Agilent 7800 Quadrupole ICP-MS

ORS⁴ AND HELIUM MODE FOR MORE EFFECTIVE INTERFERENCE REMOVAL IN COMPLEX SAMPLES

Benefits of helium mode

- Helium is inert, so no new reaction product ion interferences are formed
- Helium does not react with analyte ions, so loss of sensitivity by reaction does not occur
- Helium is effective against all polyatomic overlaps, so method development is simple, and accurate multi-element analysis is possible in complex matrices

Reaction mode

Collision/Reaction Cells (CRCs) in ICP-MS can operate as reaction cells (when a reactive gas is used) or as collision cells (when an inert gas is used). While the hardware used for these two approaches is similar, the mode of operation is very different.

With a reactive cell gas, interference removal is based on the relative reaction rates of the cell gas with the analyte and interfering ion. To choose which reactive gas should be used, the interference must therefore be identified, which means the matrix composition must be known in advance. Reaction mode is also typically only effective against one specific interfering ion.

However, in most applications the sample matrix is unknown, variable, and often complex, so multiple polyatomic ions may interfere at each analyte mass. Under these circumstances, reactive cell gases will lead to serious analytical errors:

- Each reaction gas only reacts with specific interferences; unreactive interferences remain, leading to errors.
- Reaction gases create new cell-formed reaction product ions causing new, matrix-dependent polyatomic interferences.
- Reaction gases react with some analyte ions, leading to severe signal loss and poorer detection limits.

With an inert cell gas, interference removal is mainly by kinetic energy discrimination (KED). This process works because polyatomic interferences are molecular ions, and so have a larger ionic cross section than analyte (single atom) ions at the same mass. Polyatomics collide more often with the cell gas and lose more energy, and so can be prevented from passing into the analyzer by applying a KED bias voltage at the cell exit.

The key benefits of collision mode are that it can remove multiple interferences on multiple analytes, no new polyatomic interferences are produced regardless of the sample matrix, and selective analyte signal loss by reaction does not occur.

The 4th generation Octopole Reaction System (ORS^4) used in the Agilent 7800 ICP-MS is optimized for high performance in helium (He) collision mode. The ShieldTorch System provides a narrow initial ion energy spread, and the small internal volume, octopole-based ORS^4 cell maintains high ion transmission at the high cell gas pressure needed for effective KED.

He mode in the ORS^4

Figure 1 compares the effectiveness of the different cell modes for the removal of multiple interferences on the 1st row transition elements, in a blank matrix mix containing 5% HNO_3, 5% HCl, 1% H_2SO_4 and 1% IPA. All spectra are shown on the same intensity scale. In no gas mode (Figure 1, top) the complex polyatomic interferences created in this matrix mix are obvious. In H_2 reaction mode (Figure 1, middle) some (unreactive) polyatomics remain, and several new ones are created. By contrast, He mode (Figure 1, bottom) effectively removes all the polyatomic interferences in this complex matrix. High sensitivity is maintained in He mode, as shown by the inset spectrum of a 10 ppb spike measured under the same conditions.

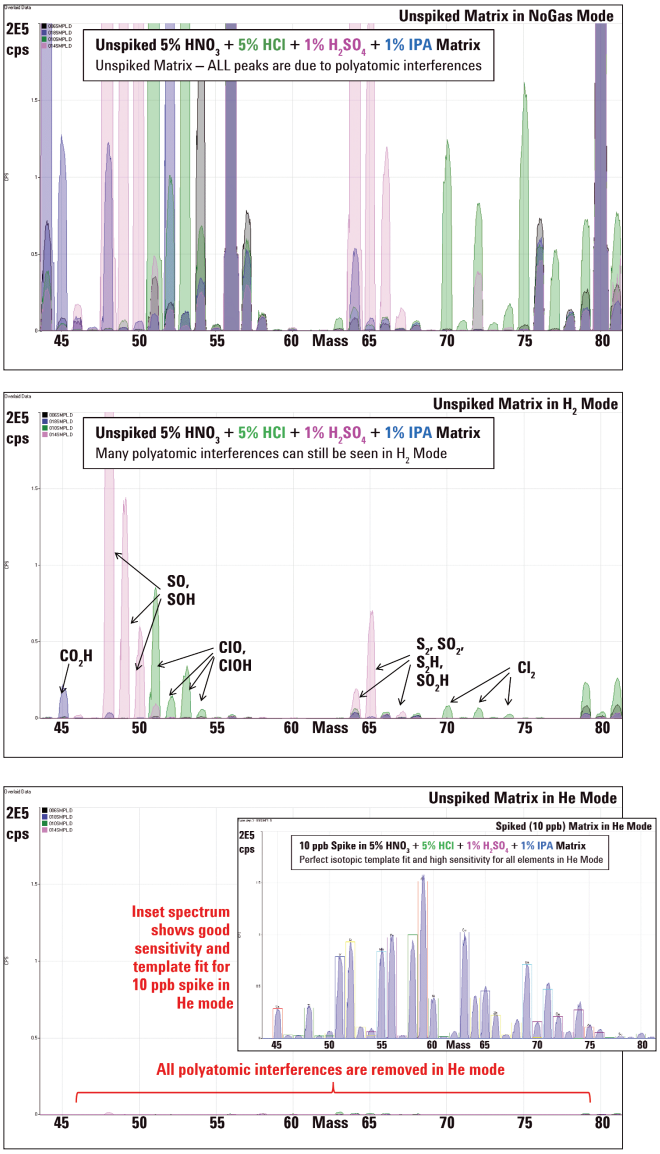

Figure 1. Mixed matrix blank in no gas, H_2 and He mode (inset: Same matrix with 10 ppb spike in He mode).

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