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On the Temperature Variations in Alcohol-Argon Filled G-M Counters

OM PARKASH
Punjab University Physics Laboratories, Government College, Hoshiarpur, Punjab, India

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RECENTLY Tanyel[1] has noticed an improvement in plateau of a xylene-argon filled counter with rest period after filling. This is believed to be due to the formation of a continuous film on the cathode. The partial removal of the film, on heating the counter at 120°C and then cooling it slowly, produced an increase in slope of the plateau, which improved again with time. The effect, which the author[2] reported, in the case of ethyl alcohol-argon filled counters has also been attributed to the alteration of the film. However, our recent experiments, at even higher temperatures than those reported in the previous case, do not seem to confirm the above view, at least, in the particular case of alcohol-argon filled counters.

Counter *B* of the previous communication was successively raised to higher temperatures through 20° steps (up to 180°C) in a thermostat (±0.5°C) and kept at each temperature for 2 to 3 hr. Counting rate-voltage curves were obtained (Fig. 1) at different high temperatures and soon after each heating (within 30 min.) when the counter came to the room temperature. The curves obtained at room temperature before and after heating come out to be practically similar. A very large increase in counting rate and slope of the plateau is observed at high temperatures. Finally the plateau disappears. This is not in accord with the view of Tanyel in that he finds a semipermanent increase in slope which improves with time. If we consider the effect which we reported to be due to the partial removal of the film, then we must assume that either (a) this does not occur within the temperature range investigated or (b) the film removed on heating is restored soon after cooling.

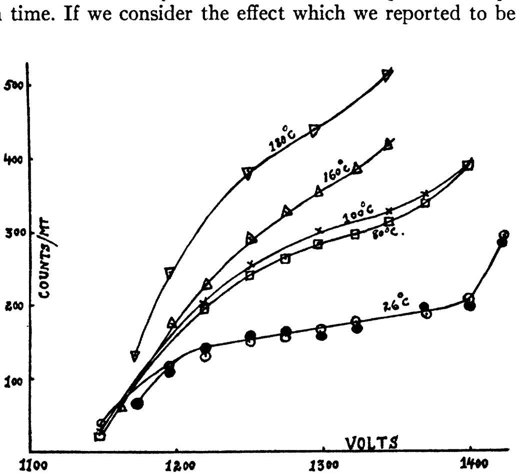

FIG. 1. Counting rate *vs.* voltage curves for counter *B* at different temperatures. Curves (●) before heating and (⊙) after heating at 26°C are exactly similar. Other repetitions have been omitted.

The large counting rate and greater slope at higher temperatures, together with the fact that there is a "residual slope"[3] always present with self-quenching G-M counters, may occur because of the spurious pulses which arise due to the positive ions[4] striking the cathode. If we assume that the secondary emmission from the cathode by the positive polyatomic ions is negligible at ordinary and even higher (?) temperatures, then the positive ions responsible for spurious pulses, and hence for the above-mentioned effects, may be of mercury. That mercury vapor can produce spurious pulses is not unexpected, since mercury has a low ionization potential (10.4 v) with the result that some ions are able to reach the cathode. (It may be mentioned that mercury vapor is always present in the counters owing to the mercury manometers, etc., which are connected with the filling apparatus.) However, the mercury ions are probably less effective at ordinary temperatures[5] but more important at high temperatures[6] and this explains the mentioned effects. Simpson[7] has recently reported an increase in slope in neon-argon counters from 0.035 to 0.11 percent per volt with mercury contamination and organic vapor impurities from greases. This supports the above view and further shows the effect of mercury vapor even at ordinary temperatures. The author's observations, therefore, seem to be a temperature effect rather than the cathode film effect. Detailed work on temperature effects in counters with and without mercury vapor contamination will be reported.

Thanks are due Dr. H. R. Sarna, Director of the Punjab University Physics Laboratories, for providing facilities for this work.

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Multiple Scattering of Fast Electrons in Nuclear Emulsions*

DALE R. CORSON
Cornell University, Ithaca, New York

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IN view of the increasing importance of multiple scattering in nuclear emulsion work[1] some preliminary scattering measurements on 115±5-Mev electrons in Ilford G-5 plates will be of interest. For each of 50 tracks the *y*-coordinate was measured with a calibrated eyepiece scale at 50μ-intervals along the *x*-coordinate. The angle between successive chords drawn between the ends of the intervals is given by $\alpha=D/X$ where D is the second difference $(2y_n-y_{n-1}-y_{n+1})$ and X is the interval length. The mean angle $\langle\alpha(X)\rangle_{\mathrm{Av}}$ between chords for interval lengths X of 50, 100, 200, 300, and 400μ has been computed and is shown in Table I. The corresponding mean angle $\langle\alpha(100)\rangle_{\mathrm{Av}}$ for a 100μ-interval (computed by assuming α proportional to $X^{\frac{1}{2}}$) is shown for each interval. For short intervals the measured mean angles

TABLE I. Second difference $\langle D(X)\rangle_{\mathrm{Av}}$ and mean angle $\langle\alpha(X)\rangle_{\mathrm{Av}}$ between successive chords for interval of length X. Also corresponding mean angle $\langle\alpha(100)\rangle_{\mathrm{Av}}$ for a 100μ-interval.

X	$\langle D(X)\rangle_{\mathrm{Av}}$	$\langle\alpha(X)\rangle_{\mathrm{Av}}$	$\langle\alpha(100)\rangle_{\mathrm{Av}}$
50μ	0.24μ	0.28°±0.01°	0.40±0.01
100	0.46	0.26 ±0.01	0.26±0.01
200	0.97	0.28 ±0.02	0.20±0.02
300	1.61	0.31 ±0.03	0.18±0.02
400	2.26	0.32 ±0.03	0.16±0.02