AASIFIT – Advanced Alpha-Spectrometric Simulation and Fitting

AASIFIT is a simulation and spectrum analysis tool for alpha spectrometry that combines the Monte Carlo simulations and spectrum unfolding. The software is developed especially to analyze challenging alpha spectra such as those obtained from non-processed samples or measured at ambient air pressure. The software can be also be used for the source characterization.

Features

- Combination of simulations and fitting
- Peak shapes from Monte Carlo simulations (AASI program)
- Peak family fitting after the peak shape generation
- Gaussian detector response with low-energy side exponential functions accounted for in the peak shape (same peak shape parameters as in the ADAM program)
- Source characteristics, material between the source and the detector, and the detector response accounted for in the simulations
- Alpha-electron/photon coincidences included in the peak shape generation
- Calculation of the geometrical detection efficiency
- Calculation of the absorbed number of alpha particles in the source
- User-friendly GUI
- Nuclide library for the simulations and fitting

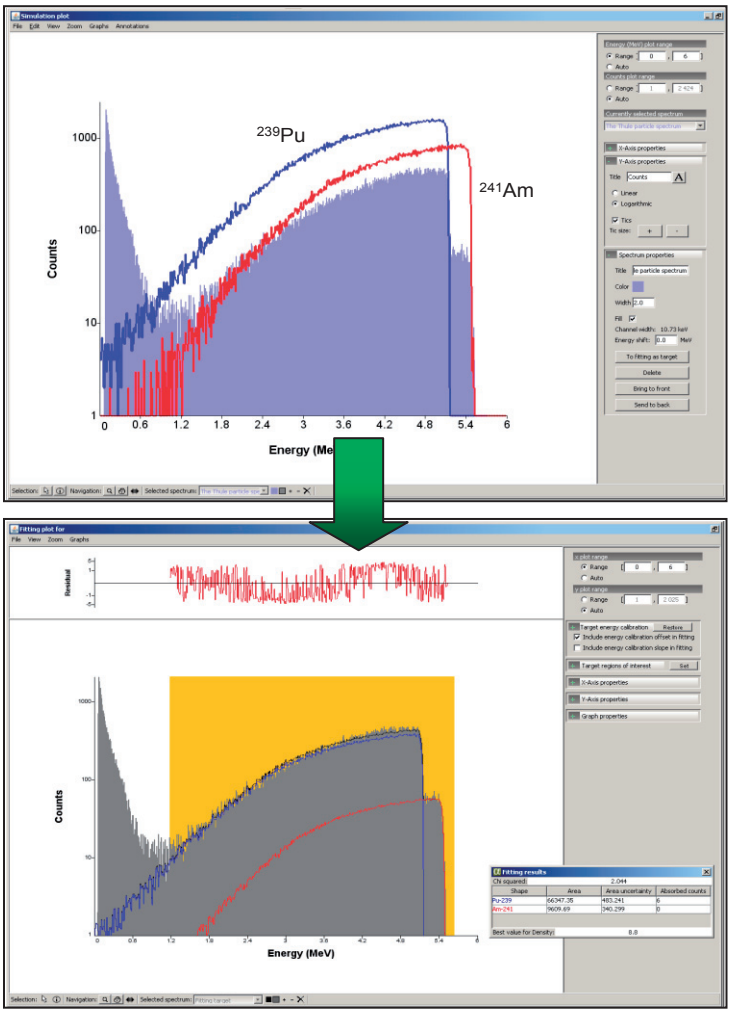

Fig. 1. Measured alpha spectrum from a nuclear bomb particle containing ^{239}Pu and ^{241}Am with simulated peak family shapes (at the top) and respective area-fitted shapes (bottom).

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Applications

Nuclear forensics

AASIFIT can be used for source characterization. From known dimensions of a particle (SEM pictures) AASIFIT can estimate the particle density (Fig. 2).

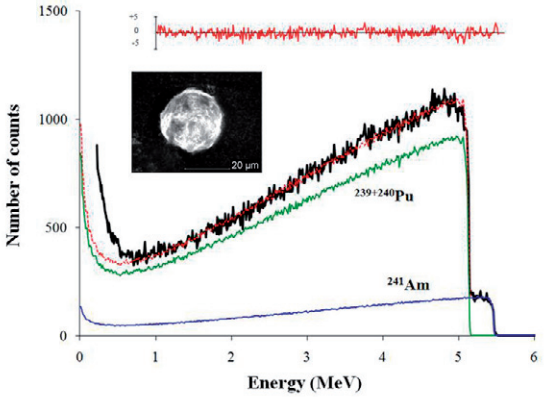

Fig. 2. Alpha spectrum from a nuclear bomb particle of diameter 25 µm unfolded by AASIFIT.

U particle properties

Reference particles composed of U have been measured using alpha spectrometry and the resulting spectrum was analyzed successfully by AASIFIT (Fig. 4).

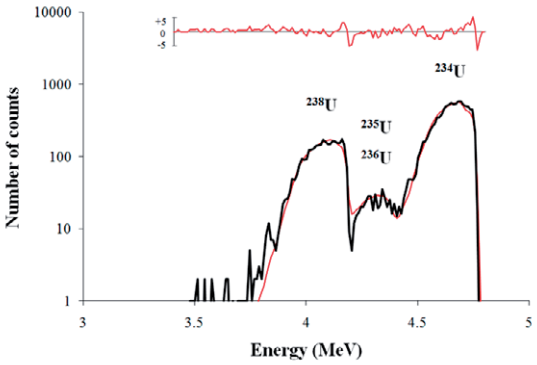

Fig. 4. Unfolding an alpha spectrum from particles containing U.

Depth distribution of aerosol particles in a filter

When collecting outdoor air particles the particles penetrate the filter. The alpha particles from radon progeny suffers energy loss and causes peak tailing. AASIFIT can assess the depth distribution (Fig. 3).

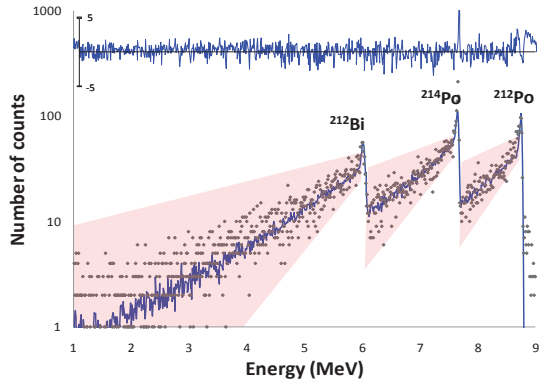

Fig. 3. Alpha spectrum from a glassfibre filter and fitted peaks of ^{212}Po, ^{214}Po and ^{212}Bi. The shaded areas illustrate the effect of varying penetration depth

Alpha spectrum from a DU penetrator

Measurement of alpha spectra from thick objects (smooth surface) and in ambient air pressure is possible (Fig. 5). AASIFIT can take into account air between the source and the detector.

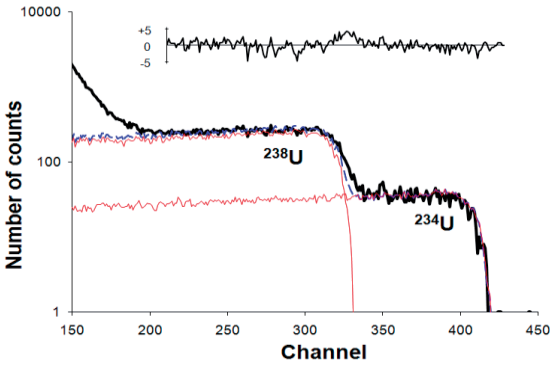

Fig. 5. Unfolding an alpha spectrum from a DU penetrator.

Installation

The simulation program AASI, i.e. AASIFIT without the fitting capability, with its documentation can be downloaded free from website: www.stuk.fi/tutkimus/programs/aasi/en_GB/aasi/

References

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- T. Siiskonen et al. New approach to spectrum analysis: iterative Monte Carlo simulations and fitting. Progress in Nuclear Science and Technology 2: 437–441, 2011.
- R. Pöllänen et al. Deconvolution of alpha spectra from hot particles. In: NATO Science for Peace and Security Series C: Environmental Security. Springer; 2009. p. 209–220.

Technology Readiness Level 6

STUK-TTL-FLYER-2011-002, 16 Oct 2012
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