TECHNICAL NOTE

Atomic Absorption

HGA Graphite Furnace AA – Automatic Matrix Modification for Improved Analytical Quality and Sample Throughput

The matrix modification technique is a very important feature in the concept of interference-free trace metal determinations. Applying this technique, the chemical forms, and thereby the physical properties, of the element under study and/or the matrix can be changed by adding a suitable reagent in excess to the sample and standard reference solutions.

Matrix modification

- Decreases the volatility of the analyte element and prevents its loss during thermal pretreatment. This also allows application of higher pretreatment temperatures for better matrix removal.

- Increases the volatility of matrix components and promotes their removal before atomization. PerkinElmer furnace autosamplers feature automatic matrix modification with the ability to apply one or more matrix modifiers sequentially or simultaneously.

The following tables provide detailed information on how to prepare the most common matrix modification solutions.

Table 1. **HGA Graphite Furnace: Matrix Modifiers for Routine Applications.**

Modifier	Major Application	Absolute Mass Required	Stock Reagents Required	Working Solutions (for a 5-µL modifier addition)	
				Preparation	Concentration
Pd + $Mg(NO_3)_2$	Ag, As, Au, Bi, Cd, Cu, Ga, Ge, Hg, In, Sb, Se, Sn, Te, Tl[a]	15 µg Pd + 10 µg $Mg(NO_3)_2$	1% (10 g/L) Pd* + 1% (10 g/L) Mg **	Dilute 3 mL of Pd stock solution and 0.3 mL of Mg stock solution to 10 mL with 18 MΩ deionized water.	0.3% (3 g/L) Pd + 0.2% (2 g/L) $Mg(NO_3)_2$
$Mg(NO_3)_2$	Al, Be, Co, Cr Fe, Mn, V, Zn	50 µg $Mg(NO_3)_2$	1% (10 g/L) Mg**	Dilute 1.7 mL of Mg stock solution to 10 mL with 18 MΩ deionized water.	1.0% (10 g/L) $Mg(NO_3)_2$

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Table 1. **HGA Graphite Furnace: Matrix Modifiers for Routine Applications, cont.**

Modifier	Major Application	Absolute Mass Required	Stock Reagents Required	Working Solutions (for a 5-µL modifier addition) Preparation	Concentration
$NH_4H_2PO_4$	Pb for D_2 background correction	200 µg $NH_4H_2PO_4$	Use either: **A:** 10% (100 g/L) $NH_4H_2PO_4$ liquid*** or **B:** solid ultrapure $NH_4H_2PO_4$ **Caution:** do not use $(NH_4)_2HPO_4$	**A:** Dilute 4.0 mL of $NH_4H_2PO_4$ stock solution and 10 mL with 18 MΩ deionized water: or **B:** Dissolve 0.4 g $NH_4H_2PO_4$ in 18 MΩ deionized water and make up to 10 mL.	4.0% (40 g/L) $NH_4H_2PO_4$
$NH_4H_2PO_4$ + $Mg(NO_3)_2$	Pb, Cd for Zeeman background correction	For Zeeman technique, use 200 µg $NH_4H_2PO_4$ together with 10 µg $Mg(NO_3)_2$	Use either: **A:** 10% (100 g/L) $NH_4H_2PO_4$ liquid*** + 1% (10 g/L) Mg** or **B:** solid ultrapure $NH_4H_2PO_4$ + 1% (10 g/L) Mg** **Caution:** do not use $(NH_4)_2HPO_4$	**A:** Dilute 4.0 mL of $NH_4H_2PO_4$ stock solution and 0.3 mL of Mg stock solution to 10 mL with 18 MΩ deionized water. or **B:** Dissolve 0.4 g $NH_4H_2PO_4$ in 18 MΩ deionized water and add 0.3 mL of Mg stock solution and make up to 10 mL.	4.0% (40 g/L) $NH_4H_2PO_4$ + 0.2% (2 g/L) $Mg(NO_3)_2$

[a]*TI = with Zeeman background correction only.*

Table 2. **HGA Graphite Furnace: Matrix Modifiers for Special Applications.**

Modifier	Major Application	Absolute Mass Required	Stock Reagents Required	Working Solutions (for a 5-µL modifier addition) Preparation	Concentration
Pd + $Ca(NO_3)_2$	P	20 µg Pd + 5 µg $Ca(NO_3)_2$	1% (10 g/L) Pd* + Ca (1 g/L)****	Dilute 4 mL of Pd stock solution and 2 mL $Ca(NO_3)_2$ to 10 mL with 18 MΩ deionized water	0.4% (4 g/L) Pd + 0.1% (1 g/L) $Ca(NO_3)_2$
Use either: **A:** 95% Ar + 5% H_2 or	Halide matrices (e.g., NaCl)	Used as an alternate internal gas during dry and pyrolysis steps	None		
B: HNO_3		NA	Ultrapure conc. HNO_3	To 80 mL 18 MΩ deionized water, add 20 mL conc. HNO_3 For a 10-µL modifier addition	20% (v/v) HNO_3
CH_3OH HF HNO_3	Boric acid matrix	10 µL CH_3OH + 0.2 µL conc. HF + 0.2 µL conc. HNO_3	CH_3OH + conc. HF + conc. HNO_3	10 mL CH_3OH + 200 µL conc. HF + 200 µL conc. HNO_3 and mix all	

* *Part No. B0190635*

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Note: 1% Mg corresponds to 6% $Mg(NO_3)_2$ or 10.5% $Mg(NO_3)_2 \cdot 6H_2O$
1 µg $Mg(NO_3)_2$ corresponds to 0.17 µg Mg or 1.75 µg $Mg(NO_3)_2 \cdot 6H_2O$

*** *Part No. N9303445*

**** *Part No. N9300108*

Note: 1% Ca corresponds to 4.09% $Ca(NO_3)_2$ or 5.89% $Ca(NO_3)_2 \cdot 4H_2O$
1% µg $Ca(NO_3)_2$ corresponds to 0.24 µg Ca or 1.44 µg $Ca(NO_3)_2 \cdot 4H_2O$

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