TECHNICAL NOTE

ICP-Optical Emission Spectroscopy

Avio 500 ICP-OES Optical System and SCD Detector

The optimized optical system of the Avio® 500 ICP-OES centers on a unique high-performance solid-state detector – the Segmented-array Charge-coupled Device (SCD) detector. An echelle-based polychromator was designed to fully utilize the capabilities of the SCD. Using a PerkinElmer echelle grating optimized for UV performance and a unique Schmidt cross-disperser grating, the Avio 500 system has exceptional optical throughput and excellent resolution, providing you with superior detection limits and line selection.

Why an SCD? Flexibility, Simultaneity and Low Noise

PerkinElmer experts engineered patented detector technology with our SCD, which offers maximum flexibility providing thousands of emission lines with simultaneous background measurement. This technology was created specifically for plasma emission spectroscopy.

Superb UV quantum efficiency, dynamic range, and negligible read-out noise make it the ideal detector for the ideal spectrometer. This solid-state detector provides exceptional long-term performance and reliability. Each silicon-based detector consists of hundreds of discreet subarrays which have from 20 to 80 photosensitive areas or "pixels" per subarray. The subarrays are strategically positioned to take advantage of the best emission lines for all of the elements. The position and size of each subarray are engineered carefully to match each wavelength order produced by the echelle polychromator.

Next to each subarray on the detector are the output electronics for that subarray. The positioning of the electronics adjacent to the subarray provides extremely low readout noise, much lower than any other charge transfer device. This eliminates the time-consuming multiple readouts needed to reduce detector noise. Each subarray is individually addressed through the adjacent interface logic. This provides the capability to read any subarray without the necessity of reading out an entire detector, thereby reducing the analysis time.

The SCD detector, unlike many Charge-Coupled Devices (CCDs), is designed to prevent charge "blooming". "Blooming" occurs when a pixel fills up with electrons and the excess electrons spill into an adjacent pixel, much like an overfilled bucket. Should a pixel on the SCD exceed its capacity during an integration, the excess electrons flow into the output register where they are electronically swept away. For secondary protection, a guard band also surrounds each subarray. This anti-blooming design helps to ensure the integrity of your results.

The subarrays capture different portions of the wavelength spectrum at the same time, allowing simultaneous measurement of thousands of emission and background wavelengths. The peak emission and the spectral background are measured simultaneously (with user-selectable background parameters), reducing data-acquisition time and increasing your sample throughput. Analytical precision and detection limits are also improved, since simultaneous measurement of analyte and background can compensate for signal variations attributable to the sampling system.

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For the Better

The Avio 500 ICP-OES Optical Platform

Energy from the plasma enters the spectrometer and is focused on the entrance slit by two flat mirrors and two toroidal mirrors (Figure 1). The first toroid is computer-controlled and can be automatically positioned to optimize the plasma viewing position in the axial view. For radial viewing, a separate toroid moves into place of the first toroid and the shutter is moved into the radial viewing position blocking light from the axial view. The second toroidal mirror directs the plasma energy to the entrance slit and onto a flat mirror. The light then travels to a parabolic mirror, which collimates the energy onto the echelle grating, which separates the light into high dispersion, overlapping orders.

The next optical component, the Schmidt cross-disperser, serves three purposes. First, with dual-detector configurations, a hole in the center of the optic is used to split the light into separate UV and visible channels. Light passing through the hole is dispersed by the prism and is focused onto the surface of the visible wavelength detector. The energy reflected off the surface of the cross-disperser is sent through the UV channel. The use of separate UV and visible channels effectively doubles the detector area. This ensures there are no compromises in spectral range, resolution or energy throughput and that analyses at all wavelengths can be performed simultaneously.

The second purpose of the Schmidt cross-disperser is to serve as a grating that separates the light by order. The dispersed light is sent to the camera sphere optic and then onto the UV wavelength detector via the fold flat mirror, the size and shape of which are matched to the hole in the cross-disperser so that no energy is lost.

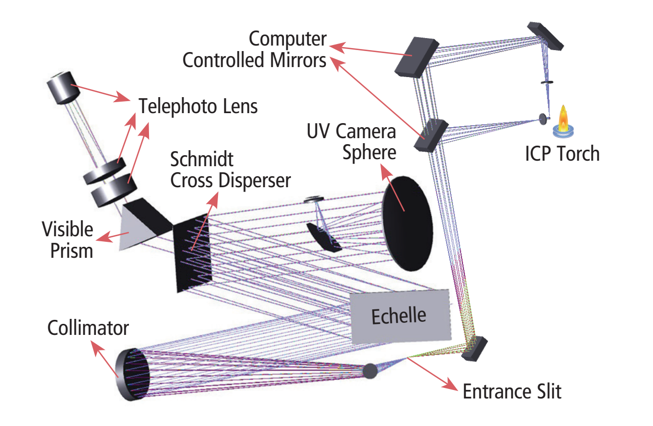

Figure 1. Avio 500 ICP-OES optical diagram.

The third use of the Schmidt cross-disperser is to optically correct for spherical aberrations, distortions of the optical image. By correcting for these aberrations, the Avio 500 spectrometer produces clean, sharp images at the detector for highest resolution. To provide long-term stability, the entire Avio 500 optical system is enclosed in a thermostatted housing. This isolates the optical system from the ambient environment and ensures exceptional wavelength stability. Better stability means better productivity, because less time is required for recalibration.

Exceptional Results, Fast

Even if you don't need to reach the trace detection limits that the Avio 500 ICP-OES provides, that power translates into improved precision, accuracy, and speed, supplying clearly better analytical results, faster. You can be assured that if your requirements change, you have a system that has the ability to grow with you.

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