

and the value of  $\alpha_F^{res}$  can be determined from independent measurements of the ferromagnetic-resonance frequency, is therefore a method for directly verifying experimentally the existence of the exchange Faraday effect of the second kind  $\alpha_F^1$ .

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#### INFLUENCE OF THE ELECTRIC FIELD ON THE RADIATION-INDUCED FLUORESCENCE OF AROMATIC HYDROCARBONS IN CYCLOHEXANE <sup>1)</sup>

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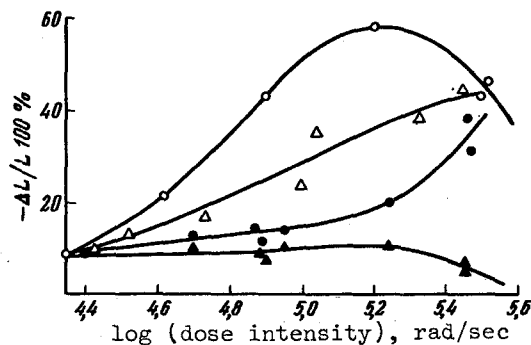
Irradiation of dilute solutions of aromatic hydrocarbons leads to the formation of electron-excited molecules of the dissolved substance [1-3]; this reaction has a high yield. The results of experiments in which charge capture was investigated [2,3] indicate that the most probable process of formation of electron-excited molecules of substance dissolved in cyclohexane is charge transfer from the solvent, accompanied by charge recombination. We investigated the influence of an electric field on the yield of electron-excited singlet molecules of anthracene (A) and pyrene (P), by studying the fluorescence of solutions of A and P in cyclohexane.

The investigated solution flowed continuously through a quartz ("Spectrosil") cell containing two parallel platinum electrodes, separated by a 4 mm gap. The volume between the electrodes was irradiated by a continuous beam of 3-MeV electrons accelerated by a Van de Graaff accelerator. The irradiation caused fluorescence, which was observed in a direction perpendicular to the electron beam, by means of a system containing a set of mirrors, a monochromator, and a photomultiplier. The fluorescence intensity was measured at the maxima of the spectra at wavelengths 395 and 470 nm for the normal and excimer fluorescence of pyrene and at 400 nm for normal fluorescence of anthracene. The bandwidth was 10 nm.

Application of a constant electric field  $10^3 - 1.5 \times 10^4$  V/cm decreased the fluorescence intensity in the solutions of both substances. The percentage change of the fluorescence intensity (i.e.,  $(\Delta L/L)100$ , where  $L$  is the intensity corrected for the Cerenkov radiation) is shown in the figure as a function of the dose intensity for the pyrene solution. The electric field intensity was  $1.25 \times 10^4$  V/cm. At dose intensities much higher than indicated in the figure ( $\sim 10^9$  rad/sec), obtained by periodic pulsed illumination, the electric field did not influence the fluorescence. Results similar to those shown in the figure were ob-

<sup>1)</sup> Work performed at the Center of Radiation Research in Leeds, England, during the exchange visit of E. L. Frankevich (Institute of Chemical Physics, USSR Academy of Sciences).

Relative change of fluorescence intensity of pyrene solution in cyclohexane in an electric field vs. dose intensity. The curves were drawn for different pyrene concentrations:  $\circ$  -  $2 \times 10^{-5}$  M,  $\Delta$  -  $10^{-4}$ ,  $\blacktriangle$  -  $10^{-3}$  - normal fluorescence;  $\bullet$  -  $10^{-3}$  - excimer fluorescence.



tained also for anthracene solutions. In the investigated range of concentrations of A and P and of the dose intensities, the value of  $|\Delta I/I|$  increased with increasing electric field intensity to  $7 \times 10^3$  V/cm; in stronger fields, up to  $1.5 \times 10^4$  V/cm,  $\Delta I/I$  changed little. Qualitatively similar effects were observed also with a 50-Hz alternating voltage. An increase of the concentration of P decreased the sensitivity to the electric field of both the normal and excimer fluorescence, but at high dose intensities ( $10^5$  rad/sec) the dependence of the excimer fluorescence on the dose intensity differed from the analogous dependence for the normal fluorescence at the same pyrene concentration: the former increased with increasing dose intensity, and the latter decreased. This result is a good indicator that the electric field influences the secondary processes in which charged particles participate and which lead to fluorescence, but not the primary processes of excitation or ionization: in this case the sensitivity of the normal and excimer fluorescence to the electric field would be expected to be the same.

Relatively weak electric fields, similar to those used in the present investigation, can influence processes in which charged particles take part in two ways:

- a) by causing drift of the free electrons and ions to the electrodes, leading to elimination of volume recombination of the charges, and
- b) by deforming the potential well produced as a result of the Coulomb attraction between the positive and negative charges. It is known that such a deformation leads to a change in the radiative yield of the free charges [5], and can lead to a change of other characteristics of the irradiated system.

At low dissolved-molecule concentrations, only the long-lived charged particles - free ions and electrons - can transfer their charge to the molecules. The effect (a) cannot be realized under conditions in which the lifetime of the free charges ( $\tau$ ) in the absence of an electric field is short compared with the drift time ( $t$ ) of these charges between the electrodes under the influence of an applied electric field. For solutions in cyclohexane [6] the ratio is  $t/\tau = 1.8 \times 10^{-3} l R^{0.5}/E$ , where  $l$  is the distance between the electrodes in cm,  $R$  is the dose intensity in  $\text{eV/cm}^2\text{-sec}$ , and  $E$  is the electric field intensity in V/cm. For our conditions ( $l = 0.4$  cm,  $E = 1.25 \times 10^4$  V/cm), at dose intensities  $2.5 \times 10^4$  rad/sec and

$3.2 \times 10^5$  rad/sec, calculation leads to  $t/\tau = 65$  and 230 respectively. Consequently, effect (a) is of no significance; in any case, the sensitivity of the fluorescence to the electric field would decrease with increasing dose intensity as a result of (a), thus contradicting the experimental data. More hopeful is the allowance for the deformation of the potential well, which leads, in final analysis, to a change in the recombination rate of the charges.

It is quite interesting to note that the sensitivity of the normal and excimer fluorescence to the electric field turns out to be different. It is known that the formation of excimer molecules occurs in the process  $'S^* + S \rightarrow 'SS^*$ . If this process were to be the only one leading to the formation of excimers, then the normal and excimer fluorescence would behave in similar fashion under all conditions. The observed difference in the sensitivity to the electric field indicates that the excimers are produced also in other processes, such as recombination of the ions  $P^+$  and  $P^-$  [7] or the formation of dimer ions  $PP^+$  with subsequent recombination.

An investigation of the sensitivity of the fluorescence to the electric field, observed in the present paper, may be a useful method of distinguishing experimentally between the processes of charge transfer and excitation-energy transfer in radiation physics and chemistry.

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#### POSSIBILITY OF DIRECT INVESTIGATION OF THE INFLUENCE OF DISLOCATIONS ON THE PROCESSES OF MAGNETIZATION OF YTTRIUM IRON GARNET CRYSTALS

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Ever since it became known that materials with specified magnetic properties can be produced by different plastic-deformation and heat-treatment procedures, the influence of defects of the crystal structure and the associated internal stresses on the magnetization of ferromagnets has received much attention. Particular interest attaches to investigations of the interaction of dislocations with the magnetic structure of the crystal, since the dislocations are the most important source of the long-range internal-stress field.

A theoretical study of the influence of dislocations on the magnetization of ferromagnets is based on the consideration of the magnetoelastic interaction between the stress field due to the dislocations and the magnetization in the domains and domain boundaries [1-6]. It turns out that the result depends appreciably on the concrete form of the dislocation and