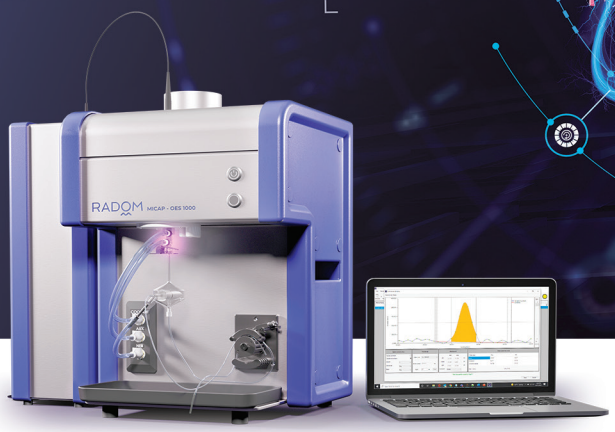
RADOM™

Reimagine Plasma



MICAP™- OES 1000 Case Study

Better than Atomic Absorption

Radom Corporation is a global leader in advanced plasma technologies, providing sustainable and innovative plasma solutions for industries including analytical instrumentation, clean tech, and hydrogen generation. The core technology is CERAWAVE™.

Our products and instruments lead to safer processes, faster performance, and the reduction of pollution with the promise of continuing to detoxify our earth.

Cerawave™

Revolutionary Technology

The CORE in all we do.



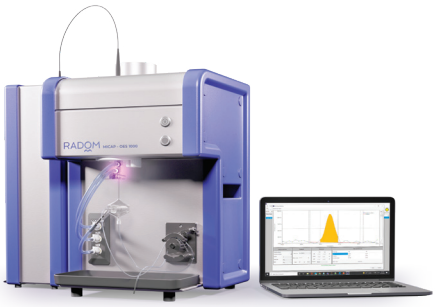
Advantages of
MICAP - OES 1000

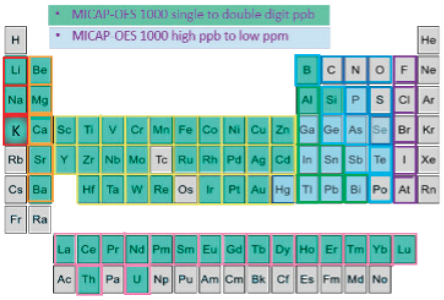
01 **Advantages over Flame AA**

02 **MICAP Product Description**

03 **Experimental Examples**

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01

MICAP-OES 1000 Advantages over Flame AA

- Safer by eliminating the need for combustible gases and potential for flashback.
- No optimization of fuel/oxidant ratios, burner height or rotation which can be subjective to individual users.
- Simultaneous elemental measurements in less than 3 minutes/sample (3 replicates).
- Full wavelength spectrum analysis and simultaneous measurement
- Library of interference minimization, result confirmation and expansion of elemental fingerprint information
- Less expensive to operate:
  - Less sample preparation – extended linear range better detection limits.
  - Less chemistry – no sample modification.
  - Less consumables required – no hollow cathode lamps.
- Box to Bench - User installable, standard 3 year warranty

02

MICAP-OES 1000 Product Description

Most trace metal analyses are performed on single element analysis flame atomic absorption or argon plasma emission spectrometer techniques. Radom Corporation evolved the technology to Microwave Inductively Coupled Atmospheric Plasma – Optical Emission Spectrometer which removes the traditional pain points associated with commercial instruments sold today. The MICAP-OES is a nitrogen inductively coupled plasma and research grade echelle spectrometer. This equates to less expensive full spectrum analysis using, nitrogen gas.

The plasma temperature is approximately 5,500°C which supplies energy to sufficiently ionize most elements on the periodic table.

The independent plasma source is coupled to an echelle based, research-grade spectrometer via a fiber optic connection. The plasma is viewed axially with auto-optimized plasma tail removal. The optimized viewing position is ensured with the torch alignment system. The entire echelle spectrum (194nm to 625nm) is simultaneously captured with each replicate measurement.

The application software, RIS (Radom Intuitive Software) is supplied pre-loaded on a Dell Laptop.

03

Experimental Examples

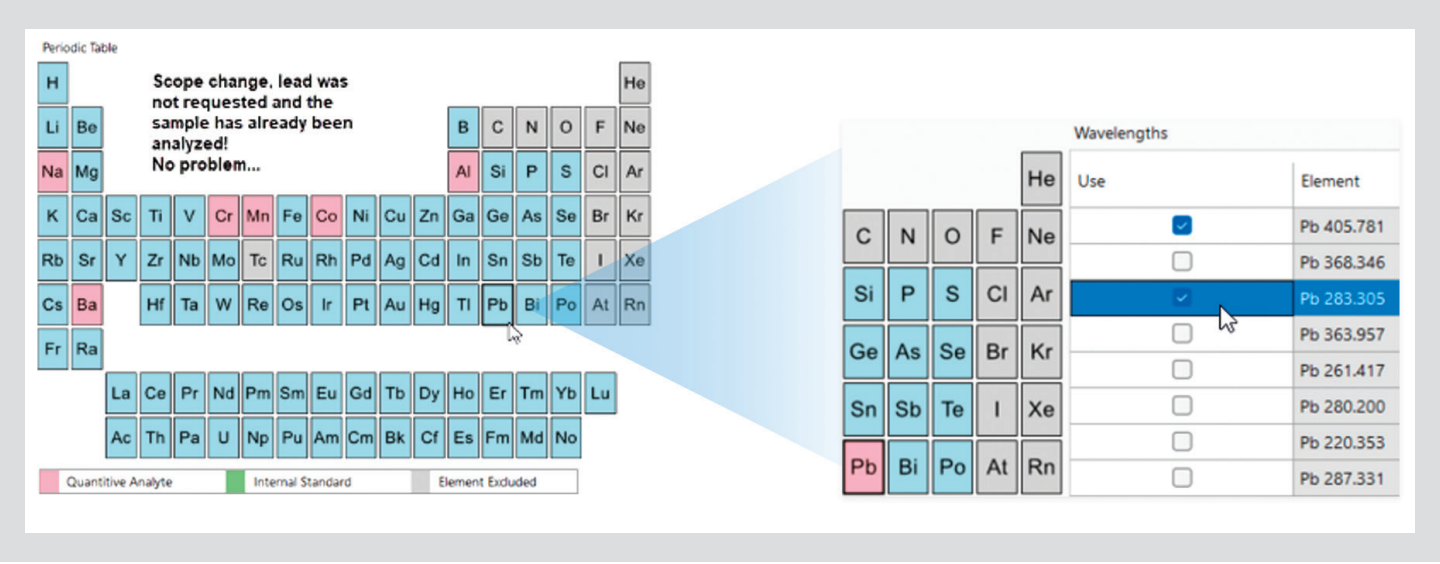
MICAP-OES 1000 provides maximum flexibility to select multiple elements and multiple wavelengths without adding to the analysis time. In less than 3 minutes, all target elements and confirmatory wavelengths are determined.

Inadvertent omission of an element in the method or your client changes scope of target element requested? Is the sample in analysis or already analyzed?
NO PROBLEM. Simply add the element/wavelength during or after the analysis session without repreparing/ reanalyzing the sample.

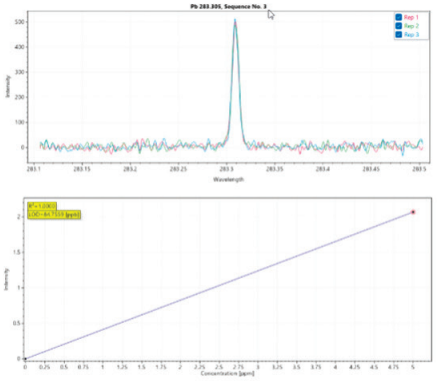
No need to reprepare and repeat the analysis!

Example, customer forgot to request lead for the sample analysis. Simply edit the method during or after the analysis and select the desired wavelength.

Customer satisfaction without additional sample handling or re-analysis.



Sample Name	Sample Type	Mn 259.372 [p...	Mn 403.076 [p...	Na 588.995 [p...	Na 589.592 [p...	Pb 283.305 [p...	Pb 405.781 [p...
IV-RADO...	Standard 1	0.000	0.000	0.000	0.000	0.000	0.000
IV-RADO...	Standard 2	5.000	5.000	5.000	5.000	5.000	5.000
IV-RADO...	Sample	4.963	5.017	5.029	5.046	5.186	5.040
IV-RADO...	Sample	5.071	5.013	4.978	4.989	5.103	5.143
IV-RADO...	Sample	4.981	4.851	4.905	4.919	4.934	4.910



Test Example - Beryllium

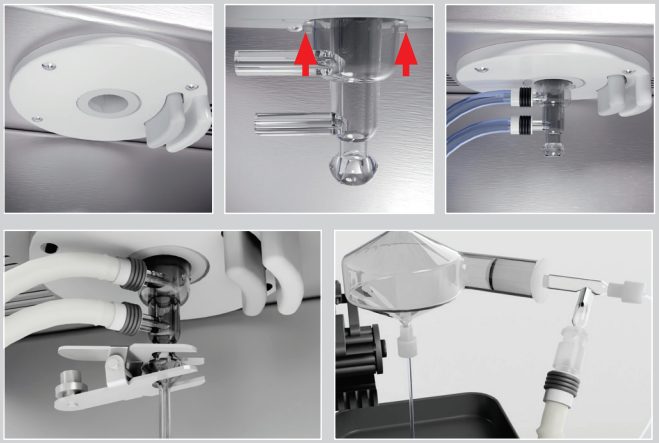
Flame AA Conditions

Nitrous oxide/Acetylene flame
5 cm burner
Critical burner height and fuel/oxidant ratio optimization required to minimize interferences. (user subjective)
Wavelength 234.9 nm
Optimum working range 0.04 ppm to 4.0 ppm

MICAP-OES 1000 Conditions

Nitrogen Plasma with industry standard sample introduction components. Easy installation and no optimization required. Standard aqueous condition sets with less than 18L/min nitrogen used. Axial viewed plasma for maximum sensitivity.

- Easy and Reproducible no optimization or alignment required
- Industry Standard Torch configuration
- Flexible spray chamber and nebulizer options attach to the ball-joint of the torch



No sample dilution necessary, choose multiple wavelengths.
Flexible element selection, never reanalyze a sample again

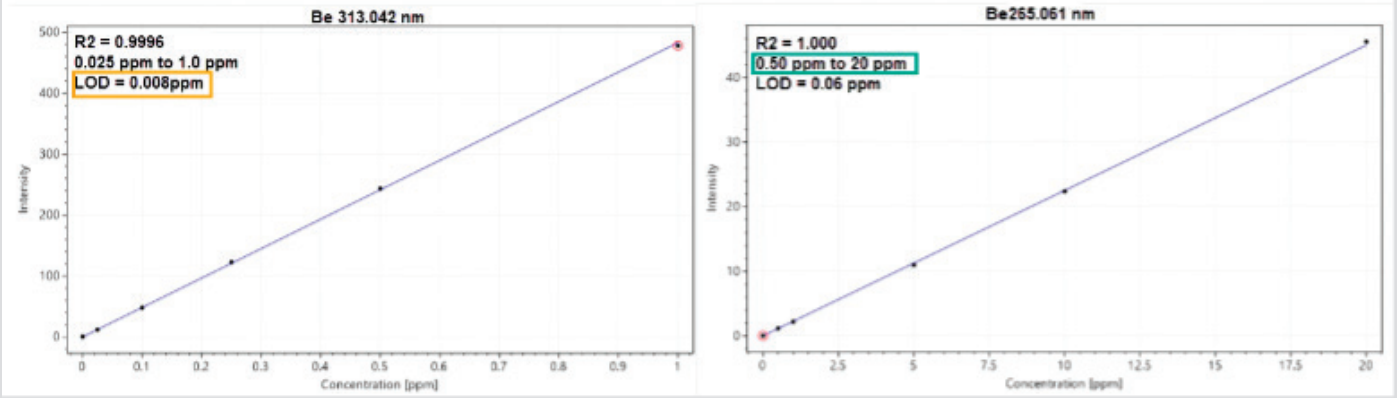


Figure 1. MICAP-OES 1000 Beryllium from 0.025 ppm to 20 ppm, LOD of 0.008 ppm

MICAP-OES 1000 provides an elemental fingerprint and result confirm for unknown samples without adding additional analysis time or preparation time.

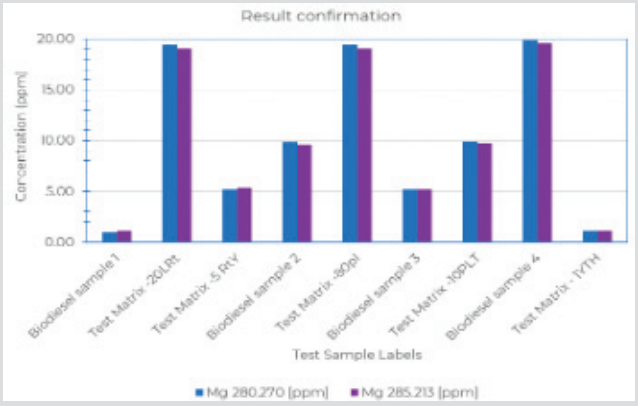


Figure 2. Test Sample Results Measured for Magnesium at two wavelengths. RPD 2% for Result Comparison

04

Time and Cost Advantages

Flame AA/element cost considerations:

Flame AA analyses are very quick, typically less than 40 secs/sample. However, the instrument is capable of only one element determination at a time. Therefore, for the 6 elements required, the analyst will introduce 20 samples to the instrument 6 times. Also, with all elemental techniques, a calibration curve and quality control samples are required. Typically, 20 unknown sample session will require 35 test solutions to be analyzed.

In addition, the 6 target elements require very different flame conditions (burner changes) multiple fuel/oxidant ratio condition sets, sample preparations and standard curve preparations.

Flame AA
Analysis time Considerations

Number of elements = 6
Number of Solutions = 35
Time per sample analysis for 3 replicates (secs) = 40
Burner/Fuel/Lamp optimization and warmup time (minutes) = 30 minutes
Sample preparation time (minutes) = 20

Total time for 6 elements (some elements required chemical modification during preparation)

Preparation Time (6 elements) = 2 hours
Instrument Setup/warmup time (6 elements) = 3 hours
Analysis time 6 elements (hours) = 2.5 hours

Six elements for 20 Test solutions cannot be completed in one typical 8 hour shift.

- No result confirmation
- Linear range is extended with manual dilution
- Client need changes may not be possible if the flame components are not available. Sample will be reprepared and reanalyzed.

MICAP-OES 1000
Analysis time Considerations

Number of Elements = 6
Number of Solutions = 35
Analysis Time (hours) = 1.5
Plasma warmup time (minutes) = 20
Sample preparation time (minutes) = 20
Total Time (preparation, warmup and analysis, hours) = 2.16

No special instrument optimization or sample/standard preparation requirements.

The entire spectrum is captured from 194 nm to 625 nm.

- Result confirmation
- Better sensitivity
- Linear range extension
- Add elements during or after analysis!

Flame AA Considerations for Analysis

Parameter	Cost Example	Frequency of consumption	
Gases		Assume 4 to 6 hours/day (1,560 hours)	
Acetylene	8.33	@ 2L/min air - 17 cylinders @ 5L/min N2O	$4,845.00
Nitrous oxide	4.08	@ 10L/min – 23 cylinders	$1,840.00
Air	7.58	15 gallon ($1,125.00)	
Filtration system	Air filter/water separator	One time cost $240.00	$32.00
	Air inlet filter	Annually	
Consumables			
Hollow Cathode Lamps Excess tubing	$300.00 to $500.00	Annually	$1,800 to $2,200
Chemical Modifiers			
Releasing Agent Lanthanum Chloride	$642.50/4 L 5% wt/vol	Annually	$625.50
Ionization suppressant			
Strontium chloride, potassium	$290.00 1L (20,000 ppm)	Annually	$250.00
Chloride	$106.00 1L (20,000 ppm)		
Cesium chloride	$1,150.00 1L (10,000 ppm)		
Electricity	$0.16/kW	1kW of power	$249.60
Total annual expense*			**$9,741.00**

*Table does not include labor costs for multiple standard and sample preparations but should be considered based on the test model above

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This information is subject to change without notice.