DEVELOPMENT OF A NEW SEQUENTIAL ICP-AES

Yoichi HARADA
Seiko Instruments Inc., Oyama Plant, 36-1, Takenoshita, Oyama-cho, Sunto-gun, Shizuoka 410-13, JAPAN

Abstract
We have developed a new sequential ICP-AES with the main goal of automation and faster analysis, with a secondary goal of higher wavelength resolution.

Key word ICP-AES, New Instrument, High Resolution Automation, AI, Back Ground Correction.

Introduction
The abilities of Inductively Coupled Plasma Atomic Emission Spectrometer (ICP-AES) are fairly well established. We can try to improve the sensitivity with different attachments, but can select either the Furnace Atomic Absorption Spectrometer or the ICP-Mass Spectrometer. There is no great hope that there will be a large jump in accuracy. In this situation, as more ICP-AES are introduced to market, demands for ICP-AES become oriented towards easy operation, automation, and faster analysis.

We have developed a new sequential ICP-AES with the main goal of automation and faster analysis, with a secondary goal of higher wavelength resolution.

The main hardware specification are shown below.
1. Two identical monochromators (vacuum, 1 m)
2. Use of Artificial Intelligence (AI)
3. Automation of each area.

Automation
You can control items from the computer.
1. ON/OFF of Plasma
2. RF Power Control
3. RF Matching Control
4. Plasma Gas Flow Rate Control
5. Auxillary Gas Flow Rate Control
6. Carrier Gas Flow Rate Control
7. Wet/Dry Carrier Gas
8. ON/OFF of Purge Gas
9. Observation Heights
10. Width of Slits
11. Which Monochromator is Used
12. Voltage of Photomultiplier Tubes
Most of the conditions above can be modified for each element at sequential analysis.

Fig. 1 Block Diagram
Control of Analytical Conditions by Artificial Intelligence (AI)

You can use the AI for decision of analytical conditions. Summary of the algorithm is shown below.

Faster Analysis

1. Two monochromators are identical, and both have enough performance for ICP-AES. We can save up to half the analysis time by using the two monochromators simultaneously when compared to using only one.
2. By using Simultaneous BG Correction Method, we can reduce the time for integration of BG to zero.
3. Auto sampling device has a mechanism for fast introduction. It reduces time for introducing samples from the end of sample introduction tip to the nebulizer. Time reduced from 40 seconds to 5.

Because of improvements shown above, you can analyze sample of ten elements in 2 minutes.

Spectrometer

Vacuum. Focal length is 1 m. It is consists of two symmetrical monochromators.

Two monochromators are controlled individually, cutting time by up to one half.

From point of resolution and range of wavelength, you can choose from three types of gratings. 2400, 3600, 4320 (gr/mm)

Simultaneous Background Correction Method (SBGCM)

SBGCM is consist of the following three units.
1. Exit slit unit for signal. (Exit slit, Photomultiplier tube, Scanning mechanism)
2. Exit slit unit for BG
3. Half mirror

These three units are arranged as shown in the figures right. SBGCM are operated below.
1. Grating is set roughly.
2. Two exit slit units scan and measure wavelength profiles.
3. Two exit slits are set to peak position and BG position.
4. Integration of the analysis signal.

According to the above, we can reduce the time for integration of BG to zero and making analysis faster.

Analysis of Real Samples

We analyzed NBS SRM 1577 Bovine Liver and NIBS SRM No.1 Pepperbush as real samples.