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Compilation of Detection Sensitivities in Thermal-Neutron Activation

The detection sensitivities of the chemical elements following thermal-neutron activation have been compiled from the available experimental cross sections and nuclear properties and presented in a concise and usable form. Calculating the sensitivities for each situation is time-consuming and tedious, and alternate counting methods must often be used and possible interfering activities must be considered.

The detection sensitivities of neutron-activated elements were calculated and tabulated using 4π beta, single-gamma, gamma–gamma, alpha–gamma, and beta–gamma coincidence, beta–gamma–gamma triple coincidence, plus triple gamma coincidence counting techniques. The material presented permits a rapid, qualitative estimation of the detection limits and best detection methods for these elements.

The information and tables presented would be useful for the following:

1. Identification, prediction, and estimation of the amount of induced radioactivities and interferences.
2. Comparison of the relative detection sensitivities of the chemical elements.
3. Feasibility of nondestructive or radiochemical analysis.
4. Selection of counting techniques.
5. Selection of irradiation and cooling times.
6. Choice of target matrix.

As further aids to these applications, some of the calculated sensitivities are plotted as a function of time of irradiation. Most of the results plotted are the maximum sensitivities for the target element (or isotope). The decay half-lives versus coincidence-gamma energies and the decay half-lives versus the sum of the coincidence-gamma energies are also plotted for the nuclides covered in the report.

The detection sensitivities were calculated for irradiation times of 0.5, 5, 50, 500, and 5000 minutes at a flux of 10^{14} thermal neutrons/sec-cm^2. The calculated sensitivities can be alternately read as sensitivities for one-gram samples at a flux of 10^8 thermal neutrons/sec-cm^2.

Several of the nuclides are formed from pairs of isomeric product nuclides. The sensitivities for these nuclides were calculated from the two paths of formation, one from the metastable state and the other from the ground state of the product nuclide.

For single-gamma counting, the source was 3 cm and 9.3 cm from the face of a 3-in. by 3-in. NaI (Tl) crystal. For coincidence counting, the source was 3 cm from two opposed 3-in. by 3-in. NaI (Tl) crystals. The single-gamma counting results have been compared with existing experimental data for accuracy.

Notes:

1. All calculations were performed by an IBM 1620 II computer.
2. The report also includes the equations and nuclear parameters used in the calculations.
3. This information would be of interest to persons concerned with activation analysis.
4. Complete details are contained in *Detection Sensitivities in Thermal-Neutron Activation*, by J. Wing and M. A. Wahlgren, ANL-6953, December 1965, Argonne National Laboratory, Argonne, Illinois. This report is available from the Clearinghouse for Federal Scientific and Technical Information, Springfield, Va. 22151. Price $3.00 each (microfiche, $0.65).

(continued overleaf)

5. Inquiries concerning this innovation may be directed to:

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Reference: B67-10641

Source: J. Wing and M. A. Wahlgren
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Patent status:

Inquiries about obtaining rights for commercial use of this innovation may be made to:

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