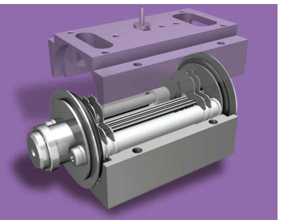
7700 ORS³ and Helium Mode

More effective interference removal in complex samples



Collision or Reaction Mode

Collision/Reaction Cells (CRCs) in ICP-MS can operate either as reaction cells (when a reactive gas is used) or as collision cells (when an inert gas is used). Since the first commercial CRC ICP-MS systems were introduced 10 years ago, the relative performance of these two approaches has been the subject of intense debate.

With a reactive cell gas, interference removal is based on the relative rates at which the selected reaction gas reacts with the analyte and interfering ion pair. In order to select which reactive gas should be used, the interference must therefore be identified in advance, which means the matrix must be known, relatively simple, and consistent.

In some applications (e.g. semiconductor process chemicals) these criteria are met, and reaction mode can be used successfully. However, in most applications the sample matrix is unknown, variable, and often complex. Under these circumstances, reactive cell gases will lead to serious analytical problems:

- Each reaction gas will only react with certain interferences; unreactive interferences will remain, leading to errors.
- All reaction gases will create some new polyatomic ions (cell-formed product ions) causing new, matrix-dependent interferences.
- Reaction gases react with some analyte ions, leading to severe signal loss for some analytes, degrading detection limits.

With an inert cell gas, interference removal is mainly by kinetic energy discrimination (KED). This process works because polyatomic interferences are by definition molecular ions, and 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 fixed KED bias voltage.

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 3rd generation Octopole Reaction System (ORS³) featured in the Agilent 7700 Series ICP-MS has been developed to give the highest performance in helium (He) collision mode. This requires an extremely narrow initial ion energy spread (delivered by the ShieldTorch System), and the capability to maintain high ion transmission at the high cell gas pressure needed for effective KED (provided by the small internal volume, octopole-based ORS³ cell).

Helium Mode in the ORS³

Figure 1 illustrates the relative performance of different cell modes for the removal of multiple interferences on the 1st row transition elements. No gas mode (top), H_2 reaction mode (middle) and He mode (bottom) spectra are shown for the same matrices (5% HNO_3, 5% HCl, 1% H_2SO_4 and 1% IPA), on the same intensity scale. The complex polyatomic interferences created in this matrix mix are evident in the no gas mode spectra shown in Figure 1 (top).

Figure 1 (middle) shows that H_2 reaction mode leaves some residual overlaps, and creates several new ones. By contrast, Figure 1 (bottom) confirms that He mode 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.

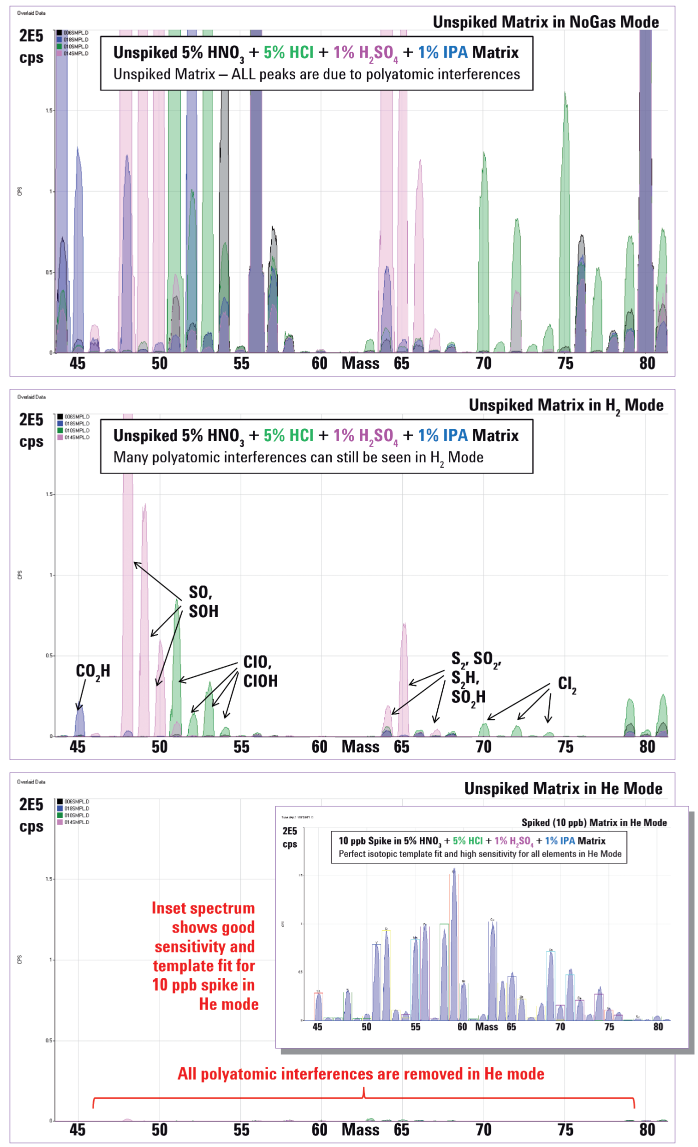


Figure 1. Mixed matrix in no gas, H_2 and He mode (inset: with 10 ppb spike)

For more information on the 7700 Series ICP-MS visit the Agilent Technologies web site at: www.agilent.com/chem/icpms