Many such screw 'deformations' occur in bending chromium platelets of this kind.

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A Highly Sensitive Chemical Dosimeter for Ionizing Radiation

AN aqueous dosimeter capable of measuring radiation doses of less than 100 rads would be an extremely useful tool in the field of radiobiology. Although doses of a few rads can be accurately measured using the resorcinol-stabilized tetrachlorethylene-dye systems¹, such systems where the radiation-induced reaction proceeds by a chain mechanism exhibit certain undesirable characteristics. An alternative to the radiation-induced chain reaction involves the measurement of extremely small amounts of an irradiation product by means of a sensitive analytical technique. Some idea of the extreme sensitivity required is obtained from the fact that a dose of 100 rads will produce approximately 10^{-7} moles of product per litre of solution, assuming a reasonable production-rate of unity for G_{prod} . (that is to say, 1 molecule of product formed per 100 e.v. absorbed). An analytical method capable of accurate measurement at such high dilution is spectrophotofluorometry. The production of salicylic acid (which fluoresces in aqueous solution) in irradiated aqueous solutions of benzoic acid seemed to merit investigation, especially because this reaction had been proposed² as suitable for chemical dosimetry.

During irradiation a mixture of the three isomeric hydroxybenzoic acids is produced in the ratio of 5 : 2 : 10 for the *o* : *m* : *p* isomers respectively³. However, at 400 m μ (exciting wave-length 290 m μ) the fluorescent intensity of the *m* and *p* isomers is small compared with that of salicylic acid and can be neglected. Diphenyl has also been identified as a radiation product, but it does not fluoresce at 400 m μ if excited at 290 m μ . The fluorescent intensity of salicylic acid solutions is a linear function of concentration in the range 10^{-7} – 10^{-8} M, and is independent of acidity from pH 5–11. Since the reproducibility of the measurements was only about ± 10 per cent, presumably because of the fluctuations in the intensity of the light source of the Aminco-Bowman spectrophotofluorometer, each experimental run was calibrated separately in the following manner. The fluorescent intensities of two standard salicylic acid solutions were measured immediately before and immediately after measurements were carried out on a series of irradiated solutions, and the salicylic acid concentrations in the latter solutions were computed using the average value of the 'fluorescence coefficient':

$$\text{Fluorescent coefficient} = \frac{\text{fluorescent intensity of standard}}{[\text{salicylic acid}]}$$

All dose-rates were determined using the ferrous sulphate – 0.8 N sulphuric acid dosimeter⁴. Corrections for the decreased energy absorption in water were made as described previously⁵.

From Fig. 1 it is seen that the concentration of salicylic acid in irradiated 10^{-4} M calcium benzoate solutions (pH 5) increases in a linear fashion with dose of X- and γ -radiation over the range 0–100 rads, and is independent of dose-rate over the range 4–50 rads/min. For a given dose the fluorescent intensity is almost identical for cobalt-60 and caesium-137 γ -rays. The rates of salicylic acid production expressed as G_{Sal} , were computed to be:

Incident radiation	Co ⁶⁰ γ -rays	Cs ¹³⁷ γ -rays	300-kV. peak X-rays	100-kV. peak X-rays
Effective energy (MeV.)	1.25	0.66	0.16	0.05
G_{Sal}	0.63 (15.5)	0.63 (15.5)	0.63 (15.5)	0.52 (13.8 $\pm$ 0.5)

The values in parentheses refer to the values of the oxidation yield of the ferrous sulphate dosimeter used in the computation of G_{Sal} .

Fig. 1. $\circ$, 100-kV. peak X-rays (20 rads/min.); $\square$, 300-kV. peak X-rays (17 rads/min.); $\bullet$, 600-keV. caesium-137 γ -rays (4 rads/min.); $\bullet$, 1.25-MeV. cobalt-60 γ -rays (20 rads/min.); $\bullet$, 1.25-MeV. cobalt-60 γ -rays (50 rads/min.).

It is interesting to note that the G_{Sal} values are in reasonable agreement with the value of 0.73 deducible from the results of Weiss and co-workers³ on the irradiation of 1.6×10^{-2} M solutions of benzoic acid at pH 5 with 200-kV. peak X-rays.

These preliminary experiments indicate that doses of electromagnetic radiation in the range 5–100 rads may be accurately measured (about ± 5 per cent) from the fluorescence induced in calcium benzoate solutions. It is hoped to extend these experiments to the measurement of doses below 5 rads.

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