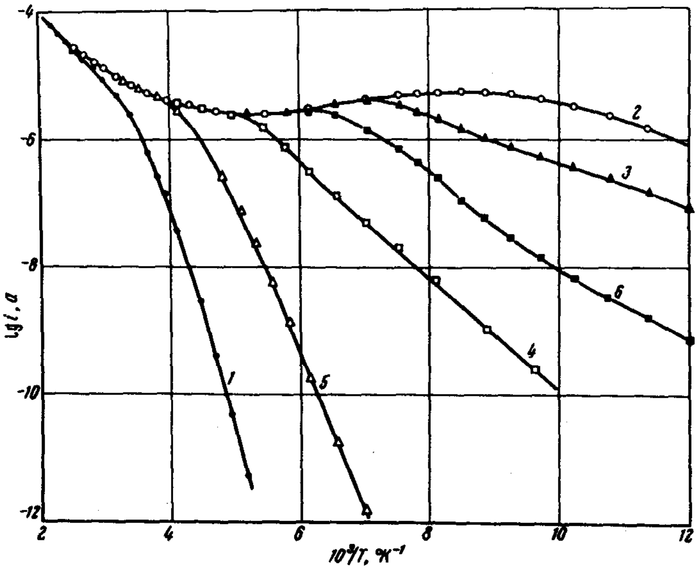
The phenomenon of frozen-in conductivity (FC), wherein the initial conductivity of cooled objects is retained for a long time after the photoexcitation is turned off [1], is presently explained on the basis of the Rose-Gibson barrier model [2 - 4]. We shall show that an analysis of the known [1 - 5] and new experimental facts leads, in an essentially unique manner, to a new FC model.

1. The experiments in which the FC was quenched with an electric field and the singularities on the quasistatic current-voltage characteristics show that noticeable effects appear in relatively weak geometric fields, $\sim 5 \times 10^3$ V/cm [1]. This circumstance, and also the nonlinearity of the dark current-ampere characteristics, offer evidence of spatial electric inhomogeneity of the semiconductor along the current lines, i.e., point to the existence of macroscopic barriers. It is natural to assume, for example, that in a polycrystalline film such barriers are due to depletion layers on the crystalline interfaces.



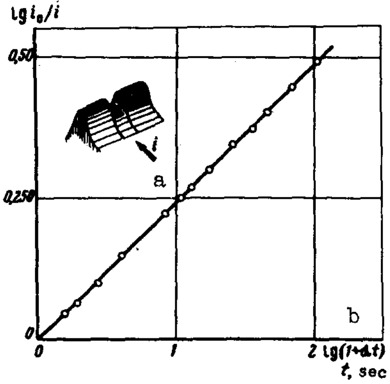


Fig. 1. Temperature dependences of the dark and frozen-in conductivities (FC) in epitaxial films of cadmium sulfide: 1) dark conductivity, 2) FC (after photoexcitation at 80°K); 3, 4, 5) FC after partial temperature quenching by heating to 123, 188, and 243°K, respectively; 6) after partial quenching with a field 1.8×10^3 V/cm at 80°K.

Fig. 2. a) Inhomogeneous barrier relief, b) kinetics of damping of frozen-in conductivity. The initial FC current (i_0) is taken to be the current at the instant $t = 240$ sec ($t = 0$ is the instant when the photoexcitation is turned off). This excludes from consideration the initial section of the experimental FC damping curves in which relaxation processes not connected directly with the FC predominate. The value $\alpha = 4.9 \times 10^{-3}$ sec^{-1} was obtained from the experimental plots of $\log i_0/i \propto \gamma\alpha t$ and $\log i_0/i \propto \log \alpha t$ for the limiting cases $\alpha t \ll 1$ and $\alpha t \gg 1$, respectively.

2. The characteristic FC relaxation times are $10^6 - 10^7$ sec [1, 5], from which it follows that the barrier height is $\phi \simeq 0.2$ eV at $T \simeq 100$°K ($\tau \simeq 10^6$ sec $= \tau_0 e^{\phi/kT}$, $\tau_0 \simeq 10^{-4}$ sec).

3. The current density in the FC state for such barriers should amount to $j = qnv_T e^{-\phi/kT} \simeq 10^4 e^{-\phi/kT}$ A/cm^2 $= 10^{-6}$ A/cm^2 ($n \simeq 10^{17}$ cm^{-3}, $v_T \simeq 10^6$ cm/sec). Experiment [1] yielded $j \simeq 1 - 10$ A/cm^2. Consequently, there is a discrepancy of 6 - 7 orders of magnitude. This means that the barriers through which the current flow are much lower than the recombination barriers ($\sim$0.2 eV). We thus arrive at the conclusion that in the FC there exist simultaneously recombination barriers and barriers to the current (drift barriers).

4. From experiments with the temperature dependence of the FC it follows that the drift barriers at maximum FC have a height $\sim$0.05 eV and increase with increasing temperature or field quenching of the FC (Fig. 1). It is therefore clear that in the state of thermal conductivity the current flows through high drift barriers, which become much lower after photoexcitation.

5. Since the current is transported in the FC state by non-equilibrium carriers through lowered drift barriers, and the recombination of the carriers occurs at other, recombination barriers, it must be concluded that the lowering of the height of the drift barriers upon photoexcitation is due to the carriers that "arrive" from the region of the recombination barriers.

The FC theory based on such a model of inhomogeneous barrier relief makes it possible to describe quantitatively all the foregoing facts and consequences. We confine ourselves here to the result of the calculation of the most important FC characteristic, namely the kinetics of its decrease. The FC damping law is given by

$$i_o/i = i(0)/i(t) = (1 + \alpha t)^{\gamma},$$

where i(t) is the FC current at the instant of time t, α is the constant determined by the height of the recombination barrier at t = 0 and by the temperature, and $\gamma < 1$ and depends on the ratio of the recombination and drift barrier heights.

The foregoing formula with $\gamma = 0.26$ describes very well the experimental data of [1, 5] (Fig. 2).

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INFLUENCE OF INHOMOGENEOUS STATES ON THE PARAMAGNETIC-FERROMAGNETIC PHASE TRANSITION

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The experiments of Drabkin et al. [1, 2] on the scattering of polarized neutrons by single crystals of nickel have shown convincingly that there is inhomogeneous magnetization in the vicinity of the Curie temperature. At the same time, in the theoretical investigations of the phase transition from the para- into the ferromagnetic phase it is customary to consider only homogeneous magnetization states [3, 4]. We shall show in this article that allowance for the field of the magnetic dipole interaction causes this transition to proceed from the paramagnetic to the ferromagnetic phase with an inhomogeneous distribution of the magnetization; we calculate the parameters of this distribution.

We start from the following expression for the free energy of a ferromagnetic sample

$$F = \int\left\{\frac{1}{2} x_o^2\left(\frac{\partial M_i}{\partial x_k}\right)^2 - \frac{1}{2}\beta M_z^2 + \frac{1}{4} b(M^2 - M_o^2)^2 + \frac{1}{4}[(\beta^2/b) + 2M_o^2\beta]\right\}dv + \int \frac{\mathbf{H}_m^2}{8\pi}dv, \qquad (1) \qquad (1)$$

where the first term is the exchange energy ($x_0^2 \sim (I/\mu^2)a^5$, I is the exchange integral, μ the Bohr magneton, and a is the lattice constant) connected with the inhomogeneities of the magnetization, β is the magnetic-anisotropy constant ($\beta >> 1$), the third term is the usual expansion of the free energy of a