Neutron activation analysis

Instrumental neutron activation analysis (INAA) is a very sensitive method of quantitative elemental analysis based on the nuclear activation of the chemical elements present in a sample. Around 65 elements may be measured using the technique. Activation is achieved by placing the sample in the neutron flux of the OPAL reactor. The specific activity of each radionuclide may be determined by measuring the characteristic gamma radiation emitted from the sample after it has been removed from the reactor.

Two methods of standardisation are available, the relative (comparator) method and the k_0-method. The irradiation time can be selected to optimise the detection limit for particular elements, making use of the short residence time (SRT) and long residence time (LRT) facilities, as indicated below. A complete elemental analysis requires sub-samples to be irradiated in both the SRT and LRT facilities.

Delayed neutron activation analysis (DNAA) can measure the uranium content of a sample at concentrations from 0.5 to 1,000,000 ppm. The technique determines the concentration of the isotope ^{235}U by measuring the rate of emission of delayed neutrons from the sample after it has been irradiated in the OPAL neutron flux.

There are strict requirements on the handling and nature of samples that are to be irradiated in OPAL facilities. In some cases samples will need to be analysed by XRF prior to irradiation, for an additional fee. Samples can only be loaded into approved polyethylene irradiation containers at the Lucas Heights site by authorised ANSTO staff or collaborators working under the direct supervision of authorised ANSTO staff. Please contact ANSTO early in the process of project development to discuss target and canning aspects as there may be a delay of up to two months to gain approval for the irradiation of a new type of material. Samples should be dry, powdered and homogeneous.

Unused samples will be stored for six months prior to disposal. If requested, this unused material can be returned at the client's cost.

In certain circumstances, it may be possible to return irradiated samples to the client, subject to ARPANSA regulations.

Capability selection

- **NAA Short Irradiation:** a selection of elements that can be measured in the short residence time facility are Al, Ca, Cu, Cl, Dy, I, In, Mg, Mn, Na, Rh, Ti, and V. Around 50 - 100 mg of sample will typically be required for each measurement. Results from this facility can be provided within two weeks of irradiation.

- **NAA Medium Irradiation:** a selection of elements can be measured using an extended irradiation in one of the short residence time facilities, including Br, Er, Ga, K, Mn, La and Na. Up to 300 mg of sample will typically be required for each measurement. Results from this facility can be provided within two weeks of irradiation.

- **NAA Long Irradiation:** a selection of elements that can be measured in the long residence time facility are: Ag, As, Au, Ba, Br, Cd, Ce, Co, Cs, Cr, Eu, Fe, Ga, Gd, Ir, Hf, Ho, K, La, Lu, Mo, Na, Nb, Nd, Pd, Pr, Pt, Rb, Ru, Sb, Sc, Se, Sm, Sn, Sr, Ta, Tb, Te, Tm, Th, U, W, Yb Zn and Zr. Around 50 - 100 mg of sample will typically be required for each measurement. Results from this facility can be provided within six weeks of irradiation.

- **DNAA:** Subject to initial review by ANSTO, the uranium concentration of any dry, stable, non-corrosive powder may be determined using this method. The uncertainty of the analysis is around 3% (one sigma) of the stated uranium concentration above 5 ppm and about 10% below 5 ppm. Up to 10 g of sample will typically be required for each measurement. Results from this facility can be provided within two weeks of irradiation.

For further information please contact:

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