SuperCell™

Enhanced Aerosol Transport

Introduction

Once a laser induced aerosol is generated it must be transported from the laser chamber to the ICP spectrometer. Though laser wavelength, fluence and pulse width determine the character of an aerosol generated by the coupling of photon energy to a sample surface; the dynamics associated with transporting the aerosol to an inductively coupled plasma will have a significant effect on all subsequent data. In this note we describe a unique cell design capable of dramatically shortening the resonance time of the laser aerosol within the sample chamber. This is accomplished without reducing the lateral dimensions of the cell, enabling larger samples to benefit from rapid sample cell washout.

Background

Sample chambers designed for laser ablation have traditionally had large, cylindrical volumes (20cc to 80cc). The driving force behind these large volume designs is primarily based on the desire to fit many samples (and standards) in the cell at one time, enhancing analytical throughput. Under normal operating conditions the carrier gas flow through these cells range from 0.5L min^{-1}. to 1.5L min^{-1}. per minute (8cc to 25cc $sec.^{-1}$). For these conventional sample cells the time required for complete evacuation of an aerosol generated by a single laser pulse is > 6 seconds.

Cell geometry, and the method of carrier gas injection and evacuation (e.g. injector and exit tube diameter, and number) effect the flow dynamics within the cell chamber, increasing or decreasing sample mixing within the cell and extending or contracting the time to complete aerosol evacuation (Fig. 1).

Figure 2: SuperCell installed onto the Universal Platform stage
Switching from the standard cell to the SuperCell™ is completed in < 5 minutes. This can be accomplished without changing the state (shutting off) the Spectrometer's ICP.

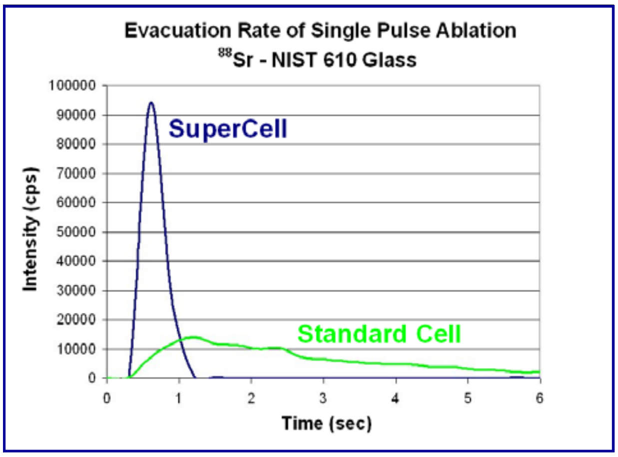

Figure 1: Comparative evacuation plots for ^{88}Sr in NIST 610 glass
Due to a design that optimizes sample cell geometry and gas flow dynamics the evacuation rate of the SuperCell is significantly enhanced compared to a conventional, high efficiency cell.

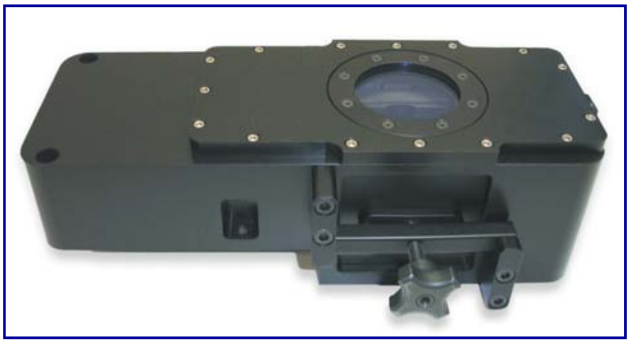

Figure 3: SuperCell rugged, flexible design
The SuperCell™ is compatible with all Universal Platform systems (UP-266, UP-213, UP-193HE and UP-193 Solid State).

NEW WAVE™ RESEARCH

A recent study (Bleiner et al 2001) has suggested that the greatest effect on aerosol density is the volume of the sample cell. Exit tube length and tube ID (inside diameter) also play a lesser role.[1] However in this study the reduction in sample cell volume was primarily accomplished by a reduction in sample cell diameter. Though the results were significant, reducing the volume of the cell in the lateral dimension (diameter) limits the size and number of samples that may be analyzed at one time. They also reported that as the diameter of the cell is increased, the flow characteristics induced by a single gas injector, becomes increasingly inefficient at evacuating the larger cell geometry; creating both low and high efficiency environments and turbulent flow.

The geometry and flow characteristics of the SuperCell (Figs. 4 & 5) has been specifically designed to enable rapid evacuation of the laser generated aerosol in a large format cell. Though the cell volume is 33cm^2 the aerosol evacuation profile is similar to the 0.25cm^2 and 1.48cm^2 cells described in the Bleiner et al study.

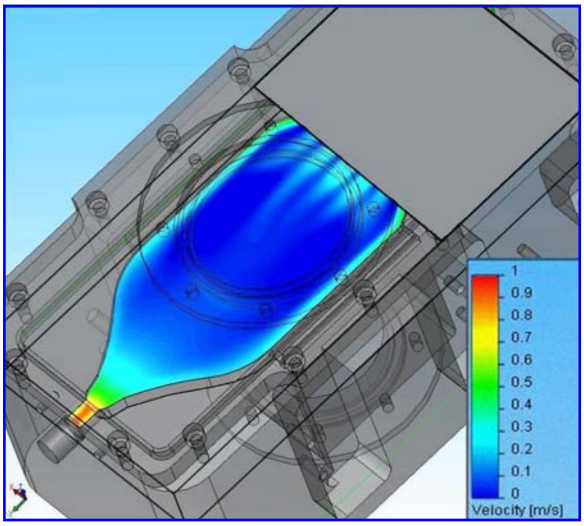

Figure 5: SuperCell™ flow characteristics
CosmosFloworks™ (CFD) a computational fluid dynamics program was used in the development process to model the optimal design and achieve the best flow through the cell. This includes a unique, proprietary gas inlet system which evenly distributes the gas flow across the entire working area.

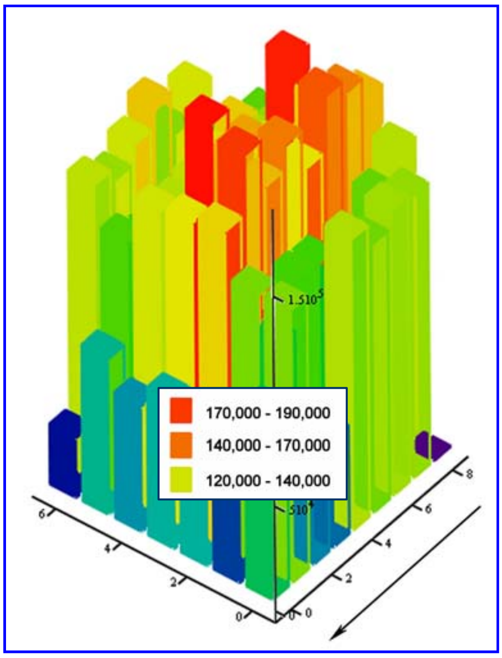

Figure 4: SuperCell single spot ^{27}Al intensity
Each bar represents integrated counts for a single spot ablation across a 12.5 cm^2 working area.

Conclusion

The SuperCell™ enhances aerosol transport through the sample chamber significantly improving evacuation of the ablated material. Unlike small volume cells, that restrict sample size, the SuperCell has a working area > 18.5 cm^2. This large format cell is especially well suited to the analysis of petrographic thin sections, 2D electrophoresis gels and layered materials.

Transient signals benefit from increased aerosol densities; increasing the signal to noise ratio (Fig. 1) and improving limits of detection. Steady-state signals (continuous ablation) also benefit from rapid cell wash-out times, reducing memory effect and increasing sampling frequency.

Compatible with the entire Universal Platform product line; the SuperCell can be installed in under 5 minutes.

References

1. Bleiner, D. & Gunther, D., *J. Anal. At. Spectrom.*, [16] 449-456, (2001)

Ordering Information

Part number:

SuperCell 266: 0020-0263
SuperCell 213: 0020-0266
SuperCell 193: 0020-1370

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