THE NU ATTOM HIGH RESOLUTION ICP-MS: SEMI-QUANTITATIVE ANALYSIS FOR RAPID SAMPLE SCREENING

INTRODUCTION

Fast, multi-elemental analysis for preliminary evaluation of sample concentrations is a must in routine laboratory work. This kind of screening has been proven to be a useful tool to help choose the best analytical technique or as a "ballpark" figure to determine approximate concentration figures for further analytical investigation (i.e. determination of required dilution factors, concentration calibration standard range, or for spiking for ID-TIMS analysis).

Quadrupole ICP-MS instruments are typically used for this application. However, high resolution ICP-MS (HR-ICP-MS) instruments may also have a role to play due to their superior detection limits, better sensitivity and ability to resolve isobaric interferences.

In this note we describe the use of a Nu Attom HR-ICP-MS in a semi-quantitative screening role to determine its suitability for this application.

Instrumentation

The Nu Attom is a double-focusing, high-resolution magnetic sector mass spectrometer. The instrument is entirely purpose designed and built to provide the best performance and reliability coupled with flexibility and ease-of-use for precise and accurate elemental and isotope ratio analysis. A unique detector system gives the Nu Attom a large dynamic range, and its electrostatic scanning capability has the widest range in its class (40%). Furthermore, the continuously variable high resolution means that sufficient resolution for isobaric separation can be selected with minimum compromise in sensitivity.

Experiment

The first step in this experiment was to generate a mass response curve using a multi-elemental standard (SPEX CertiPrep Group, USA) diluted to 1ppb using 2% HNO_3 and spiked with an internal standard. Blanks, standards and samples were all spiked in this way with 1ppb Rh for internal normalization processes. Internal standard normalization and blank correction were applied to the mass response curve. The standard used to determine the mass response curve contained only a selection of elements / isotopes across the mass range and not necessarily every target element / isotope. They are listed below:

Li(7)
Al(27)
Sc(45)
Mn(55)
Y(89)
In(115)
Cs(133)
Tl(205)
U(238)

Once the mass response curve had been established, an unknown sample was analysed and the concentrations were calculated directly from this curve.

A sample of the USGS standard material BCR-2 (Basalt, Columbia River, USA) was treated as the "unknown" sample and measured using the semi-quantitative mode of the Attom HR-ICP-MS.

The BCR-2 sample was taken from a stock solution and was diluted by a factor of 10 with 2% HNO_3 for analysis. A blank consisting of 2% HNO_3 was also prepared. The 1ppb Rh spike was added to the blank and sample solution. No mathematical corrections for isobaric overlap (e.g. Sn on Cd) or spectral interferences (e.g. BaO on Eu) were made.

Discussion

The results are reported in Table 1 and consist of 10 repeat analysis of the standard BCR-2. Data are shown along with certified, recommended or previously reported concentrations wherever available.

In addition, Table 1 shows the accuracy values (in the far right column) represented by the percentage difference between the measured value and the certified (or recommended / previously reported) value. It can be seen that all the results are within ± 20% of the recommended values for this particular reference material.

Conclusions

The Nu Attom is a high resolution ICP-MS that is ideal for the most demanding ICP-MS requirements where sensitivity, precision, and speed of analysis are paramount. This note highlights that the instrument is capable of being used in a rapid screening mode for the semi-quantitative analysis of multi-element samples.

BCR-2 (n=10)	ppm					
	Average	**Stdev**	**RSD%**	**Certified**	**Stdev**	**Difference%**
Be(9)	0.3	0.0	2.9	N/A		
Sc(45)	32.5	0.4	1.1	33.0	2	-1.5
V(51)	406.0	3.1	0.8	416.0	14	-2.4
Mn(55)	1749.8	11.6	0.7	1520.0	60	15.1
Co(59)	32.8	0.8	2.3	37.0	3	-11.3
Sr(88)	361.7	2.7	0.7	340.0	3	6.4
Y(89)	34.6	0.2	0.7	37.0	2	-6.6
Zr(90)	182.9	1.3	0.7	184.0	1	-0.6
Nb(93)	10.9	0.1	0.5	12.6	0.4	-13.4
Mo(95)	252.4	1.5	0.6	250.0	20	1.0
Ag(107)	0.2	0.0	11.2	N/A		
Ag(109)	0.1	0.0	5.8	N/A		
Cd(111)	0.1	0.0	10.5	N/A		
In(115)	0.2	0.0	9.1	N/A		
Sn(119)	2.1	0.1	3.7	N/A		
Sn(120)	2.1	0.1	2.6	N/A		
Sb(121)	0.1	0.0	5.2	N/A		
Cs(133)	1.0	0.0	2.1	1.1	0.1	-9.0
Ba(137)	615.3	5.3	0.9	677.0	2	-9.1
La(139)	24.0	0.3	1.1	24.9	0.2	-3.6
Ce(140)	53.3	0.5	0.9	52.9	0.2	0.8
Pr(141)	7.3	0.1	1.4	6.7	0.1	9.2
Nd(143)	31.9	0.5	1.5	28.7	0.1	11.0
Nd(145)	32.3	0.4	1.1	28.7	0.1	12.5
Nd(146)	32.4	0.3	1.0	28.7	0.1	12.8
Sm(147)	7.4	0.1	1.6	6.6	0.02	12.4
Sm(149)	7.5	0.2	2.0	6.6	0.02	13.9
Eu(153)	2.4	0.0	1.8	2.0	0.01	20.4
Gd(157)	7.6	0.2	2.2	6.8	0.03	13.0
Tb(159)	1.2	0.0	1.7	1.1	0.03	15.3
Dy(163)	7.7	0.1	1.4	6.4	0.05	20.0
Ho(165)	1.6	0.0	1.8	1.3	0.03	21.2
Er(166)	4.4	0.1	1.9	3.7	0.01	20.8
Tm(169)	0.6	0.0	3.1	0.5	0.04	18.3
Yb(172)	4.2	0.1	2.8	3.4	0.02	24.0
Lu(175)	0.6	0.0	3.0	0.5	0.009	17.3
Hf(178)	5.7	0.1	1.9	4.9	0.1	15.5
Ta(181)	0.8	0.0	3.2	0.7	0.02	4.4
W(182)	0.5	0.0	3.4	N/A		
Re(185)	0.0	0.0	27.8	0.01	0.003	-17.4
Hg(202)	0.1	0.0	13.4	N/A		
Tl(205)	0.3	0.0	4.6	N/A		
Pb(208)	9.4	0.2	2.5	11.0	1	-14.3
Bi(209)	0.0	0.0	15.3	N/A		
Th(232)	5.8	0.1	2.0	5.7	0.5	1.2
U(238)	1.8	0.0	1.9	1.7	0.19	9.2

Table 1 : *The data displayed is from 10 repeats of BCR-2 (Basalt, Columbia River, USA).*
Also displayed are certified, recommended or previously reported values where these are available.
The far right hand column shows the differences between the measured and certified values.