

The Avio 220 Max ICP-OES: A Unique Double-Monochromator Optical System



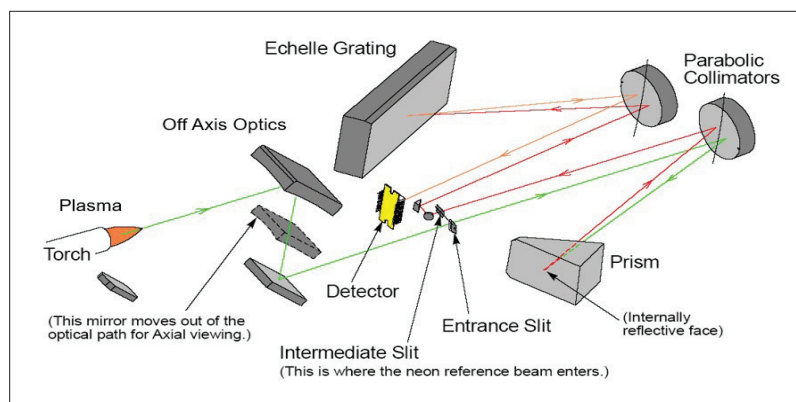
Introduction

PerkinElmer's Avio® 220 Max ICP-OES gains its outstanding analytical performance from its novel optical system, including a unique double monochromator, dual backside-illuminated charge-coupled device (DBI-CCD) detector, real-time dynamic wavelength stabilization for plug and play (cold start to sample analysis in 10 minutes), in line attenuation by wavelength, and automatic dual viewing of the plasma torch. It's the combination of these innovative components that provides the Avio 220 Max ICP-OES with:

- Excellent spectral resolution
- High analytical flexibility
- Lowest argon consumption
- Expanded linear dynamic range
- Reduced spectral interferences
- Maximum light throughput
- Exceptional analytical speed

Key Benefits:

- Fastest startup
- Better sensitivity
- Lower cost
- Simultaneous background correction
- Small footprint



The Avio 220 Max ICP-OES spectrometer's unique double monochromator.

Exceptional analytical speed

The unique CCD design concept of the Avio 220 Max ICP-OES yields an instrument of unparalleled analytical performance. This is possible with the Avio 220 Max ICP-OES because the two dispersing elements (the prism and the grating) typically are rotated less than ± 2 degrees to access any wavelength in the operating range. This small range of rotation and simultaneous acquisition of both components using high-speed, precision stepper motors yields extremely high analytical speeds while maintaining exceptional wavelength accuracy. The Avio 220 Max ICP-OES can accurately travel the extremes of its wavelength range, 165-900 nm, in less than three seconds.

Preselection monochromator

The Avio 220 Max ICP-OES uses a unique double monochromator to obtain fast simultaneous spectral acquisition, excellent resolution and high optical throughput. The first, or pre-monochromator, uses a CaF_2 prism with excellent UV transmission characteristics to disperse a single order of light. The pre-monochromator acts as a highly effective "filter," passing only a limited section of the spectrum, which contains the analyte wavelength, to the intermediate slit. The intermediate slit is the exit slit of the pre-monochromator and the entrance slit for a high-resolution echelle monochromator. The advantages of this approach, relative to conventionally designed, high-resolution echelle monochromators, are superior light throughput and reduced complexity.

High-dispersion echelle monochromator

The second monochromator is a high-dispersion system based on an echelle grating. The high performance echelle grating disperses the narrow spectral region provided by the pre-monochromator into its individual wavelengths, the image of which is optically matched to the custom-designed solid-state detector. This monochromator provides high dispersion using a large, high-efficiency echelle grating. It also provides excellent resolution with a compact focal length (0.3 m). By preselecting the spectral range that enters the second monochromator, there is no need to use the echelle grating in a cross-dispersed mode, eliminating the need for a larger, expensive array detector as used in simultaneous ICPs.

Minimized spectral interferences

Traditional systems achieved high resolution through the use of multiple overlapping orders. Invariably, this approach presents problems since peaks from multiple wavelengths can appear in the analytical window, and peak identification problems occur. Analytical reliability and productivity can suffer.

With the Avio 220 Max double-monochromator system and included off-axis optics, only the required analytical spectrum of interest is passed to the high-dispersion Echelle monochromator. This "filtering" effect minimizes order overlap and ghost peaks, and combined with extensive baffling and masking of all reflective surfaces, reduces stray light to exceptionally low levels for enhanced analytical performance.

Compact footprint, maximum light throughput

Since the order separation is carried out externally, i.e., prior to the echelle monochromator, the usable slit height is limited only by aberrations. Therefore, the Avio 220 Max ICP-OES can work with much larger slit heights than conventional systems, significantly increasing light throughput. This maximized light throughput and the high resolution provided by the short focal-length (0.3 m) echelle monochromator allows the Avio 220 Max ICP-OES to be among the smallest instruments with no sacrifice in performance. The compact monochromator design also provides much higher thermal stability. In addition, the exceptional wavelength stability of the Avio 220 Max is a benefit from PerkinElmer's use of dynamic wavelength stabilization, using a reference spectrum from a low-pressure neon discharge lamp to correct for any residual spectral shifts. The Avio 220 Max has a fast startup, allowing to go from cold start to sample analysis in 10 minutes, without worrying about spectral shifts in the warm-up process.

Expanded linear dynamic range

The Avio 220 Max ICP-OES provides attenuation mode, a unique mode to selectively reduce analyte signal, which allows higher concentrations to be measured, thereby extending the dynamic range of ICP-OES without affecting the ability to measure analytes present at lower concentrations. Attenuation mode will reduce the signal by $\approx 90\%$. Because the Avio 220 Max is a unique hybrid simultaneous instrument, attenuating the signal for a specified analyte will not affect others, thereby allowing both high and low concentration analytes to be measured in the same method.

Simultaneous background correction

The Avio 220 Max ICP-OES simultaneously measures a wavelength range around the analytical wavelength(s). Background correction can be automatically applied or freely selected within the range. No time-wasting peak search routine is required. Background correction readings are made at the same time as analyte measurements, which significantly improves analytical accuracy, precision and detection limits. The analytical performance achieved on the Avio 220 Max ICP-OES is unmatched.