Enhanced Helium Mode Cell Performance

for Improved Interference Removal in ICP-MS

Helium Collision Mode in ICP-MS

Helium (He) mode with kinetic energy discrimination (KED) is accepted as the preferred mode for effective and reliable removal of mulitple polyatomic interferences in CRC (Collision/Reaction Cell) ICP-MS. While reactive cell gases may be very effective at removing individual interferences from individual analyte isotopes, they are unable to simultaneously remove all the interferences that occur in real-world applications, where the sample composition is often unknown, complex, or variable.

However, a few elements have previously still required the use of reactive cell gases for the best detection limits. A good example is the low-level analysis of Se, where a reactive gas (typically H_2) was required in order to give single ng/L (ppt) detection limits.

Enhanced Helium Mode Performance in the ORS^3

The 3rd generation Octopole Reaction System (ORS^3) introduced in the Agilent 7700 Series ICP-MS has significantly improved interference removal performance in He mode, as a result of the following unique cell design innovations:

- A longer, higher frequency octopole, increasing the collision rate
- Higher cell gas flow rates for higher cell pressure
- Higher bias voltage and greater collision energy

The combined effect of these developments is illustrated in Figure 1, which compares the residual ion energy overlap for the previous design of Agilent ICP-MS CRC (ORS^2) and the new cell used on the 7700 (ORS^3). The ORS^3 provides a much smaller overlap between the residual energies of the analyte ions (^{78}Se, in green) and the interfering ions (Ar_2, in red), with the result that KED at the cell exit provides more effective separation of the analyte from the polyatomic interferences.

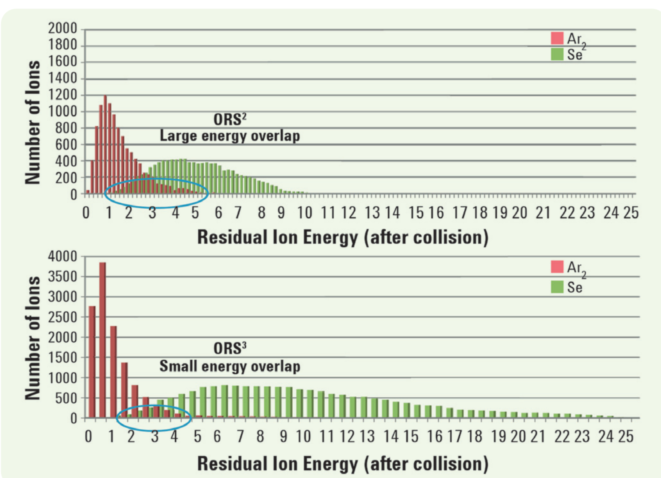

Figure 1. Comparison of analyte/polyatomic ion separation with ORS^3 cell on the 7700 (bottom) compared to previous ORS^2 cell (top)

An additional benefit of ORS^3 He mode on the 7700 Series is that the higher collision energy provides collisional dissociation of some polyatomic ions, as the energy of the polyatomic ion's collision with the cell gas is higher than its bond energy.

Again, the Ar_2 interference on Se is a good example, as shown in Table 1, where the collision energy of Ar_2 in the ORS^3 (4.88eV) is higher than the bond dissociation energy of Ar_2 (1.33eV).

	Ecm (1st collision) [eV]
Ar_2 Bond Dissociation Energy	**1.33eV**
Normal Collision (Ei=20eV)	**0.98 (<1.33)**
ORS^3 Collision (Ei=100eV)	**4.88 (>1.33)**

Table 1. Center-of-Mass Collision Energy (Ecm) at normal and ORS^3 ion energies, leading to collision induced dissociation (CID) with ORS^3

The combination of collisional dissociation and the enhanced separation of residual kinetic energy means that the background equivalent concentration (BEC) for ^{78}Se is significantly reduced (to around 2 ng/L (ppt)) with the ORS^3, as shown in Figure 2.

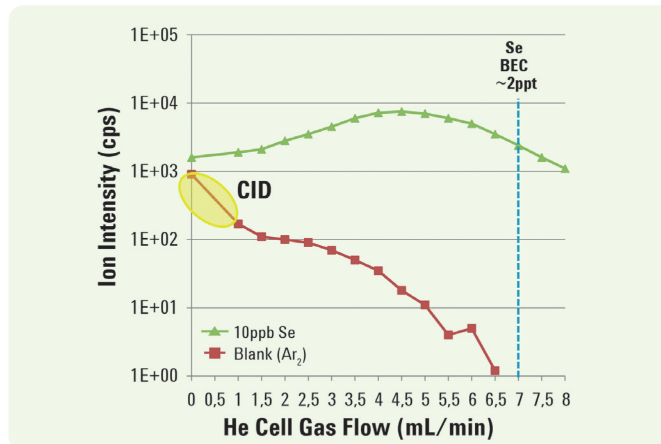

Figure 2. He cell gas optimization plot, showing Ar_2 dissociation (CID)

The He mode performance available with the ORS^3 is remarkable, as illustrated for Se, where the detection limit is improved from about 150 ppt (ORS^2) to <5 ppt (ORS^3 – Figure 3). Detection limits for S, P and Fe are also improved with ORS^3, eliminating the need for reactive cell gases in many applications.

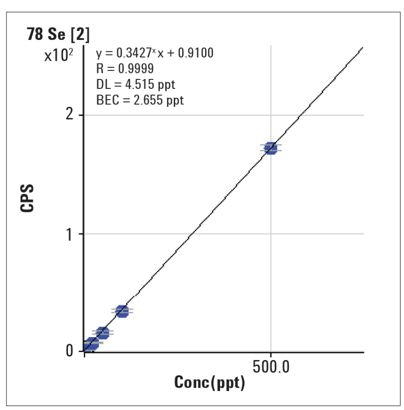

Figure 3. Calibration for ^{78}Se in ORS^3 He mode (DL 4.5 ppt; BEC 2.7 ppt)

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