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Contract No. W-4205-eng-48

PULSE CHARACTERISTICS OF ANTHRACENE SCINTILLATION COUNTERS

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Berkeley, California

May 12, 1948

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Results obtained by various investigators(1)(2)(3)(4) using naphthalene and anthracene as scintillation counters have been duplicated at this laboratory. In one arrangement, the fluorescence due to beta particles induced by gamma radiation from a radium source in a piece of anthracene 1" x 1" x 1/4" was detected as pulses of up to 1/2 volt height at the output of a 1P21 photomultiplier detector operated at room temperature with 70 volts per stage. Under these conditions, the pulse output due to the direct photoelectric effect by the gamma radiation on the photomultiplier surface was indistinguishable from thermal noise.

For photomultiplier stage voltages up to 120 volts, the signal-to-noise ratio remained substantially constant at about 5:1, for the largest pulses in this particular arrangement. It was further determined that this ratio is insensitive to the voltages applied to stages beyond the first two. Hence, by applying higher voltages to the seven last stages (180 to 200 volts) it is possible to raise the total gain sufficiently to dispense with conventional vacuum tube pulse amplifiers. The standard commercially available 1P21 9-stage photomultiplier mounted directly at the deflecting plate terminals of a ~~5UP1~~ oscilloscope tube shows individual pulses (for the same geometry and source as described above) of up to 20 volts in height. Since the charge transferred through the last few photomultiplier stages is then quite large it is necessary to bypass those stages at the socket with small mica capacitors. The total voltage across base pins 10 and 11 is in the neighborhood of 1800 volts, so that precautions must be taken against breakdown. A slot was cut halfway through the base and socket between these pins, and a small sheet of 1/32" polystyrene was inserted snugly into that slot. The tube base

was filled with ceresin wax after cutting off the locating key, and the socket and circuit elements were likewise liberally coated with ceresin wax.

The arrangement described permits direct determination of the duration of the counting event by variation of the decrement of the output circuit. Rough measurements confirmed previous visual oscilloscope observations of an event duration of perhaps .1 microsecond. This is a factor of 100 longer than the response time of a photomultiplier, so that this appears to be the ultimate limit of resolution of the anthracene as a detecting substance. It is a reasonable assumption that the other benzene chain compounds would not exhibit radically different behavior in this regard.

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* This letter is based on work performed at the Radiation Laboratory under Contract No. W-4205-eng-48 with the Atomic Energy Commission.

(1) H. Kallman, Natur und Technik (July, 1947)

(2) M. Deutsch, Bull. Am. Phys. Soc. Vol. 23, No. 2

(3) G. Collins & R. Hoyt, " " Vol. 23, No. 2

(4) P. Ball & R. Davis, " " Vol. 23, No. 3

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