Isotopx

The culmination of
40 years experience
in TIMS

Phoenix TIMS

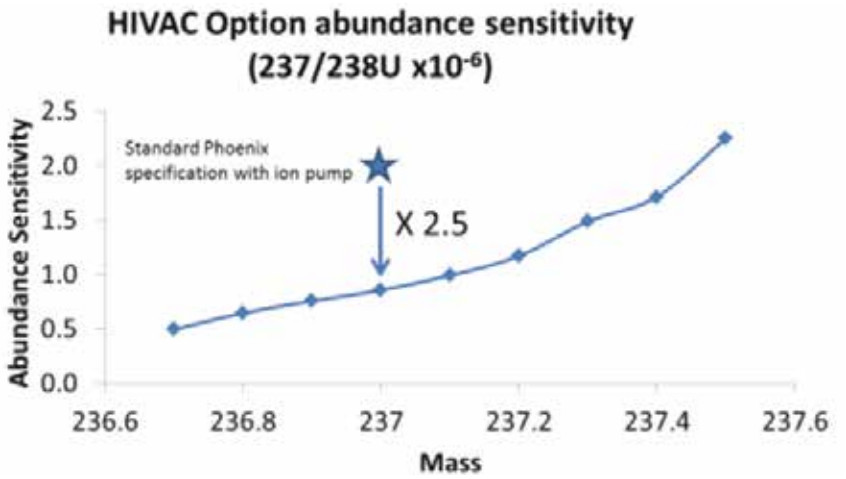
Thermal Ionization Mass Spectrometer

Latest developments from Isotopx
High abundance sensitivity (HAS) option

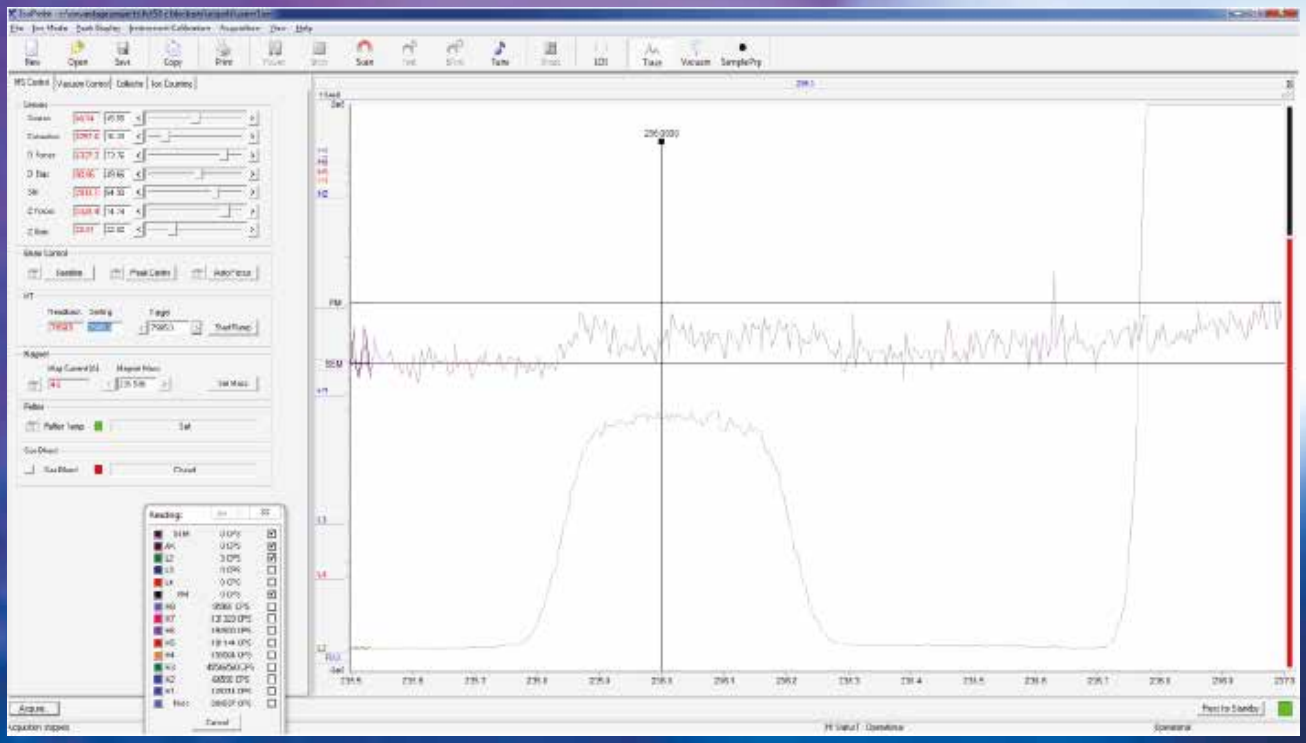
Isotopx continues to advance Thermal Ionization Mass Spectrometry technologies with the Phoenix Mass Spectrometer

HAS Pumping option

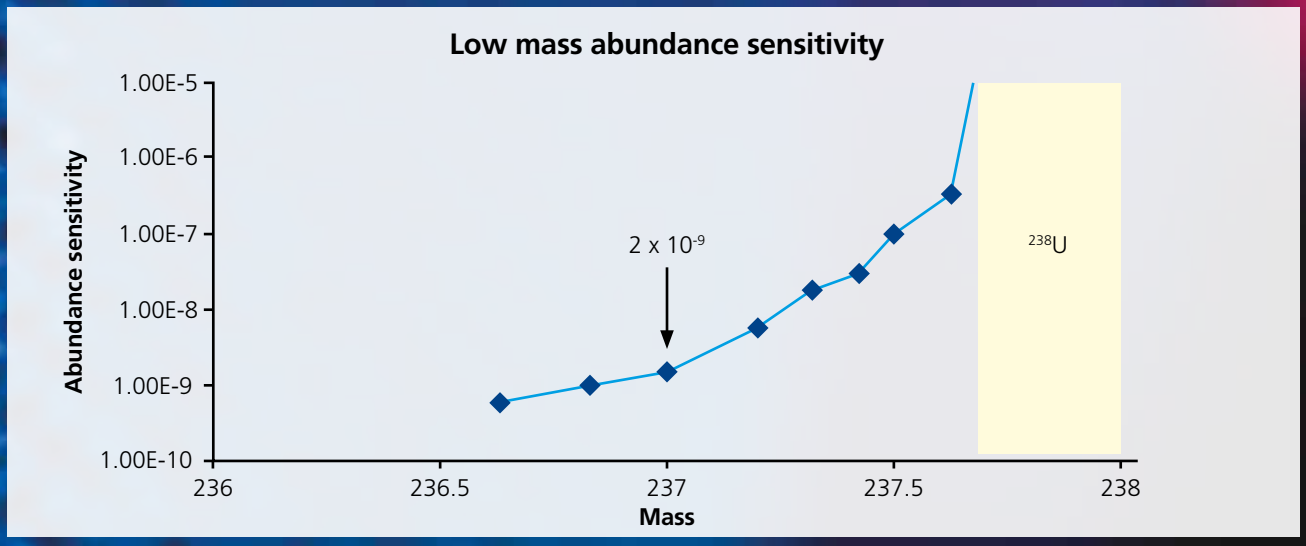
- >1000l/s turbomolecular and ion pumping
- Source vacuum <1e^{-9} mbar, analyser 1e^{-10} mbar
- <0.7ppm abundance sensitivity without energy filter (237/238U)
- <5ppb with energy filter



Since the advent of TIMS the preferred pumping system for the mass spectrometer analyser are ion pumps. The analyser vacuum is limited to about 2x10^{-9} mbar, and this would degrade if moisture from poor source vacuum entered the analyser vacuum, since ion pumps cannot pump water vapour. The quality of the analyser vacuum has a direct influence on the abundance sensitivity which is the amount of peak tailing from a major isotope on an isotope of lower mass. Reducing or eliminating this tailing is crucial for accurate determinations of ^{236}U in the presence of large ^{238}U in natural samples, or determination of ^{234}U in the presence of large ^{235}U, or measurement of baselines at low ion intensity prior to total evaporation analysis. The use of energy filters to remove these peak tail effects is essential for ion counting measurements of single isotopes such as ^{236}U and ^{230}Th, however, these devices cannot be practically applied to Faraday collectors or multiple ion counting arrays. The standard Phoenix collector block is pumped with a 70l/s ion pump, via a 16cm CF flange. This wide flange provides maximum gas conductance. Yet analyser vacuums below 1 x 10^{-9}mbar can only be attained after baking. Secondly ions from the ion pump increase the dark noise on multiple ion counting detectors which do not have an energy filter in front of them. Isotopx has replaced this ion pump with a Pfeiffer Hi-Pace 300l/s turbo molecular pump to increase the pumping speed. The pump is backed by a scroll pump and a gate valve is positioned between the pump and the flight tube, and it will close in case of a power failure. The 40l/s ion pump at the front of the flight tube remains to ensure the vacuum is maintained in the flight tube should the gate valve close. With this system the analyser vacuum after instrument baking is in the 1 x 10^{-11}mbar region and is routinely in the low 1 x 10^{-10}mbar region. The enhanced analyser pumping also improves the source vacuum which is typically <1 x 10^{-9}mbar.(Standard source turbomolecular pump of 700l/s capacity). Abundance sensitivity is improved by about a factor of 3 over an ion pumped system.



Mass scan of IRMM184 on non energy filtered conversion dynode ion counters. ^{236}U on axial multiplier coincident with ^{234}U on off axis CDM multiplier. The abundance of the ^{236}U is 0.12ppm relative to ^{238}U. The ^{236}U is clearly resolved from the peak tail which would not be the case with an ion pumped analyser vacuum



Abundance sensitivity with WARP filter

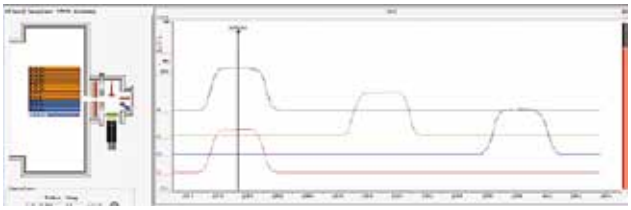
Phoenix Thermal Ionisation Mass Spectrometer. Latest developments from Isotopx.

Isotopx have further developed their multiple ion counting system. The conversion dynode geometry remains, however the channeltron multiplier is replaced by a Sjuits large dynamic range multiplier. Up to 6 multipliers can be positioned together, each of which is independently movable relative to each other and other collectors in the collector block. The scan to the right shows 4 ion counters positioned at unit mass spacing with respect to Uranium. The minimum separation is unit mass with respect to UO2.

The detectors can be used by themselves or with Faraday collectors or the ion counting Daly detector or axial SEM

Performance summary

- Dark noise <3 counts per muinute
- Gain >90% relative to Faraday cups
- Dynamic range up to 1 million cps
- Linearity <0.3% up to 3e5cps.
- Deadtime <30ns
- Gain stability <0.2% 1RSD over 30 minutes at 2e5cps.



Mass scan of SRMU500 showing unit mass separation with respect to uranium.

6 blocks each 100, two second integrations baseline for 60 secs either side of peaks.
No deadtime correction
With no cup factors

Block	238	236	235	234	234/238	%1rse	235/238	%1rse	236/238	%1rse
1	167689	242	167052	1730	0.01047	0.08	0.996603	0.012	0.001465	0.18
2	115905	168	115649	1192	0.01037	0.21	0.997526	0.028	0.001443	0.49
3	104507	151	104413	1083	0.01040	0.20	0.998722	0.031	0.001445	0.44
4	168120	245	167793	1758	0.01046	0.15	0.997637	0.024	0.001448	0.43
5	175534	261	174696	1835	0.01045	0.15	0.995394	0.024	0.001475	0.40
6	253911	377	252800	2668	0.01054	0.13	0.99588	0.018	0.001488	0.35
MEAN	164278	241	163734	1711	0.01045	0.15	0.99696	0.023	0.001461	0.38
1SD	53103	80	52748	565	0.00006	0.048214	0.001235	0.00678	0.000019	0.108651
1RSD	32%	33%	32%	33%	0.6%	31%	0.12%	30%	1.3%	29%

SRMu500 measured in static mode with no collector efficiencies

Each block 100 2 second integrations							
Each block 4 minutes							
	238U	236U	235U	234U	234/238	235/238	236/238
	Mean (After)	Mean (After	Mean (After)	Mean (After)	Mean (After)	Mean (After)	Mean (After)
	190854	0.05	1391.5	10.5	5.558E-05	0.007291	3E-07
	181907	0.06	1322.3	10.1	5.528E-05	0.007263	3E-07
	188250	0.00	1368.6	10.4	5.549E-05	0.007271	0E+00
	192015	0.05	1400.9	10.6	5.511E-05	0.007297	3E-07
	193957	0.05	1416.0	10.6	5.446E-05	0.007305	2E-07
	194832	0.06	1426.0	11.0	5.627E-05	0.007315	3E-07

IRMM184 natural uranium measured in static mode with no collector efficiencies

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