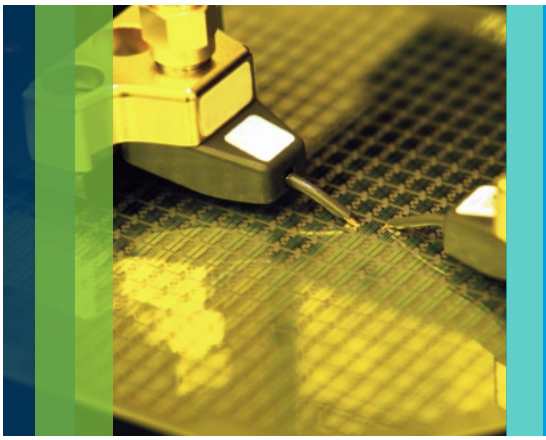

Agilent 7900s ICP-MS for Semiconductor Applications

Technology brief

Agilent is a leading supplier of ICP-MS systems to the semiconductor industry with a choice of single and triple quadrupole ICP-MS systems to address any application and budget. Benefits of Agilent systems include:

- High transmission off-axis ion lens giving high sensitivity, low random background, and ppt or sub-ppt DLs
- Flexible collision/reaction cell operation, combining the most efficient helium mode and optional reactive cell gases.
- Reliable, high performance cool plasma operation—pioneered by Agilent—enables ICP-MS to address all required analytes in semiconductor applications
- Reduced cleanroom setup costs due to compact, benchtop instrument design and efficient venting of waste heat
- Fully stainless-steel chassis with cleanroom-ready shipping preparation ensure fast installation and minimize contamination
- A low-flow, inert sample introduction system, available for all Agilent ICP-MS systems, reduces contamination and handles very small sample volumes
- Agilent applications expertise in the analysis of high-purity chemicals and high-performance materials supports semiconductor laboratories worldwide

Agilent ICP-MS in the semiconductor industry

When the ICP-MS technique was developed in the 1980s, it was of great interest to semiconductor manufacturers and chemical suppliers due to its high sensitivity, low detection limits, and multielement capability. The use of ICP-MS for semiconductor applications increased rapidly in the 1990s, with the release of the Agilent HP 4500. This instrument included an innovative off-axis "Omega" ion lens and "cool plasma" capability. These innovations improved detection limits and enabled ICP-MS to measure critical trace elements Na, K, Ca, and Fe, which previously required graphite furnace AAS.

Working closely with users in the semiconductor industry, Agilent has continuously improved the ICP-MS technique. In 2012, Agilent released the first triple quadrupole ICP-MS, the Agilent 8800 ICP-QQQ. The 8800 and its successor, the Agilent 8900s ICP-QQQ, have become the industry standard approach for analyzing ultra trace contaminants in the highest purity semiconductor process chemicals and raw materials.

Agilent has also continued to refine and improve conventional (single quadrupole) ICP-MS instruments. The semiconductor configuration Agilent 7900s ICP-MS is ideally suited to the analysis of typical semiconductor process chemicals where the ultimate performance of the Agilent 8900 ICP-QQQ is not required, as illustrated overleaf.

Figure 1. Compact, cleanroom-ready, benchtop Agilent 7900s ICP-MS provides high sensitivity and flexible modes for interference control.

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Agilent 7900s performance for trace element analysis in semiconductor process chemicals.

The Agilent 7900s quadrupole ICP-MS combines high performance with easy cleanroom installation and proven reliability. With an efficient, low flow sample introduction system, Pt-tipped interface cones, and high transmission ion lens, achieving low detection limits has never been easier. To resolve polyatomic overlaps on interfered elements, the 7900s includes the ORS^4 collision/reaction cell with He cell gas line. Up to two further reaction cell gas lines can be added, for applications that benefit from reaction gases, such as H_2, O_2, and NH_3.

Semiconductor process chemicals such as ultrapure water (UPW), hydrogen peroxide (H_2O_2), nitric acid (HNO_3), hydrochloric acid (HCl), and hydrofluoric acid (HF), have low and consistent levels of matrix. This makes them suitable for analysis using cool plasma, which provides a powerful and complementary approach to collision and reaction cell modes. The Agilent 7900s has the flexibility to switch cell gas and plasma modes during the analysis, providing high performance for all analytes and matrices.

The ppt level calibration for potassium (K) in 20% HCl, shown in Figure 2, illustrates the high sensitivity and effective interference control of the 7900s. The combination of cool plasma and NH_3 reaction mode controls $^{37}Cl^1H_2$ and $^{38}Ar^1H$ interferences to deliver excellent performance for this difficult analyte. The sub-ppt detection limit (0.4 ng/L, ppt) and background equivalent concentration (BEC, 0.5 ppt) are exceptional for ICP-MS.

When analyzing volatile samples such as IPA, ammonium hydroxide (NH_4OH), and TMAH, the 7900s' maintenance-free, solid state, digital drive, 27 MHz RF generator ensures stable, reliable operation. Figure 3 shows the excellent long-term stability achieved when directly analyzing 20% NH_4OH spiked at 100 ppt.

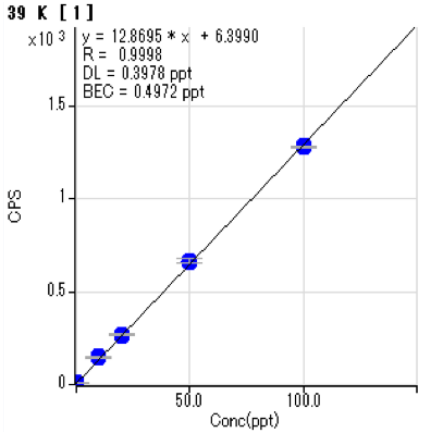

Figure 2. Calibration at ng/L (ppt) level for K in 20% HCl using cool plasma and NH_3 reaction cell gas mode.

Conclusion

The Agilent 7900s quadrupole ICP-MS offers a high-performance solution for laboratories analyzing typical semiconductor chemicals.

The 7900s is proven, robust, and flexible. The instrument is supported by a worldwide network of Agilent ICP-MS experts with decades of experience in semiconductor industry applications. The 7900s provides a cost-effective alternative to the Agilent 8900 ICP-QQQ, easily meeting the needs of most routine semiconductor laboratories.

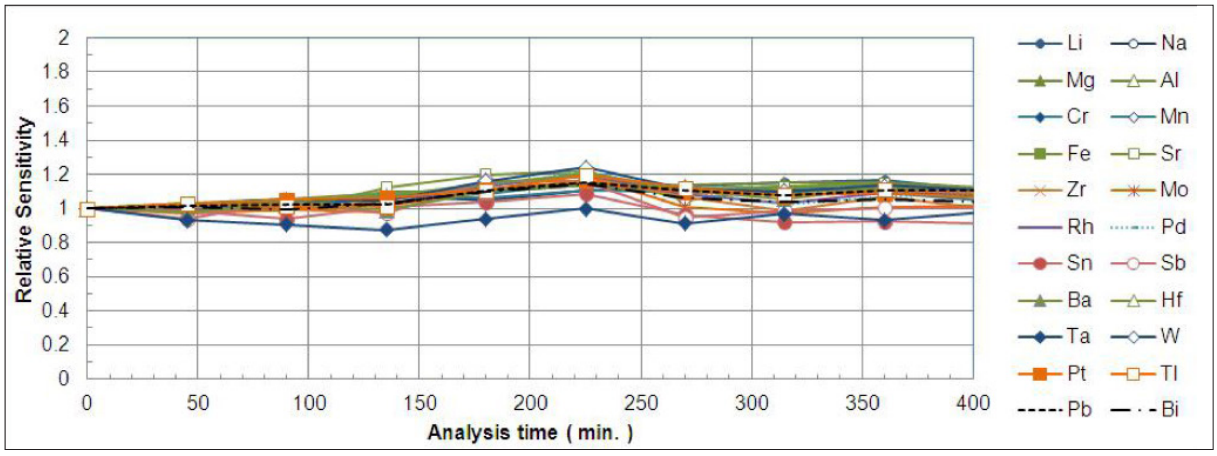

Figure 3. Long-term stability (almost 7 hours) for multiple elements spiked at 100 ppt in 20% NH_4OH analyzed directly.

Learn more:

www.agilent.com/chem/icpms

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