

U6000AT+ Application Note

Analysis of Isopropyl Alcohol (IPA) using Ultrasonic Nebulization with Membrane Desolvation and Quadrupole ICP-MS Detection

Trace element measurement in organic solvents such as isopropyl alcohol (IPA) is an important application in the semiconductor industry. Inductively coupled plasma mass spectrometry (ICP-MS) offers parts per trillion (ppt) and sub-ppt detection limits for many elements, but introduction of volatile organic solvents can present a number of problems: plasma instability and/or failure, carbon buildup on the sampling interface, and solvent-based mass spectral interferences.

The CETAC U6000AT+ Ultrasonic Nebulizer / Membrane Desolvator removes most of the IPA solvent during analyte transport to the ICP-MS instrument, allowing stable plasma operation. The CETAC BGX-100 Blend Gas Accessory is used to add a low-flow of oxygen (approx. 10 mL/min) between the U6000AT+ and the ICP-MS; this prevents any buildup of carbon on the ICP torch. A block diagram below shows the experimental setup.



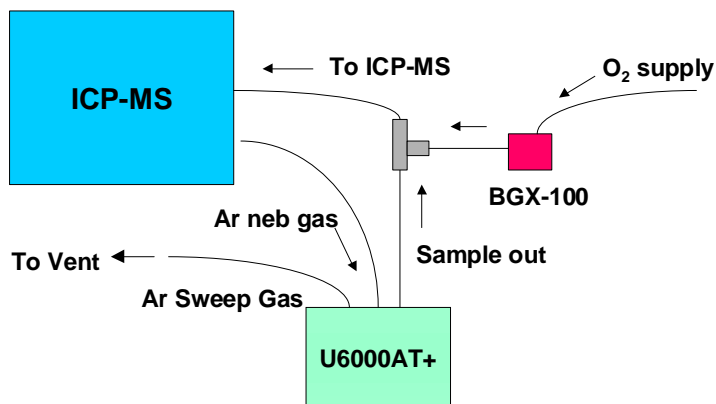
Operating Conditions

ICP-MS: PerkinElmer ELAN 9000
Plasma power: 1350 W
Nebulizer gas: 0.57 L/min
Integration time: 3.0 s

CETAC U6000AT+:
Heater temp: 140°C
Cooler temp: -10°C
Membrane oven temp: 160°C
Sweep gas flow: 2.00 L/min
Uptake rate: 1.0 mL/min
Inlet pump tubing: Tygon®
Oxygen rate (BGX-100): 10 mL/min

Tygon is a registered trademark of Saint Gobain Performance Plastics

Block Diagram



Detection Limits

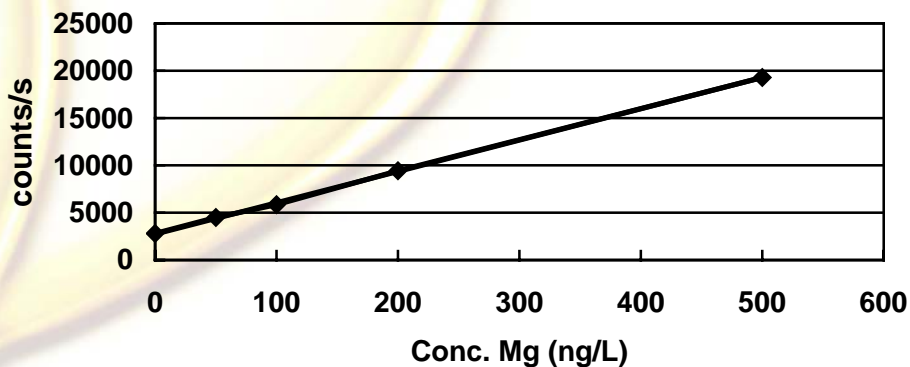
Instrument detection limits (IDLs) with the U6000AT+ and ICP-MS were obtained for 16 elements. These include Mg and Cr, which suffer from severe carbon-based interferences (C_2^+ and $ArCH^+$) at $m/z = 24$ and 53 , respectively. A high-purity grade of IPA was spiked with a known amount of Conostan S-21 organometallic standard for the detection limit determinations (based on 3σ). IDLs are all in the ppt to sub-ppt range and were obtained under non-cleanroom conditions.

Element	m / z	IDL ($\mu\text{g/L}$)	Element	m / z	IDL ($\mu\text{g/L}$)
Mg	24	0.005	Cu	63	0.006
Al	27	0.01	Zn	66	0.05
Ti	48	0.005	Mo	95	0.001
V	51	0.02	Ag	107	0.0003
Cr	53	0.06	Cd	111	0.001
Mn	55	0.0003	Sn	118	0.001
Fe	56	0.030	Ba	137	0.002
Ni	60	0.03	Pb	208	0.0006

Calibration

Calibration curves were run for low levels of Mg and Cr spiked into a high-purity IPA matrix. Note the much reduced backgrounds at $m/z = 24$ and 53 . Correlation coefficients for both curves are excellent: 0.9997.

Mg Calibration in IPA; $m/z = 24$



Cr Calibration in IPA; $m/z = 53$

