Using a Desolvating Nebulizer System with Inductively Coupled Plasma Mass Spectrometry: Key Optimization Parameters

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Abstract

Multicollector ICP-MS instruments are very specialized devices for high precision isotope ratio measurements. For useful measurement of low abundant isotopes and mass-limited samples, signal enhancement is often required. In addition, sample preparation and/or sample aerosol desolvation may be necessary to reduce or eliminate mass spectral interferences such as oxides and hydrides.

This poster will examine key optimization parameters of a desolvating nebulizer system for high and stable analyte signals with lowest backgrounds. Experimental parameters such as nebulizer gas flow, argon sweep gas flow (outside the membrane desolvator), nitrogen addition gas (post membrane), and ICP-MS ion optic voltage settings will be examined. In addition, setup of the sweep gas outlet line and trap bottle will be discussed in relation to minimization of localized condensate buildup.

Instrumentation - I

Figure 1. Aridus II Desolvating Nebulizer System

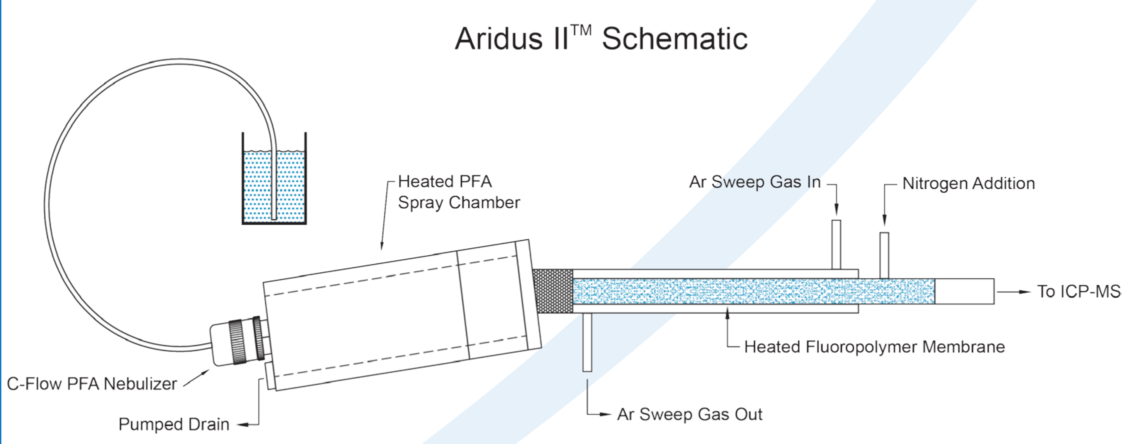


Figure 2. Aridus II System Schematic

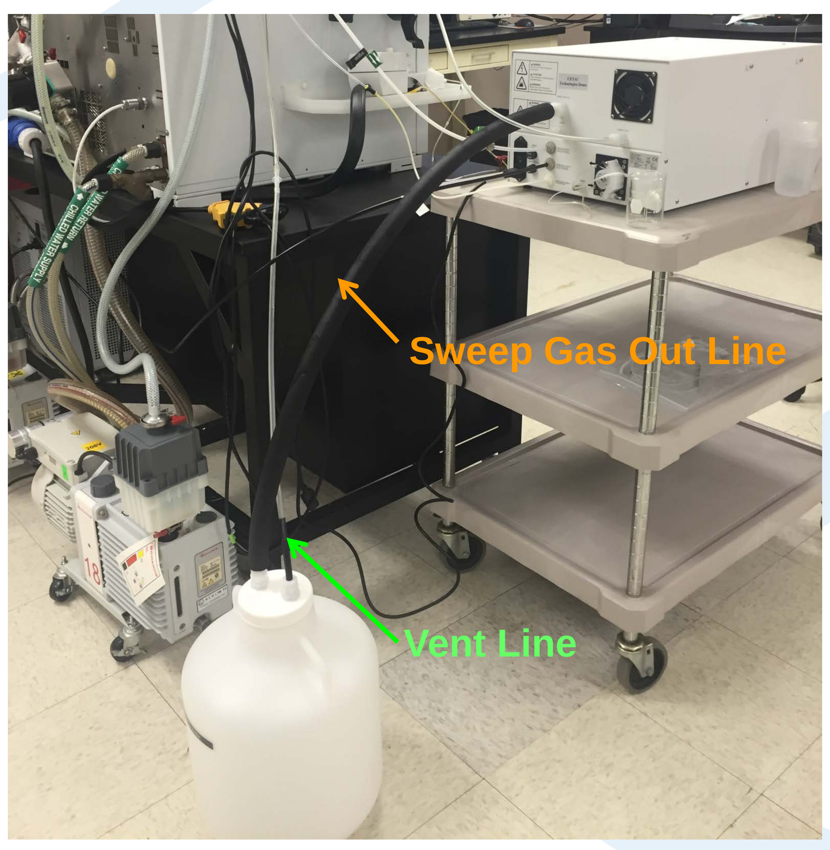


Figure 3. Aridus II Trap Bottle Placement

Notes: Trap bottle is placed below level of the AridusII, with the insulated sweep gas out line curving downward to allow drainage of any condensed liquid; vent line from trap bottle goes directly up (no bends or flat areas) to exhaust source.

Instrumentation - II

Figure 4. Thermo Neptune MC-ICP-MS & Teledyne CETAC AridusII Desolvating Nebulizer System

Figure 5. Argon Sweep Gas Control Knob

Note: Locking ring can be removed, allowing higher Ar sweep gas flows up to 9 L/min or greater.

Operating Conditions

Thermo Neptune MC-ICP-MS Conditions:

ICP Power	1200 W
Coolant Gas	15 L/min
Auxiliary Gas	0.7 L/min
Sample Gas	0.9 L/min
Interface	Jet Type
Extraction	-2000 V
Focus	-609 V
X-Defl.	7.61 V
Y-Defl.	0.02 V
Shape	193.00 V
Rot Quad 1	0.01 V
Source Offset	-10.00 V

Teledyne CETAC AridusII Conditions:

PFA Nebulizer	Aspire 100
Uptake Rate	100 µL/min
Spray Chamber Temp	110°C
Membrane Oven Temp	160°C
Ar Sweep Gas	9.75 L/min
N_2 Addition Gas	6 mL/min

Suggested Tuning Steps

1. Set the Ar sweep gas flow to 2.00 L/min and the N_2 flow to 000 (zero) before starting the ICP-MS plasma.

2. Start the ICP-MS plasma and set the PFA nebulizer gas flow to 1.00 L/min.

3. Introduce a tuning solution (ex. 1 ppb) containing elements such as Co, Y, In, Ce, and Pb to the AridusII.

Suggested Tuning Steps

4. Increase the Ar sweep gas flow until the Ce signal stops increasing and the %CeO/Ce ratio begins to go over 0.1%. A typical Ar sweep gas range is 4 to 9 L/min.

5. With the %CeO/Ce ratio at 0.1%, slowly add the N_2 addition gas. A typical N_2 range is from 3 to 12 mL/min (shows as 003 to 012 on the readout display). Add the N_2 until the analyte signal increase begins to level off or slightly decreases.

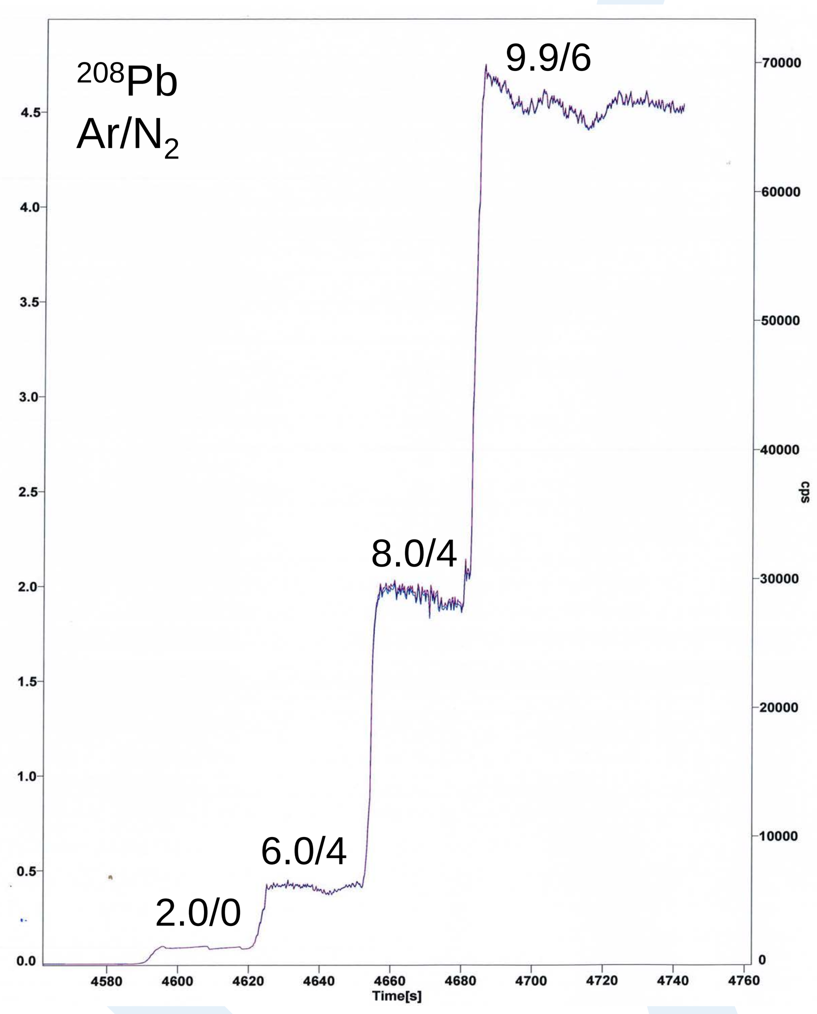
6. Adjust the Ar sweep gas flow (usually downward) until the %CeO/Ce ratio is at 0.1% or less. Often the analyte signal (ex. In, Ce) will increase slightly after the Ar sweep gas is adjusted.

7. Optimize the ICP-MS torch xyz sampling position for highest analyte signal.

8. Optimize the ICP-MS ion optics for highest analyte signal.

9. Adjust the PFA nebulizer gas flow rate for highest signal and lowest oxides. The Ar sweep gas and N_2 addition gas may be fine tuned for best signal and lowest oxides; the %CeO/Ce will typically be 0.05% or less.

Ar Sweep Gas / N_2 Tuning Scan



Reference

G.L Scheffler and D. Pozebon, Advantages, drawbacks, and applications of mixed Ar-N_2 sources in inductively coupled plasma – based techniques: an overview, Anal. Methods, 2014, 6, 6170-6182.

Acknowledgement

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