

General Features of the New Agilent 7500 ICP-MS

Technical Note

ICP-MS

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Building on the worldwide success of its 4500 model Inductively Coupled Plasma Mass Spectrometer (ICP-MS), Agilent Technologies has produced the 7500a, 7500i and 7500s models. Each product is optimized to cater for a specific type of analytical problem. The 7500a is a full featured and powerful instrument designed for the general purpose and environmental user; the 7500i for high sample throughput, mission critical applications such as those encountered in a contract or production laboratory situation; and the 7500s for routine quantification at single figure and sub ppt levels.

The new Agilent 7500 series ICP-MS have been designed around a single powerful and robust ICP-MS analytical platform. As a consequence they all share the same basic strengths in design and performance. This document describes the common features and strengths of the 7500 platform.

Sample Introduction

The low flow nebulizer/Peltier cooled spray chamber and wide diameter injector torch combine to ensure excellent tolerance to high dissolved solids and low polyatomic species. In conjunction with an ICP powered by an industry standard 27.12MHz RF solid state RF generator cerium oxide:cerium ratios, used widely as a measure of the robustness of a sample

introduction system in ICP-MS, are typically less than 0.5% (figure 1a).

Allowing high precision motorized positioning of the ICP in the x, y and z planes with respect to the interface ensures that the optimum sampling depth is available at all times, in all matrices.

Interface

The 7500 shares the same sampling interface as the previous 4500 model. As a consequence the new 7500 series have retained the same resistance to cone clogging that helped the previous model to gain such rapid acceptance. As figure 2a illustrates, samples containing high levels of total dissolved solids (in this case 1:5 dilution of CASS 3 seawater), can be analyzed repeatedly over extended periods without deterioration in performance.

The twin ion extraction/accelerating lenses can be operated in a unique "soft extraction" mode. In preliminary studies, this mode of operation has demonstrated exceptionally low Background Equivalent Concentrations (BECs) for ultra pure materials, allowing very low detection limits to be obtained.

Ion Lenses

Off axis lens system designs were pioneered and perfected in the HP 4500. The Agilent 7500 series have a second generation Omega II off axis lens system as standard. This high efficiency ion optic produces very high efficiency ion transmission and extremely low random backgrounds that are typically 2-5cps in normal plasma and <0.5cps when analyzing in Shield Torch mode. The calibration curve in Figure 3a highlights the potential quantification limits when using such a high efficiency lens system.

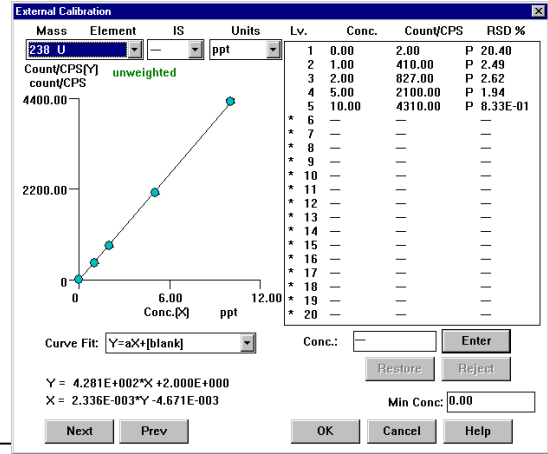
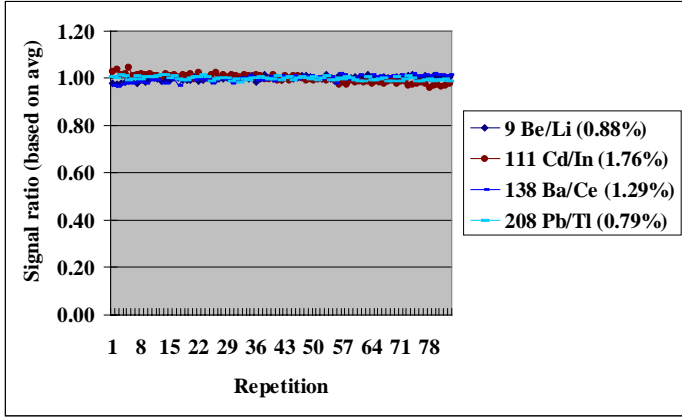
Quadrupole

The precision ground profiled molybdenum rods ensure the production of *true* hyperbolic electric fields that are the ideal contour for quadrupole performance. Driven by a novel digitally synthesized RF generator oscillating at 3.0MHz, the mass filter system produces high transmission unit resolution, unmatched peak shape and mass stability. The spectrum in figure 4a illustrates the routine performance of the mass filter, note the symmetry of the peak as well as the absence of "structure" at the base and peak top.



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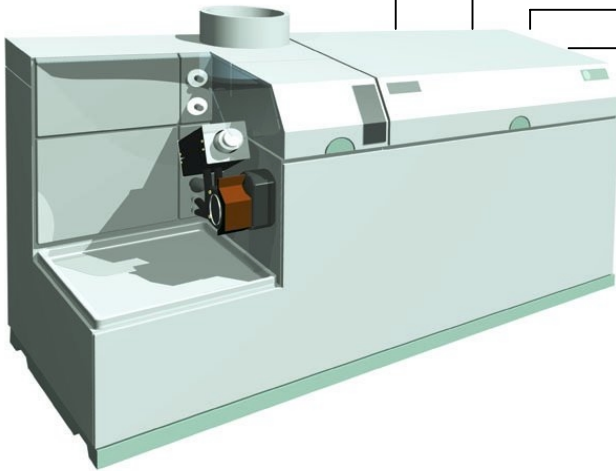


Interface

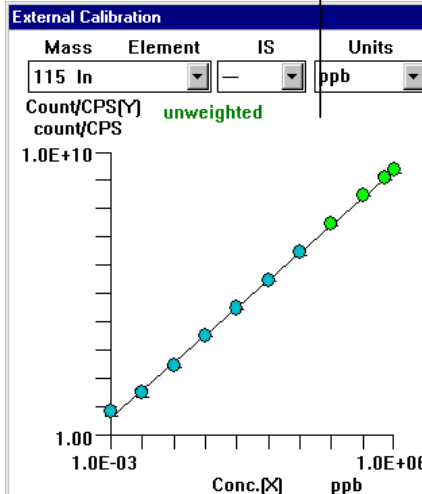
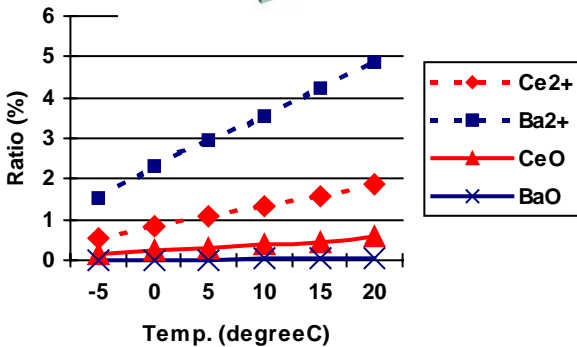
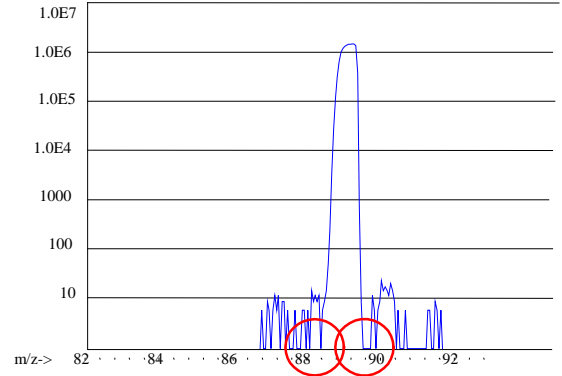
The robust interface ensures the ultimate stability even when analyzing "difficult" matrices such as seawater. In this example, a 1:5 dilution of spiked seawater has been analyzed over 12 hours with no drift or deterioration in signal.

Lens system

The Omega lens system provides high ion transmission, allowing excellent signal to noise. The figure above is a calibration curve for U with 1, 2, 5 and 10 ppt standards. Note the excellent sensitivity and very low noise.



Spectrum.1 [10.409 sec]:YCS8.D#[CPS][Log]



Quadrupole

The true hyperbolic quadrupole rods and 3.0MHz digitally synthesized RF drive provide the ultimate in quadrupole performance. Note the superb symmetry and peak shape in this example

Detector

The new simultaneous pulse counting and analog detector provides a very wide linear dynamic range of up to 9 orders of magnitude. In this example the "blue" points have been measured in pulse counting, while the "green" are in analog mode. The novel log amplifier means that is no need to compromise acquisition speed when analyzing in extended dynamic range.

Sample Introduction

The optimized sample introduction system contributes to the very low molecular species such as "oxides" and doubly charged. In this illustrative data, the CeO/Ce ratio is less than 0.5% even at high spray chamber temperatures

Detector

The 7500 series use a new simultaneous pulse counting and analog detector, that allows seamless measurement of unknown concentrations over nine orders of magnitude linear dynamic range. Figure 5a highlights this capability in a calibration curve that is linear from 10ppt to 1000ppm ! This unique design employs a new high speed analog amplifier that does not compromise scan speed, even when analyzing over the extended dynamic range. The high speed amplifier allows settle times in analog mode of 200usecs, which means that transient signals can be captured over the complete dynamic range without "waiting" for the analog signal. This feature opens the possibilities for chromatographic hyphenated ICP-MS techniques such as LC-ICP-MS and GC-ICP-MS (and even CE-ICP-MS) to take full advantage of the linear range of the detector.

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