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Pulse Characteristics of Anthracene Scintillation Counters

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The experiments of Bell and Davis(1) with regard to the superiority of anthracene for scintillation counters have been confirmed. In a representative arrangement, a transparent piece (1 x 1 x 1/4" in dimension) of this material is fastened to the wall of a 1P21 photomultiplier, facing the photosensitive surface. When operating at room temperature at 70 volts per stage, individual pulses up to .5 volt height (corresponding to the emission of about 100 electrons at the photosurface) are observed at the output, upon exposure to a standard radium source. The signal-to-noise ratio of about 5:1 remains essentially constant up to 120 volts per stage applied to the first two stages of the 1P21, beyond which voltage it falls rapidly; it is independent of the potential applied to the remaining seven stages. An overall gain of 25 million is then achieved by operating stages one and two at 120 volts each, and stages three through nine at 180 volts each. Pulse heights of 20 volts and more are then observed, which are sufficient to feed directly into oscilloscopes, coincidence, mixers, etc., without recourse to additional vacuum-tube amplification.

Since upwards of 1500 volts appear between adjacent anode and cathode pins, certain precautions were taken, such as slotting the base and socket, and wax impregnation. Since the peak current in the last few stages is quite high, these were by-passed with small mica capacitors,

(1) P. Bell and R. Davis, Bull. Am. Phys. Soc. Vol. 23, No. 3

For visual pulse observation, the photomultiplier was mounted at the neck of an oscilloscope tube of the 5JP1 variety, with very short connections. The signal pulses showed a finite rise time of about .05 microsecond; this figure represents the period over which appreciable light emission by the anthracene takes place, the photomultiplier output circuit being effectively an integrator of the photoelectrons. Variation of the decrement of the output circuit (by changing the load resistor) showed that pulse height attenuation became evident for decrements lower than .15 microsecond, in agreement with the rise time observation. This figure is indicative of the resolution time to be expected in normal practice. It is significant that the rise time of noise pulses originating at the photosurface is visibly much more rapid, having no observable slope, and is much less affected by the circuit decrement.

Typical values for the output circuit elements:

circuit capacitance -- 15 micromicrofarads

load resistance -- 10,000 ohms

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