

target. A carbon rod was placed at the center of the target. It follows from the table that, within the limits of experimental error, complete muon depolarization at the precession frequency of the free muon is observed in He and Ne. The asymmetry parameter obtained in the control experiment with carbon had the expected value. Obviously, under the conditions of the performed experiment, the depolarization cannot be ascribed to molecular effect or to chemical interaction of the mesic atom. It is more likely that the complete muon depolarization at the free-muon frequency offers evidence in favor of the paramagnetic depolarization mechanism in noble gases, but direct proof of this mechanism would be the presence of residual polarization at the mesic-atom precession frequency.

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ANOMALOUS SECONDARY EMISSION AT HIGH ENERGIES

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We report here the results of investigations of the anomalous secondary electron emission at high energies, as a function of the film thickness, of the distance between the grid and the film, and of the potential of the drawing grid.

Garwin and Edgecumbe [1] investigated the anomalous secondary electron emission from friable KCl films 25 μ thick and of density 2%, at electron energies 100 - 1000 MeV, at a constant value of collector voltage. The charge was produced by prior bombardment of the film with electrons having an energy ~ 10 keV.

We have previously reported [2, 3] controllable secondary electron emission from a friable dielectric to which a voltage is applied with the aid of substrate electrodes and a control grid in contact with the friable film. These investigations have shown that when the grid is in contact with the surface of the friable dielectric, the emission takes place without an additional charge, and acquires a controllable character, i.e., variation of the voltage of the grid on the film surface causes a rapid change of the secondary-emission coefficient.

To compare the character of the processes occurring in the emitters in the case when a grid is placed on the surface of the dielectric film and in the case when the grid is at some distance from the surface, we have investigated the emission characteristics of films with the grid at some distance from the surface, i.e., under the conditions of [1], but at different values of the potential applied to the grid, and without first charging the film with transmitted electrons.

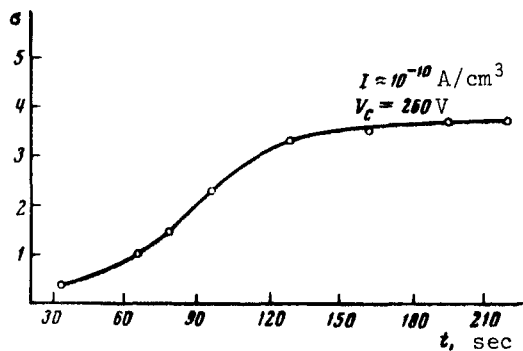


Fig. 1

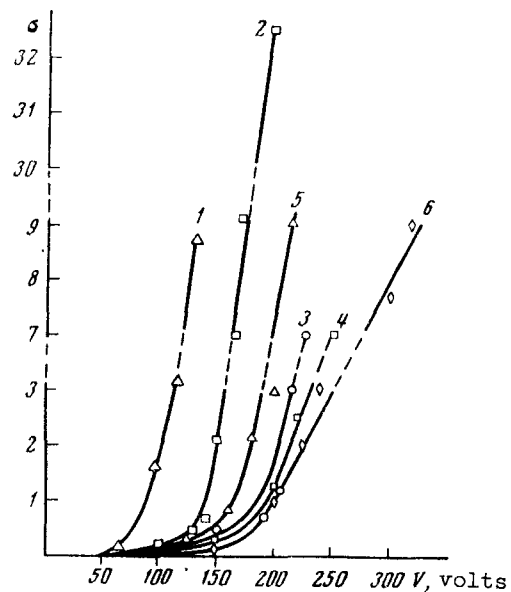


Fig. 2

Fig. 1. Secondary electron emission vs. time of bombardment with a beam of 50-MeV electrons. The grid potential relative to the substrate is $V_g = 260$ V.

Fig. 2. Plot of σ vs. V_g for films of thickness 25μ (curve 1), 50μ (2), 100μ (3), and 170μ (4). (The distance between the dielectric surface and the grid is 150μ .) Curve 5 is for a film 170μ thick, when the grid lies on the surface, while curve 6 is for a film 170μ thick and the gap between the film and the surface is 2 mm.

Obviously, when relativistic electrons pass through a dielectric film, the surface of the dielectric will become charged regardless of the value of σ , since the primary electrons pass through the film without any obstacle, and the formation of the secondary-emission electrons causes positive charge to accumulate on the film surface. At definite values of the accelerator-beam current, the layer resistance, and the grid potential V_g , the surface charge can rise to a value sufficient to produce anomalous emission. This can be seen from Fig. 1, which shows a plot of the secondary-emission coefficient against the time of bombardment with 50-MeV electrons, for a film 170μ thick and a gap of 2 mm. The growth at the start of the bombardment corresponds to the increased surface charge from the primary electrons, and the plateau corresponds to dynamic equilibrium between the processes of charging and charge leakage. The results presented below were obtained in the region of the plateau of this curve.

Figure 2 shows the emission characteristics for films of thickness 25, 50, 100, and 170μ . The gap between the grid and the surface was constant at 150μ . It is seen from these curves that with increasing potential V_g the secondary-emission coefficient σ increases first relatively slowly, after which the curves become steeper. The maximum values of the points on the plots correspond to the pre-breakdown grid voltages, i.e., further increase of the grid voltage produced breakdown in the film. When the voltage was decreased below the breakdown value, the emission properties of the film were restored.

The presence of the processes of cascade formation and secondary-electron absorption should result in the existence of an optimal thickness at which σ is

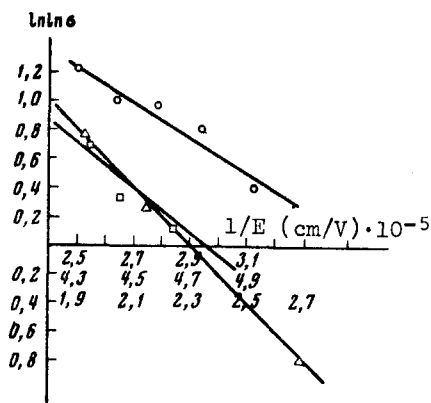


Fig. 3. Plots of $\ln \ln \sigma = f(1/E)$: triangles - film thickness 25 μ , circles - 50 μ , squares - 100 μ .

a maximum. It follows from Fig. 1 that the maximum value of σ indeed depends on the film thickness and its largest value, 32.5, occurs at a thickness of 50 μ .

The same figure shows the current-voltage characteristics for films 170 μ thick without a gap and at a gap of 2 mm between the grid and the surface.

It is seen from the figure that all the curves are similar in shape, but are shifted in voltage relative to one another, owing to the differences between the field intensities in the films, and also because the potential of the film surface cannot reach the grid potential, and is always somewhat lower; the difference between them increases with increasing distance between the film and the grid.

We have reduced the results assuming cascade multiplication of the electrons in the pores of the friable layer [4], in analogy with the multiplication in a gas discharge. According to this theory, the dependence of $\ln \ln \sigma$ on $1/E$ is a linear function (E is the field intensity in the layer). The results of such a reduction of the experimental curves are shown in Fig. 3. The plots are really straight lines, and the mean free paths calculated from them ($L_e = 1.1 \times 10^{-4}$ cm) agree within the limits of experimental error with the results of [4] as well as with Garwin's results [5], assuming a linear dependence of the electron free path on the density of the material.

Summarizing, we can conclude that the processes occurring in KCl films in contact with the grid and those separated from the grid are identical, i.e., the internal processes whereby secondary emission is produced in the films do not depend on the method whereby the potential is produced on the surface of the dielectric [6]. According to [4], however, σ_{\max} for a given grid voltage is obtained in the former case immediately after the beam is turned on, and in the latter case after a prolonged time, which is obviously connected with the time necessary to charge the film.

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