LETTER TO THE EDITOR

An integrating spectrometer for measuring spectral intensities by the counting of photo-electrons

Light intensities can be measured by counting pulses which are caused by the photoelectrons released from the cathode of a photomultiplier tube. In this case the same accessories as for scintillation-counters can profitably be used; these are: cathodefollower, broadband amplifier, discriminator, scalers and counters.

An optimum signal to dark-current ratio is obtained by keeping the voltage over the multiplier rather low (about 60 V per stage) and by using a sensitive amplifier and a rather high discriminator level.

This device we have applied for measuring the intensity ratio of a pair of ultra-violet spectral lines by means of one photomultiplier tube. We have specially investigated Cu and Ag lines produced by a d.c. carbon arc with metal vapour. The lines are separated from the spectral background by means of narrow exit slits. During the measuring time (for instance three minutes) they are interrupted by a rotating light chopper so that the two lines enter the photomultiplier alternately during $\frac{1}{100}$ sec. The corresponding signals are again separated by an electronic or mechanic relay that is synchronized and adjusted at optimum phase angle. The relay is placed between the discriminator and the scalers so that the discriminator output is alternately connected to the input of two different channels of scalers and counter. The ratio of the indications of the mechanical registers (corrected for dark-current), after the well-defined measuring time, equals the ratio of the time integrals of the two spectral line intensities.

The previous experimental arrangement showed a reproducibility better than one percent if a constant lightsource is used. The sensitivity was such that the spectral background at 3274 Å, caused by a d.c. carbon arc and by the use of an exit slit twice the critical line width, gave a photo-current which exceeded the dark-current of the multiplier by twenty times. Use was made of a RCA 1P28 photomultiplier tube and a Hilger medium quartz-spectrograph.

Some advantages obtainable with this device are:

1. Both spectral lines are measured at the same time, consequently fluctuations of the lightsource have little influence ^{1) 2)}.
2. Only one multiplier is used, so that alterations of the multiplier sensitivity have no effect on the measured intensity ratio ³⁾.
3. A (broad-band) a.c. amplifier is used so that the problems of d.c. amplifiers do not arise.
4. The measurements are integrating ones with adjustable time of integration.
5. Compared with scanning devices we have less loss of information concerning the line intensity as in these cases a line is only measured during a small part of the total exposure time ⁴⁾.
6. It is possible to extend the device to more channels and by that to more pairs of spectral lines.

It is also possible to use the device for measuring very weak light intensities. The chopped light signal with the dark-current added is then measured through one channel and at the same time the dark-current through the other channel, so that explicit correction for the dark-current is possible. If the multiplier is cooled by means of liquid air, light signals $\geq 10^{-16}$ watt incident on the photocathode (in the spectral region of 4000 Å) may be detected ⁴⁾ ²⁾.

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