# The Importance of single mass resolution when using MS/MS technology via the Agilent 8900 ICPMS

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## Introduction

With the introduction of Triple Quad ICPMS's into the market, the importance of single mass resolution when using MS/MS techniques is critical.

The advent of the triple quad with MSMS technology came onto the analytical scene with the Agilent 8800 in 2012. The reason they have become so widespread in their usage is because of their ability to remove interferences that single quad ICPMS's even with collision reaction cells cannot remove. The triple quad with MSMS capabilities inserts another mass filter (Q1) before the CRC to allow the ability to truly control what enters and exits the cell and thus better control over reaction gas based methods allowing them to be used from simple known matrices like semiconductor samples to difficult unknown or variable samples like environmental or biological samples.

Fig 1. The Agilent 8900 ICP-MS/MS in Wilmington, DE

Recently, other vendors have been claiming to have the same capabilities but neither has both the ability to have an additional mass filter nor the ability to do this with single mass resolution. This is important as the poster will demonstrate why both of these qualities are important. Instruments may have 3 quads, but if these quads are not mass filters they do not qualify as triple quads and thus they are the same as a single quad ICPMS.

Instruments that have a bandpass filter before the CRC (typically with a bandpass of 10 AMU) may be suffice for some applications (double charged, some interferences, some improvement in abundance sensitivity) however a bandpass filter does not have single mass resolution as a filter instead it has a window of masses that can be allowed into the cell, thus analyses with varying matrices, and multiple isotopes will not be useful with reaction gases like oxygen and ammonia.

## Experimental

The Agilent 8900 QQQ-ICPMS with its ability to do MS/MS technology was used to analyze Titanium, Vanadium, Scandium, and Cerium in product ion scan to show the importance of single mass resolution on analytes entering the cell. The analysis for V, Ti, and Sc was done in Ammonia mode the Cerium analysis was done in oxygen mode.

**Instrument Conditions**

| | |
|---|---|
| Scan Mode | MS/MS |
| RF Power (W) | 1550 |
| Sample Depth (mm) | 8 |
| Spray Chamber (C°) | 2 |
| Carrier Gas Flow (mL/min) | 1.0 |
| KED (V) | -5 |
| O2 Mode Flow Percentage (%) | 30 |
| NH3 Mode Flow Percentage (%) | 15 |

Fig 2. Agilent 8900 Instrumental Conditions

For the V, Sc, Ti product ion scan. 3 samples were made with single element spikes of 10 ppb of V, Sc, and Ti separately. V51, Ti48 and Sc45 were analyzed using the product ion scan capability on the 8900. This sets Q1 at a set mass (45 in the case of Sc) then scans the products of Sc45 with a reaction gas (NH3 in this case) from mass to mass 275. The purpose of this experiment is to show that without single mass resolution on the quadrupole prior to the cell issues can arise from reactive gases using bandpass technology.

For the Ce test, oxygen mode was used to demonstrate how various isotopes and mix standards (138,140,142 in this instance) can change isotopic abundance when using bandpass thus the need single mass resolution to do reactive chemistry interference removal with a mode like oxygen and its isotopes of 16,17,18.

## Results and Discussion

### Product Ion Scans

Only titanium 48 was reviewed in this instance but it has isotopes at 46,47,and 49 making the ability to determine what element or isotope is reacting around masses 83-85, 99-100, 111-119, and 127-133. Without full control of what enters the cell there is no way of telling what element or isotope is doing the reactions

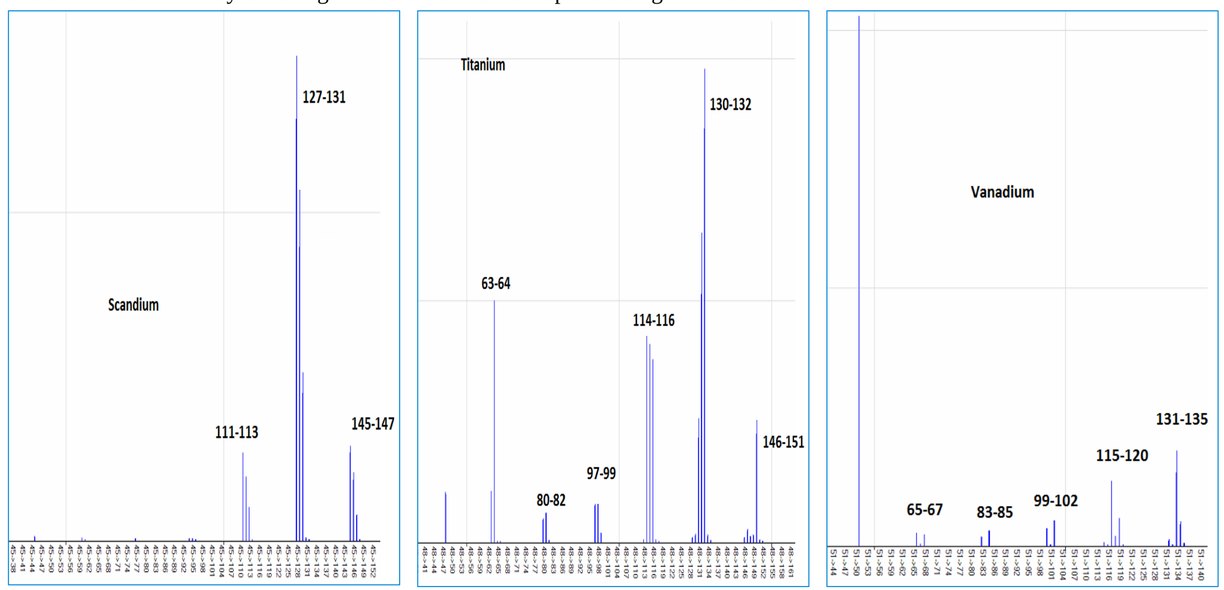
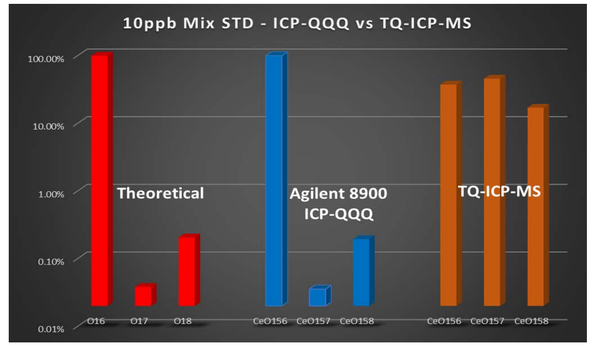



Fig 3. Product Ion Scans of Sc45, Ti48 and V51

## Results and Discussion

### Isotopic Abundance

10 ppb Mix Standard of Ce, Ba, La, Pr, and Nd was created and their oxides were monitored by single mass MSMS mode as shown in Figure 7. Figure 8 shows this mix in bandpass mode. As you can see the 8900 has a perfect isotopic template of oxygen with the theoretical value



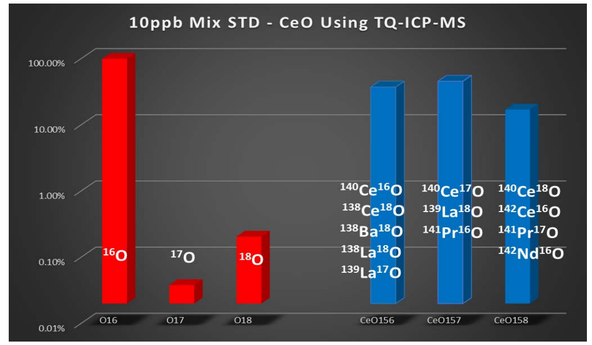




Fig 4. 10 ppb mix…Theoretical, 8900 and Bandpass

## Conclusions

In conclusion, the Agilent 8900 and its ability to completely control Quad 1 as a mass filter prior to the ions entry into the cell. Without this ability to do single mass resolution, non-target ions can enter the cell and reaction chemistry can produce unpredictable and false results on unknown and varying matrices.

The ability to do product ion scans, accurate isotopic analysis, improved abundance sensitivity, , low detection limits on difficult elements, consistent reaction modes put the Agilent 8900 ahead of all triple quads on the ICPMS market