The differences in the local conditions for the different impurity molecules lead to a scatter in the positions of the corresponding phononless line and phonon wing. The width of the phononless line is small in this case, and the width of the phonon wing sufficiently large in comparison with the magnitude of this scatter. Therefore, when several narrow phononless lines add up, a broader line is produced without a significant increase of the intensity at the maximum and when phonon wings overlap strongly, a broad band with a large intensity at the maximum is produced. Although for each individual impurity center the intensity of the phononless line at the maximum can greatly exceed the intensity of the phonon wing, when many optical bands of this type add up, an intense broad band is produced, formed mainly as a result of the superposition of many phonon wings. When the fluorescence is excited by a laser line, we affect principally only those centers in which the phononless-line wavelength is close to the laser emission wavelength. Consequently it is only these impurity centers that fluoresce most intensely, and their corresponding phononless lines appear clearly in the spectrum. The indicated scheme, however, calls also for additional experimental verification.

4. We note one more circumstance. When an alcohol solution of perylene is irradiated at 4.2°K by light from a 30-mW laser, a decrease of the phononless-line fluorescence with time is observed in the fluorescence spectrum. When the solution is heated to 20°K and then cooled again to 4.2°K, the initial spectrum is completely restored. When the laser radiation is attenuated by a factor of 100, there is practically no decrease of the line intensity. In the case of intense excitation this decrease can be connected with two-photon ionization of the perylene molecule via the triplet state [5]. To exclude this process, the measurements with alcohol solutions were performed at 0.3 mW excitation power.

5. In conclusion we note that the appearance of a fine structure in the fluorescence spectra following monochromatic excitation in the region of the 0-0 transition uncovers a new possibility of subtle spectroscopic investigations of complex molecules in both crystalline and vitreous media. We have observed this effect also in a few other molecules besides perylene.

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OBSERVATION OF SUPERHEAT INSTABILITY IN A FULLY IONIZED CURRENT-CARRYING PLASMA

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An investigation of plane gas discharges, in which the magnetic pressure is insignificant, is of interest for the study of force-free superheat-ionization instabilities that develop in a current-carrying plasma. Thus, in [1 - 3] the instability that develops when current flows in a weakly ionized plasma and is due to superheating of the ionizing gas was investigated. This instability, naturally, should not develop in an isothermal fully ionized plasma, but a superheat instability connected with the emission of radiation can develop in such a plasma. A manifestation of the latter instability may be, for example, the inhomogeneous development of a transparent plane gas discharge [4].

The nature of such an instability is determined by the fact that a considerable fraction of the energy is carried away from the strongly-ionized plasma by radiation whose power either decreases with rising temperature when recombination radiation predominates, or else can increase more slowly than the Joule heating when line emission or bramsstrahlung predominates [5, 6].

Such an instability is not damped by the electric circuit, since it can develop at fixed values of the applied electric field and of the current flowing through the discharge, via its redistribution among the neighboring regions of the discharge. In the case of a discharge with plane configuration, this should lead to its stratification into current filaments having different current densities.

To observe this effect we performed an experiment that revealed superheat instability in a fully ionized current-carrying plasma. We investigated a discharge with plane configuration, produced in a plasma consisting mainly of matter evaporated from the walls of a chamber with electrode length 30 - 40 mm, distance between electrodes 30 mm, and gap between quartz walls $d = 1.5 - 2$ mm. Prior to the discharge the chamber was filled with hydrogen or xenon with concentration $\sim 10^{18}$ cm^{-3}. The discharge was fed from a capacitor rated 600 - 1200 μF, connected in the circuit in series with a ballast inductance of ~ 80 μH. The electric field intensity was $E \leq 175$ V/cm. The discharge filled the chamber completely, as seen from the high-speed photographs, before the maximum current was reached. The total discharge duration was ~ 1 msec. The indicated parameters of the experiment have made it possible to obtain a fully-ionized optically-transparent plasma (the plasma temperature estimated from the Coulomb conductivity reached 2 eV). At the same time, the discharge current did not reach values at which pinching could occur.

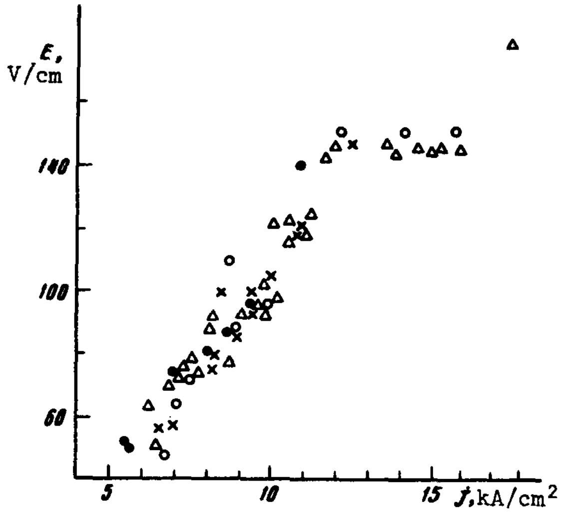

Fig. 1

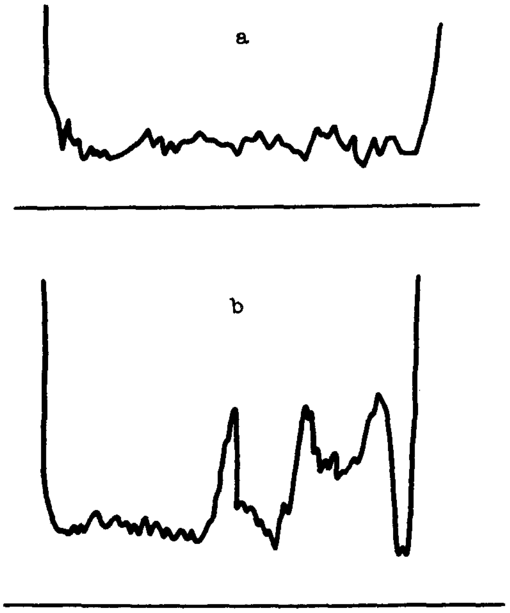

Fig. 2

Fig. 1. Average current density j vs. electric field intensity E in the discharge: Δ) d = 1.5 mm; o) d = 1.8 mm; ×) d = 2 mm; ●) d = 2.6 mm.

Fig. 2. Microphotograms of cross section of discharge for the instants of maximum discharge current: a) E = 100 V/cm, T = 1.45 eV; b) E = 150 V/cm, T = 1.64 eV.

Figure 1 shows the current-voltage characteristics of the discharge at instants when the current has a maximum. Figure 2 shows microphotographs of the discharge cross section for two different discharge conditions, and Fig. 3 shows a streak photograph of the discharge during the stage of developed instability. As seen from Fig. 1, a distinctive plateau is produced on the current-voltage characteristic at $E \simeq 150$ V/cm. On the other hand, the streak photographs show that at average discharge-current densities corresponding to the start of the plateau on the current-voltage characteristic the discharge ceases to be homogeneous and acquires current filaments having equal increased temperatures, and consequently increased current densities. The number of such filaments increases with increasing average discharge-current density.

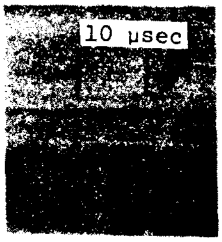

Fig. 3. Streak photograph of discharge during the stage of developed instability.

The distinctive form of the current-voltage characteristic and the inhomogeneity of the discharge at electric fields corresponding to the presence of a plateau on the characteristic indicate that superheat instability develops under the conditions in question, so that at a definite value of the electric field and in a certain current range, the only stable discharge regime is an isothermal fully-ionized plasma is a "two-phase" regime, i.e., one having plasma regions with two different temperatures determined by the radiation and thermal conductivity of the plasma [4]. Such a quasistationary discharge regime is established under the experimental conditions within a time τ much shorter than the characteristic times of discharge evolution (the Coulomb thermal conductivity yields $\tau \sim 10^{-5}$ sec).

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NEW FEATURES OF HeII FILM FLOW TRANSFER

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In the study of He II film flow transfer, great importance is attached to the material of the surface over which the film moves. The investigations of the flow rates, first performed on glass surfaces, were therefore subsequently expanded to include many materials, both metals and plastics. This has made it possible to establish [1] that the transfer flow rates over different surfaces is practically the same as on glass, provided the surface employed is sufficiently smooth.