Alpha Spectrometer
based on Silicon Ion Implanted Detector
SIID-1

1. APPLICATION
Alpha Spectrometer is intended for transformation of alpha-particle energies into electrical signals, its amplification, analog filtration, digital transformation and acquisition and further spectra processing with determination of intensities of spectral lines and corresponding activities of alpha-emitting radionuclides.

2. COMPLETE SET
Bench top alpha spectrometer consisting from:
- 1 alpha spectrometry chamber with preamplifier;
- 1 passivated alpha-particle detector;
- Spectrometric device Multispectrum for 1 input;
- Vacuum pump;
- Analysis software SpectraLineADA;
- Documentation set.

3. TECHNICAL CHARACTERISTICS
Silicon Ion Implanted Alpha Particle Detectors is a product for the precise alpha spectroscopy. The thin entrance window of the detectors provides good energy resolution even in close location of the alpha radioactive source and also provides high efficiency registration of alpha particles.

Basic features of detectors are
- The detectors can operate without hermetization due to location of P-N junction inside of the detector crystal;
- Contacts are formed using ion-implantation method and provide thin, well-formed junction;
- Thin dead layer (thickness less than 500 Å);
- High solidity entrance window;
- Possibility of annealing the detectors up to 100 °C.
**Alpha Spectrometer**

*based on Silicon Ion Implanted Detector SIID-1*

**Alpha spectrometry chamber** includes alpha particle detector, pressure sensor and preamplifier of signals from alpha detector. Basic characteristics of alpha chamber are shown in table below:

<table>
<thead>
<tr>
<th>#</th>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Energy range of detector operation, MeV</td>
<td>3 – 8</td>
</tr>
<tr>
<td>2</td>
<td>Instrumental background, cpd</td>
<td>&lt; 15</td>
</tr>
<tr>
<td>3</td>
<td>Maximum input count rate, cps</td>
<td>&gt; 10 000</td>
</tr>
<tr>
<td>4</td>
<td>Detector sensitive area, mm$^2$</td>
<td>450</td>
</tr>
<tr>
<td>5</td>
<td>Detector thickness, µm</td>
<td>400</td>
</tr>
<tr>
<td>6</td>
<td>Detector bias voltage, V</td>
<td>50</td>
</tr>
<tr>
<td>7</td>
<td>Energy resolution for 5.49 MeV, keV</td>
<td>&lt; 20</td>
</tr>
<tr>
<td>8</td>
<td>Absolute detection efficiency at the distance of 5 mm from the sensitive area of the detector, %</td>
<td>&gt; 20</td>
</tr>
</tbody>
</table>

**Bench top alpha spectrometer contains 10 measurement chambers.**

**Built-in spectrometric device Multispectrum** is intended for amplification and formation of signals from alpha detector, power supplies for detector and preamplifier.

Basic characteristics of spectrometric device are shown in table below:

| 1.  | Count rate       | 0-50 000 pulses/s |
| 2.  | Shaping time constant, switchable | 1 ms and 2 ms |
| 3.  | Variable gain coarse and fine | Up to 500 |
| 4.  | Noise level (referred to the input) | < 3 mV for 2ms |
| 5.  | Pole-zero adjustment | Available |
| 6.  | Live time correction | Available |
| 7.  | Opportunity to operate with pulse feedback preamplifier | Available |
| 8.  | Base line auto restoration | Available |
| 9.  | Gain stability    | <0.0075 %/s     |
| 10. | Integral nonlinearity | < 0.025 %   |

---

**NATS**

Bridging the Technology Gap

North American Technical Services

---

511 CENTERPOINT DRIVE • MIDDLETOWN, CT 06057, USA
PHONE: +1-860-635-6820 • FAX: 1-860-635-4962
SALES@NATS-USA.COM • WWW.NATS-USA.COM
Alpha Spectrometer
based on Silicon Ion Implanted Detector SIID-1

SpectraLineADA software allows to:
- execute spectra acquisition for the set time,
- mark and select regions of interest and examine them on a separate plane, increasing or reducing scale on horizontal and vertical axis;
- perform energy calibration of spectra on two known energies;
- determine centroids and area of peaks with background deduction and without background deduction;
- make an estimation of energy resolution at one second and one tenth height of full absorption peak;
- carry out an automatic serial spectra acquisition with automatic record on a disk;
- print out spectrum window;
- compare different spectra in one window simultaneously reducing or decreasing scale;
- Calculation of activities of alpha emitting radionuclides.

The activity calculation module uses the parametric model line of the alpha-spectrum. Spectrum of every alpha-emitted isotope line is represented by the combination of asymmetric Gauss distribution, exponent and hyperbola. These functions are combined using the conditions of the function and its first derivative continuity. This model represents alpha-spectra of both thin and thick sources, and gives good results with alpha-spectra measured by spectrometers with HPGe detectors and ionization chambers. The model parameters and activity values are specified using the minimum condition of the modified $\chi^2$-functional. The parameters of the spectrum deformation are varied. The deformation is caused by summing of alpha particles and conversion electrons impulses.

The processing results are displayed and represented in a report view. The report pattern is specified by user. The fitting results are displayed on the spectrum graphics as nuclides independent spectra for visual control of the fitting results. The peak pattern after the minimization procedure can be saved and used for the spectrum analyses by the SpectraLine methods.

The detection efficiency calculation and label operations are realized.
The measured spectra and processing results can be saved to database.
This functionality enables to analyze the specified criterions convergence of the repeated measurements.