QUALITY ASSURANCE IN INAA VIA SHORT-LIVED ISOMERIC TRANSITIONS

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As a basic step to quality assurance of INAA via short-lived isomeric transitions replicate analyses of NaCl are performed on an INAA facility specifically designed for this purpose and from the series of net peak areas of Na-24m (20 ms) and Cl-38m (715 ms) it can be shown that the system is quantitative and that its precision is determined by counting statistics. Future improvements of the method may be expected from gamma spectrometry systems with higher throughput and better resolution than that of the now used gated integrator. A resolution comparison between a gated integrator and the recently developed Preloaded Filter is given on the basis of the detector applied in this investigation and substantial improvements are exemplified.

Replicate analyses of NaCl

Our investigation on the reproducibility of the fast INAA facility at the Institut’s TRIGA Mark II reactor is based on the replicate activation of two individual samples of NaCl of 2.16 mg and 3.21 mg at a neutron flux at irradiation position of $1.3 \times 10^8$ cm$^{-2}$ sec$^{-1}$ with the aid of a fast pneumatic transport system with 20 ms transport time /1/, and on the consequent pulse height analysis of Na-24m with 20 ms half-life and 472 keV$\gamma$ and Cl-38m with 715 ms half-life and 671 keV$\gamma$ by means of an elsewhere reported gamma spectrometry system with an n-type HpGe detector of 20% relative efficiency, transistor reset preamplifier, gated integrator pulse processing and a basic resolution of 2.5 keV at 1332 keV /2/; as well as
real-time correction of counting losses based on the Virtual Pulse Generator method /3/. After a breakdown of this detector just before the measurements for this paper, it had to be replaced by another n-type detector with 15% relative efficiency, transistor reset preamplifier, and a basic resolution with gated integration of 2.9 keV at 1332 keV. Activation time was 5 s. Counting time into two successively recorded pulse height spectra was 200 ms for the first spectrum (to separate Na-24m) and 7 s for the second one (to obtain Cl-38m). While Na-24m is extracted exclusively from the short spectrum, Cl-38m is derived from a summation of the 0.2 s and 7 s spectra. Counting errors for the loss-corrected spectra are derived from the matching non-corrected spectra, which are recorded in parallel in this specific spectrometry system.

Results

Table I gives the results for 2.16 mg of NaCl. Ten loss-corrected net peak areas of Na-24m and Cl-38m, respectively, are presented in the sequence of shooting together with their counting errors, as derived from the non-corrected spectra. Mean values and most probable values are given, together with the results of corresponding Chi-square tests. Counts/mg for Na-24m and Cl-38m are derived from most probable values.

Table II gives similar results for 3.21 mg of NaCl. Here, a probable outlier has been identified, marked by an asterisk, and removed from the series.