

ratus described in the present paper was designed primarily for involatile elements analysis, where the large percentage of carbon normally mixed with the charge and the necessity for complete burn together greatly enhanced cyanogen band formation. The most important advantage of the technique described is that there is no increase in operational time, since the only departure from standard practice is the addition of silica collars after electrode preparation, just prior to arcing. The advantages of the remotely controlled, enclosed, arc stand are fully maintained. Contamination risks are slight since the jet does not come into actual contact with the electrodes, and also it may easily and quickly be removed for cleaning. The silica collars are cleaned between use by acid treatment.

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## RADIOCHEMISTRY

### Rapid Determination of Tungsten in Steel by Neutron Activation and $\gamma$ -ray Spectrometry

A NEUTRON activation analysis method has been devised for the non-destructive, rapid determination of tungsten in steel

In the present work, varying amounts (0.01–0.1 g) of a sample to be analysed are placed by turns in the nuclear reactor *JRR-1* for 4.5 sec to be irradiated with neutrons at a flux of  $3 \times 10^{11}$  neutrons per  $\text{cm}^2/\text{sec}$  and then the  $\gamma$ -ray spectra and the decay of nuclide formed are observed by use of a 2-in. thick, well-type sodium iodide crystal attached to a 256-channel pulse-height analyser, the sample being placed at about 1 cm above the well together with its container. Typical spectrograms thus obtained are shown in Fig. 1, the shapes of which have been found to be analogous to those obtained from a standard sample (tungstic acid powder). From the successive spectra (Fig. 1, A–D) the half-life of nuclide formed can be determined to be about 5.5 sec. Tungsten is thus identified from both spectra shape and half-life. Its amount can be determined by the comparative method as usual.

From Fig. 1, which represents a sample of 2.0 per cent tungsten content, it can be deduced that one-tenth of this concentration of tungsten would produce an adequate intensity of  $\gamma$ -rays. Since good results are obtained when a sample taken involves about 1 mg of tungsten, the higher the tungsten concentration, the smaller the preferable amount of the sample.

The coefficient of variation of single analyses can be deduced (from a similar experiment<sup>1</sup> in which ytterbium was determined by use of the formation of 6-sec <sup>m</sup>Yb) to be about 5 per cent if the activity level is suitable to the analyser used and interferences are negligible.

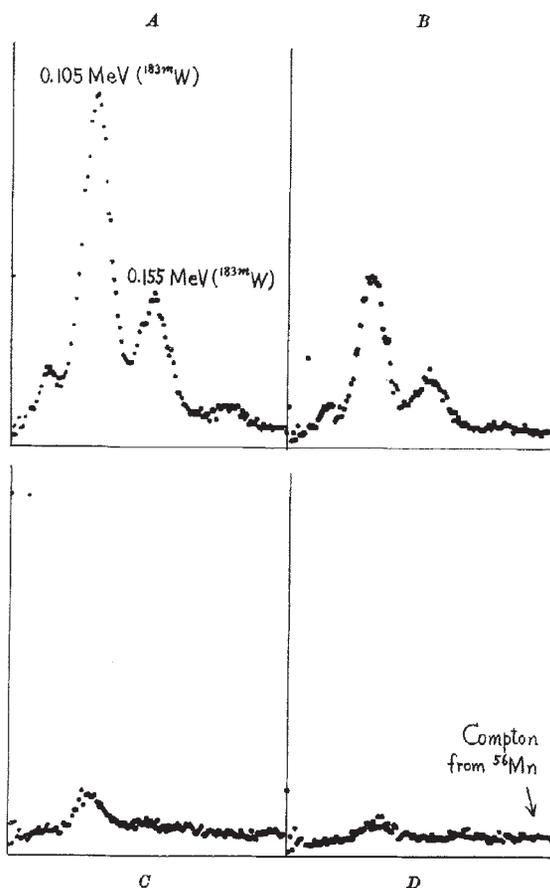


Fig. 1. Successive spectra for  $\gamma$ -rays of a steel sample (70.7 mg) irradiated for 4.5 sec. A, at 4 sec after irradiation (the pulse-height analyser was operated for 5 sec); B, at 10 sec (for 5 sec); C, at 27 sec (for 10 sec); D, at 47 sec (for 10 sec). The composition of this sample: Fe, 96.8; W, 2.0; C, 0.6; Mn, 0.4; Cu, 0.3; Si, 0.3; Cr, 0.12; Ni, 0.08

Possible interferences have been investigated by use of a graphical method<sup>2</sup> and of the effective activation cross-section of <sup>182</sup>W obtained in this work. Table 1 shows the amounts enough to interfere, at several sec after 4.5-sec irradiation, through  $\gamma$ -rays of nearly decouple the intensity of that from 1 mg of tungsten.

Table 1. AMOUNT REQUIRED TO EMIT  $\gamma$ -RAYS OF THE INTENSITY OF 10 TIMES MORE THAN THAT DUE TO 1 MG OF TUNGSTEN

Ag	1 $\mu\text{g}$	Eu	1 mg
Dy	0.01 mg	Cu	3 mg
Rh, Sc, V	0.02 mg	Ti	0.02 g
Se, In	0.03 mg	Mo	0.1 g
Er	0.1 mg	Ni	1 g
Al, Co	0.2 mg	S, Cr, Si, } > 1 g	
Mn	0.3 mg	Fe, P, C }	

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