

## LETTERS TO THE EDITORS

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## Use of Tracers in Chemical Dosimetry

THE action of X-rays and gamma-rays on a solution of ferrous sulphate in 0.8 *N* sulphuric acid has been studied by a number of investigators<sup>1</sup>. The iron is oxidized to the trivalent state, and the amount of trivalent iron is proportional to the radiation dosage. For this reason the ferrous sulphate solution has been used for radiation dosimetry. The amount of ferric ion is usually measured colorimetrically, photometrically or volumetrically. In the present investigation, some experiments have been carried out to measure the ferric ions radiometrically in order to increase the sensitivity of the dosimeter.

Ferrous ammonium sulphate was dissolved in redistilled water and acidified with sulphuric acid, and iron-59 was added to the solution as a tracer. This solution was irradiated with gamma-rays from a cobalt-60 source. After irradiation, the ferric ions formed were separated from ferrous ions by extraction of the ferric thiocyanate with isoamyl alcohol. The activity of the organic phase and of the water phase was then determined with a liquid Geiger-Müller counter tube. From these measurements one obtains the percentage of ferric ions in the irradiated solution.

The radioactive isotope iron-59 used as a tracer in this experiment was made with the Werner synchro-cyclotron by bombardment of copper with 185-MeV. protons. The iron formed was separated by extraction with isopropyl ether.

The measurements can easily be carried out with an accuracy of more than 2 per cent. By changing the concentration of the ferrous ammonium sulphate in the solution, one obtains different dosage ranges. It seems possible, for example, to measure the radiation dosage in the range 0-100 r. with an accuracy of  $\pm 2$  r. The sensitivity can probably be increased still more. The amount of tracer used must not be so large that it gives a radiation dosage which cannot be neglected in comparison with the dosage to be measured.

Experiments have also been carried out to investigate the suitability of an acid or neutral solution of potassium iodide for chemical dosimetry. The action of ionizing radiation on solutions of potassium iodide has been studied by Lefort<sup>2</sup>. In the present experiments the radioactive isotope iodine-131 was added as a tracer to a neutral, hydrochloric or sulphuric acid solution of potassium iodide, which was then irradiated with cobalt-60 gamma-rays. After the irradiation, the solution was extracted with carbon disulphide and the activity of the organic phase and of the water phase was determined as before.

At the beginning of the irradiation, the iodide is oxidized to iodine in an amount proportional to the radiation dosage. However, a state of equilibrium is soon reached because the radiation also reduces the iodine. This state of equilibrium is

reached at 25 per cent iodine for a neutral solution, at 60-70 per cent iodine for a *N* hydrochloric acid solution and at about 35 per cent iodine for a sulphuric acid solution of pH 2. The number of iodide ions oxidized by a certain dosage of radiation is considerably lower than the corresponding number of ferrous ions in a ferrous sulphate solution. For this reason one has to use very dilute iodide solutions to get a dosimeter of high sensitivity. However, these dilute solutions do not seem to be stable enough to be useful as dosimeters.

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<sup>1</sup> Rigg, T., Stein, G., and Weiss, J., *Proc. Roy. Soc., A*, **211**, 375 (1952). Fricke, H., *Amer. J. Roent. Rad. Ther.*, **18**, 430 (1927); *Phys. Rev.*, **31**, 1117 (1928). Fricke, H., and Morse, S., *Phil. Mag.*, **7**, 129 (1929). Shishacow, N. A., *Phil. Mag.*, **14**, 195 (1932). Hart, E. J., *J. Amer. Chem. Soc.*, **73**, 1831 (1951). Dewhurst, H. A., *J. Chem. Phys.*, **19**, 1329 (1951). Miller, N., *Nature*, **162**, 448 (1948); *J. Chem. Phys.*, **18**, 79 (1950). Amplett, C. B., *Nature*, **165**, 977 (1950).

<sup>2</sup> Lefort, M., *J. Chim. Phys.*, **47**, 776 (1950). Haltsinsky, M., and Lefort, M., *C.R. Acad. Sci., Paris*, **228**, 314 (1949). Lefort, M., *C.R. Acad. Sci., Paris*, **228**, 831 (1949).

## Multi-layer Dielectric Reflecting Films at Wave-lengths between 4000 and 4600 Å.

RECENT correspondence<sup>1,2</sup> has directed attention to the lack of information about the efficiency of multi-layer dielectric reflecting coatings at wave-lengths shorter than 5200 Å.; this prevents an assessment of the relative merits of dielectric and silver films as coatings for Fabry-Perot interferometer plates at these wave-lengths. To this end, multi-layer dielectric interference filters have been prepared, and their characteristics measured over the wave-length range 4000-4600 Å.

Each filter was deposited on glass, and consisted of two reflecting films, both of seven  $\lambda/4$  layers (four zinc sulphide and three cryolite), separated by a  $\lambda/2$  spacing layer of cryolite, thus giving a first-order

