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Water Technologies & Solutions

Sievers* UPW Boron Analyzer

ready for the resource revolution

suez

Continuous, online monitoring of part-per-trillion levels of boron

overview

The revolutionary Sievers* UPW Boron Analyzer is the first on-line instrument to enable continuous, unattended online monitoring of part-per-trillion levels of boron in deionized (DI) ultrapure water (UPW) applications. Sievers developed this patented UPW Boron Analyzer in cooperation with semiconductor manufacturers. As the dimensions of the semiconductor components continue to shrink, colloidal silica is becoming increasingly critical to remove from semiconductor UPW. The most valuable use of this analyzer is to minimize and control the leakage of colloidal and ionic silica from ion removal processes like mixed-bed ion exchange and electronic deionization (EDI) to improve chip yield. Additionally, it is used to control the deionization process to meet the ITRS 0.050 ppb boron limit in semiconductor UPW. It is designed specifically to meet the needs of facility managers, DI water engineers, and fab process engineers.

On-line Performance

Possessing the part-per-trillion sensitivity of ICP/MS[1] (Figures 1 and 2), the Boron Analyzer ensures the effective control of silica and boron, compliance with primary and polish loop boron specifications, and the minimization of colloidal and ionic silica. At up to ten analyses per hour, facility managers can protect against upset conditions that would go undetected with ICP/MS or other laboratory analysis methods.

Process Optimization

Numerous published articles[1-5] identify boron as the best indication of mixed-bed ion exchange resin exhaustion for the effective removal of both silica and boron. At the point of measurable increase in silica concentration, boron breakthrough has typically been underway for a prolonged period of time, causing significant exposure to processes that may be sensitive to boron. The Boron Analyzer was specifically designed to better predict mixed-bed exhaustion, allowing the optimized control of both silica and boron levels in the final polish UPW system. The Analyzer is successfully being used to increase the lifetime of the polish loop mixed-bed ion exchange to save operational expenses.[4]

Evolution

Driven by the contamination control needs for colloidal silica in today's fabs and the cost savings associated with prolonged resin life, boron control is becoming the keystone of state-of-the-art water quality management programs worldwide. One method to measure colloidal silica is by the use of a nonvolatile residual monitor (NRM) which measures both colloidal and ionic silica in UPW. In the case where the ionic silica is removed from the UPW, the NRM is an effective colloidal silica detector.

Figure 3 demonstrates the use of the Boron Analyzer as a tool to prevent the release of colloidal silica from a depleting mixed-bed ion exchange resin bed.[5,7] Note the collidal silica jump (see the NRM signal) shortly after boron began leaking from the bed, even though there was no reactive silica in the output. When the NRM jumped, the online silica (measuring the ionic silica) did not change. Because the Boron Analyzer detects an

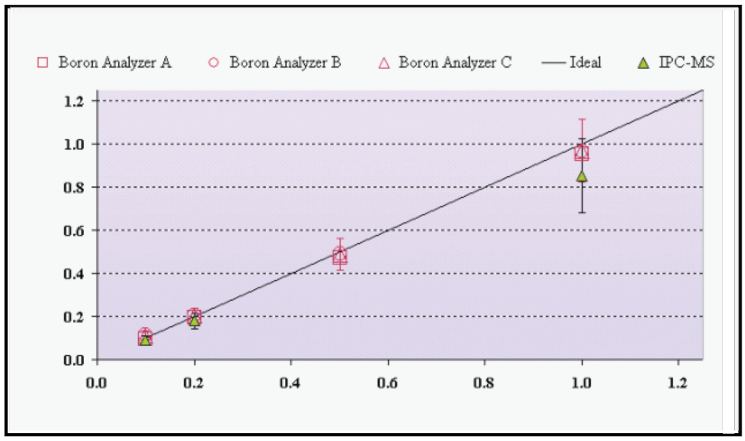


Figure 1. Comparison of low-level boron accuracy using the Boron Analyzer and ICPMS

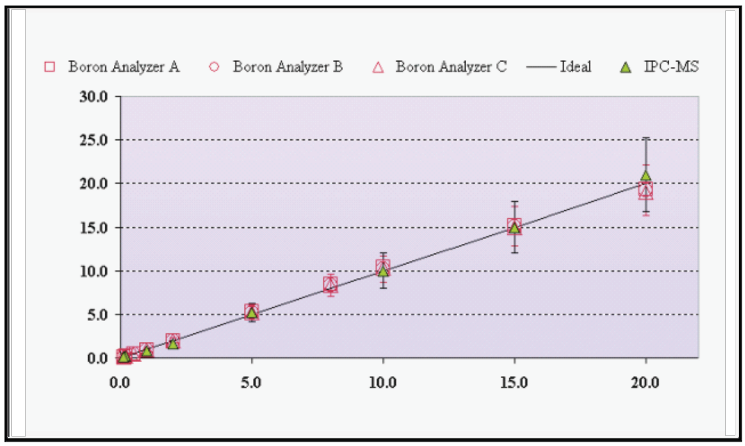
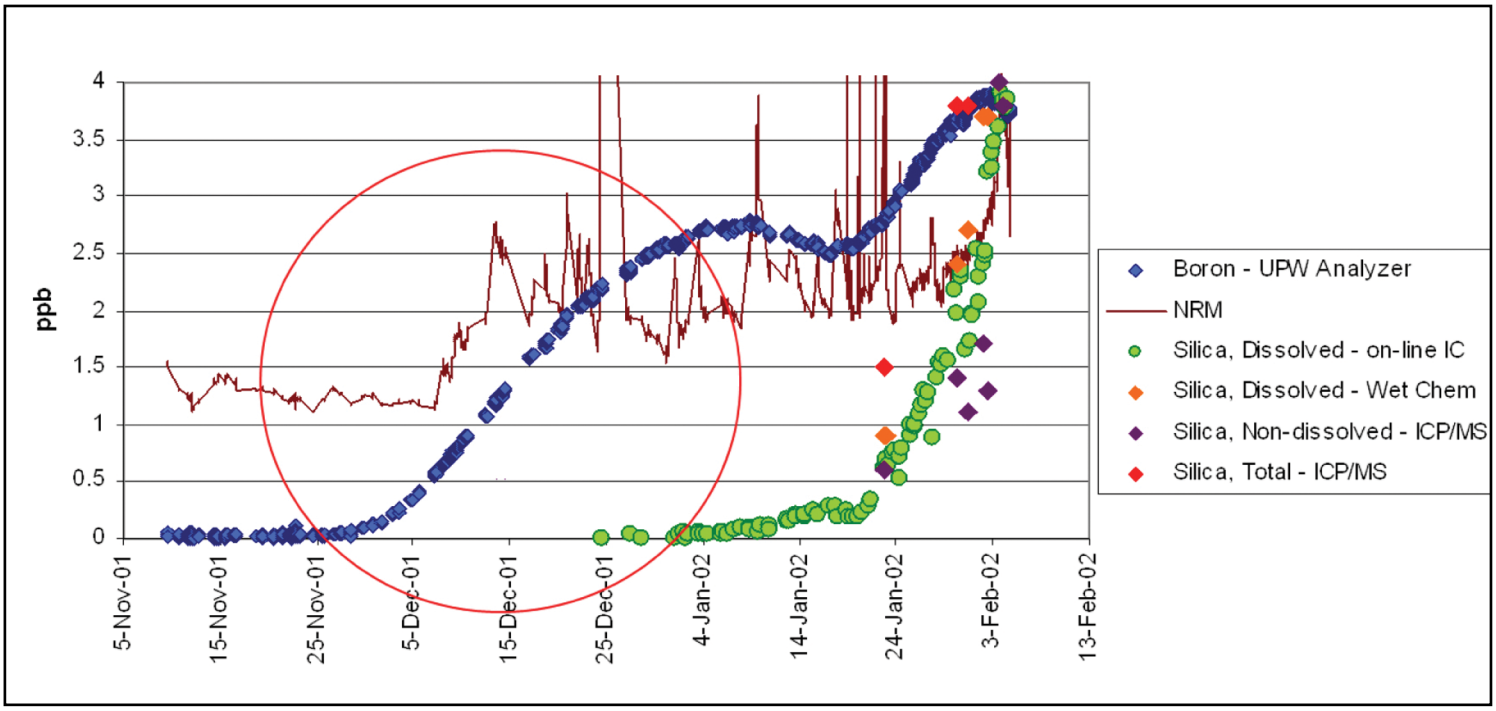


Figure 2. Comparison of high-level boron accuracy using the Boron Analyzer and ICPMS



increase in boron prior to the collidial silica increase, it can be used to prevent the leakage of colloidal silica into your ultrapure water. Only the Sievers UPW Boron Analyzer provides the means to significantly advance the quality and management of ionic silica, colloidal silica, and boron in ultrapure water ion exchange systems.

applications

Semiconductor Ultrapure Process Water

The Boron Analyzer's analytical performance exceeds that typical of ICP/MS, while providing on-line, continuous analysis. Continuous boron analysis is used to prevent DI leakage of weak acids, weak bases, silica, and colloidal silica particles.

Ultrapure Water Power Applications

Effective management of mixed-bed deionizers is critical to preventing costly downtime and repairs due to silica build-up in turbines and boilers.[6] The Boron Analyzer acts as a predictive tool to completely prevent silica breakthrough at the end of the ion exchange system operating cycle.

features

Multi-Stream Options

Available in one, two, three, or four stream configurations, the Boron Analyzer monitors up to four sample streams sequentially.

Part-Per-Trillion Sensitivity

Measures boron in the range of 0.015 to 20 ppb.

Extensive Suite of Outputs

The Boron Analyzer includes four isolated 4–20 mA outputs, one isolated RS-232, one universal parallel printer port, two alarm outputs, and four isolated binary outputs.

system specifications

operation	
Concentration Range	0.015 to 20 ppb
Limit of Quantification (LOQ)	0.05 ppb
Limit of Detection (LOD)	0.015 ppb
Accuracy	± 0.01 ppb < 0.07 ppb; ± 15% ⩾ 0.07 ppb
Precision	± 3% or 0.005 ppb, whichever is greater
Minimum Sample Resistivity	15 MW-cm
Sample Temperature	15–40° C
Sample Flow Rate	0.05–0.5 L/min
Ambient Temperature	10–40° C
Sample Pressure	20–100 psig (138-689 kPa)
Calibration Stability	Typically stable for 12 months
Sample Particulates	15 micron sample pre-filtration
Waste	Gravity drain

instrument	
Normal Operating Environment	Intended for indoor use only
Inputs	5 isolated binary inputs
Outputs	4 isolated 4-20 mA outputs; 1 RS-232 (isolated); 1 universal
	parallel printer port; 2 alarm outputs; 4 isolated binary outputs
Dimensions	21.1 H x 17.4 W x 13.1 D inches (54 x 45 x 34 cm)
Weight	48 lbs (22 kg)
Safety Certification	ETL

consumables	
Boron Reagent	90 days at 5 samples/hour; 45 days at 10 samples/hour
Reagent Column	12 months
Zero Column	12 months

References

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3. Sushma Malhotra (AMD), Otto Chan (AMD), Theresa Chu (Balazs Analytical), and Agota Fusko (Balazs Analytical), *"Correlation of Boron Breakthrough versus Resistivity and Dissolved Silica in a RO/DI System,"* Ultrapure Water, pp. 22-26, Vol. 13, No. 4, 1996.
4. Wickham, R. (IDT), Godec, R. (Sievers Instruments), *"Controlling Boron Levels in Semiconductor UPW using an Experimental On-Line Boron Analyzer,"* Semicon-ductor Pure Water and Chemicals Conference, Proceedings, pp 15-33, 2001.
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6. Dunn, R., *"New Analytical Technique Promotes Elimination of Silica in Feed, Steam and Condensate Systems,"* Presented at International Water Conference, Pitts-burgh, PA, October 2002.
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Hg The UV lamp inside this product contains mercury and must be recycled or disposed of in accordance with local, state, and federal laws.

ISO 9001:2008 QUALITY MANAGEMENT SYSTEM

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