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RELATIVE SENSITIVITIES OF SOME ORGANIC COMPOUNDS  
FOR SCINTILLATION COUNTERS

by

R. F. Taschek

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ABSTRACT

Ten organic scintillating materials have been compared for relative efficiency. Stilbene was found to be by far the best and several times better than anthracene. No correlation with condensed ring systems has been found.

\* \* \* \* \*

A search for organic materials which would serve as scintillation type detectors similar to naphthalene<sup>1</sup> has resulted in establishing the sensitivities of nine compounds relative to naphthalene<sup>2</sup>, both for 1P21 and 1P28 photomultipliers. Recrystallized and sublimed samples of all compounds were used with the exception of one sample of commercial naphthalene for comparative purposes. 1.8 grams of each material were used, packed as nearly as possible at constant volume in quartz test tubes, the scintillations observed by four photomultipliers in parallel surrounding the test tube. The pulses were amplified by a Los Alamos Model No. 500 pulse amplifier, voltage discriminated, and recorded on a scale of 4096 and register. The multipliers were not refrigerated. A 20 mc radium gamma source placed at a standard distance of 71.5 cm was used for all tests.

Figures 1 and 2 show a series of integral, pulse height distributions for the compounds investigated as observed with 1P28's and 1P21's. In addition it is desired to call attention to the following features:

1) Several compounds, in particular anthranilic acid, showed exceedingly strong fluorescence to ultra-violet excitation but were very poor as scintillating materials with radium gammas.

2) The dynode power supply was arranged so that the supply voltage could be varied and also the voltages to the individual tubes could be separately adjusted. This made it possible to equalize the detection sensitivities of the parallel tubes and after adjustment to shift all the tubes together to any desired average dynode voltage. Dynode voltage on the 1P28's was so adjusted that for two bias values the purified naphthalene counts coincided with those using the 1P21's. Since this voltage was nearly identical with that used for the 1P21's, it appears from the RCA Handbook data that the 1P28 observes about ten times more luminous flux from the naphthalene radiation than the 1P21.

3) The scintillation property appears to be connected with molecular structure since phenanthrene is a very poor material and its isomer anthracene a very good one.

4) This property does not seem to be connected with condensed ring systems in general, since 1,2-benzanthracene was exceedingly poor, but may possibly be more closely associated with the conjugate bonding observed in stilbene.

5) The stilbene, at the high biases, is at least a factor of 3 better than anthracene which has been the best material found previously<sup>3</sup>.

6) Although refrigeration was not used, the pulse height curves do not seem to extrapolate back to the same zero bias value for all the compounds. On the curves for naphthalene, anthracene, and stilbene the zero bias values could possibly be the same, as shown in the figure, indicating that most of the betas arising from the gamma radiation make enough photons to be counted. For most of the other materials, however, there seems to be some indication that not all betas are counted even at zero bias. The great advantage of the stilbene is its high conversion efficiency, i.e., large number of photons per unit beta energy loss, which is apparent at the large pulse heights. The flatness of the stilbene curve at low bias leads one to hope that a sufficiently good material may be found for which the extrapolation to zero pulse height can be made unambiguously without the use of refrigeration. Stilbene is at present being investigated with multiplier refrigeration.

#### REFERENCES

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