

Relative Sensitivities of Elements to Thermal Neutron Activation

The following table of neutron activation analysis sensitivities, taken from ORAU Report 102, Isotopic Neutron Source Experiments, by G.I. Gleason, should be quite useful to schools that have either an isotopic neutron source such as Am-Be or a small ²⁵²Cf neutron source. The numbers in the table are equally valid for thermalized accelerator neutron sources. Information can be extracted from this table in regard to unknowns that are used in the activation analysis experiments in the AN34 manual.

Experimentally determined sensitivities are relative and are based on the sensitivity of aluminum. If the irradiation and counting system is capable of measuring the results from 1 milligram of aluminum, then it is capable of measuring the listed quantity of each element in milligrams. In each case, the reaction product and gamma energy have been selected to give the best interference free sensitivity.

Irradiation to saturation is assumed for nuclides having half lives in seconds or minutes. An overnight, (16 hour), irradiation is assumed for longer lived nuclides.

Measurements of the activities were made with NaI(Tl) scintillation detectors. Sensitivity was assigned on the basis of the amount of the element required to produce a discharge count rate of 100 net counts per minute in the photopeak for the product nuclide. The listed relative sensitivities would be approximately the same for measurement with a Ge(Li) detector. With Ge(Li), longer counting periods are necessary because of their lower efficiencies; hence, very short half life activities can be expected to show a decreased sensitivity. The higher resolution of the Ge(Li) detector, however, is an advantage when interferences are present.

Atomic Number	Element	Product Nuclide	Half Life	Measured Ey (keV)	Relative Sensitivity*	Atomic Number	Element	Product Nuclide	Half Life	Measured Ey (keV)	Relative Sensitivity*
9	Fluorine	²⁰ F	11.6 s	1634	60.	49	Indium	^{116m} In	53.7 m	1293	0.006
11	Sodium	²⁴ Na	15.0 h	2754	1.5	50	Tin	^{125m} Sn	9.5 m	331	15.
12	Magnesium	²⁷ Mg	9.46 m	844	35.	51	Antimony	¹²² Sb	64.3 h	564	0.7
13	Aluminum	²⁸ Al	2.32 m	1779	1.	52	Tellurium	¹³¹ Te	24.8 m	150	5.7
17	Chlorine	³⁸ Cl	37.3 m	2168	8.	53	Iodine	¹²⁸ I	25.0 m	443	0.3
19	Potassium	⁴² K	12.4 h	1525	28.	55	Cesium	^{134m} Cs	2.9 h	127	0.4
20	Calcium	⁴⁹ Ca	8.8 m	3084	260.	56	Barium	¹³⁹ Ba	83.0 m	166	3.2
21	Scandium	^{46m} Sc	18.7 s	143	0.03	57	Lanthanum	¹⁴⁰ La	40.2 h	1597	0.8
22	Titanium	⁵¹ Ti	5.79 m	320	18.	58	Cerium	¹⁴³ Ce	33.7 h	293	14.
23	Vanadium	⁵² V	3.75 m	1434	0.07	59	Praseodymium	¹⁴² Pr	19.2 h	1576	5.
2	Chromium	⁵¹ Cr	27.8 d	320	85.	60	Neodymium	¹⁴⁹ Nd	104.0 m	211	5.
25	Manganese	⁵⁶ Mn	2.58 h	847	0.015	62	Samarium	¹⁵³ Sm	46.8 h	103	0.07
27	Cobalt	^{60m} Co	10.5 m	59	0.23	63	Europium	^{152m} Eu	9.3 h	963	0.008
28	Nickel	⁶⁵ Ni	2.53 h	1482	130.	64	Gadolinium	¹⁶¹ Gd	3.6 m	360	—
29	Copper	⁶⁸ Cu	5.10 m	1039	6.	65	Terbium	¹⁶⁰ Tb	72.0 d	299	4.
30	Zinc	^{69m} Zn	14.1 h	439	23.	66	Dysprosium	¹⁶⁵ Dy	2.32 h	95	0.01
31	Gallium	⁷² Ga	14.1 h	834	0.32	67	Holmium	¹⁶⁶ Ho	26.8 h	81	0.2
32	Germanium	^{75m} Ge	48.0 s	140	5.2	68	Erbium	¹⁷¹ Er	7.52 h	308	0.36
33	Arsenic	⁷⁶ As	26.4 h	559	0.32	69	Thulium	¹⁷⁰ Tm	129.0 d	84	90.
34	Selenium	^{77m} Se	17.4 s	162	0.27	70	Ytterbium	¹⁷⁵ Yb	101.0 h	396	1.5
35	Bromine	⁸⁰ Br	16.8 m	616	0.8	71	Lutetium	^{176m} Lu	3.7 h	88	0.2
37	Rubidium	^{86m} Rb	1.02 m	556	5.	72	Hafnium	^{179m} Hf	18.6 s	214	0.05
38	Strontium	^{87m} Sr	2.83 h	389	3.	73	Tantalum	¹⁸² Ta	115.0 d	1121	35.
39	Yttrium	^{89m} Y	16.1 s	909	23.	74	Tungsten	¹⁸⁷ W	24.0 h	686	0.4
42	Molybdenum	¹⁰¹ Tc	14.2 m	307	8.	75	Rhenium	¹⁸⁸ Re	16.7 h	155	0.07
44	Ruthenium	¹⁰⁵ Ru	4.4 h	724	12.	76	Osmium	¹⁹³ Os	31.5 h	139	35.
45	Rhodium	^{104m} Rh	4.3 m	51	0.03	77	Iridium	¹⁹² Ir	74.2 d	317	0.3
46	Palladium	^{109m} Pd	4.7 m	189	5.5	78	Platinum	¹⁹⁹ Pt	31.0 m	543	25.
47	Silver	^{110m} Ag	24.0 s	658	0.35	79	Gold	¹⁹⁸ Au	64.7 h	412	0.027
48	Cadmium	^{111m} Cd	49.0 m	245	18.	80	Mercury	¹⁹⁷ Hg	65.0 h	78	1.2

*The numbers in this column indicate the number of units (weight) of an element that provide a count rate equal to the count rate furnished from irradiation of one unit weight of aluminum.

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Specifications subject to change
030410

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