

Reduced Noise Advantages with the Agilent 500 Ion Trap LC/MS Ion Optics

Technical Overview

General Description

The API interface and ion coupling optics in the 500 Ion Trap have unique features that reduce the chemical noise from the solvent. The ion guide axis is tilted at an angle so that large solvent clusters and micro droplets pass through the ion guide and do not enter the coupling optics (Figure 1). This feature eliminates large noise spikes in the spectrum. The ion coupling and gating optics further eliminate high energy, multiply charged ion clusters from entering the mass analyzer. The cross section of the coupling optics shown in Figure 1 illustrate ions leaving the API interface capillary and passing through the skimmer cone into the ion guide where collisions with the surrounding gas thermalize their kinetic energies. Ions exiting the ion guide in one section of the vacuum chamber are focused into a second lower pressure region of the vacuum system by the “ion guide exit” and “ion guide focus” lens.



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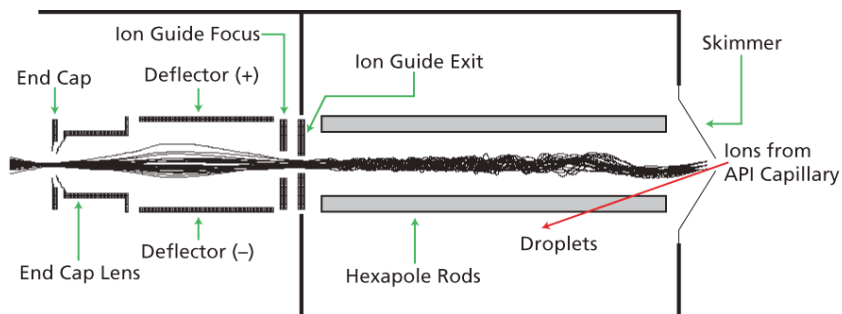


Figure 1. Schematic of API interface and ion optics of the Agilent 500 Ion Trap.

The coupling optics use a “split cylindrical” deflector lens depicted in Figure 2. When the two halves of the lens have the same potential, ions are focused into the entrance aperture of the end-cap.

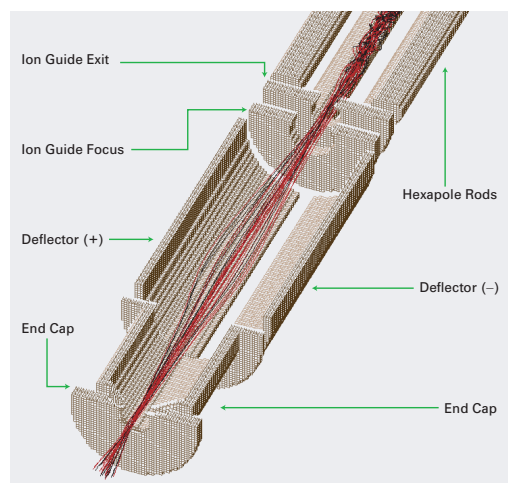


Figure 2. Ion coupling optics used in the Agilent 500 Ion Trap.

When the two halves of the split lens are at large voltages of opposite polarity, ions, solvent clusters, and any residual micro droplets passed by the ion guide, are deflected away from the entrance aperture of the end-cap. This ensures that when ions are scanned from the trap to form spectra, no charges that would contribute to spectral noise are allowed to enter the trap. In competitors instruments, ions are gated using an aperture lens to stop and turn the ions completely around to prevent them from entering the entrance aperture. This requires very large voltages to stop the large solvent clusters and micro droplets, which have very large kinetic energies, often in excess of several thousand electron volts. The use of such large voltages on a gate lens is impractical due to electrical break down.

Figure 3 contrasts the solvent noise in the background of spectra obtained using the ion guide exit lens as the ion gate (top) compared to using the deflector lens (bottom). The drying gas was off in both cases to intentionally increase the magnitude of the solvent cluster noise. Figure 4 shows the same comparison of exit lens gating with the drying gas at 11 L/min versus deflector lens with the dry gas at a much lower flow rate of 2 L/min. Although the exit lens case used five times higher drying gas flow rates, some noise can still be observed in the background of the spectrum. By contrast, the deflector lens gating has no noise spikes, even at a much lower drying gas flow rate. The lower flow rate also produces a larger sample signal.

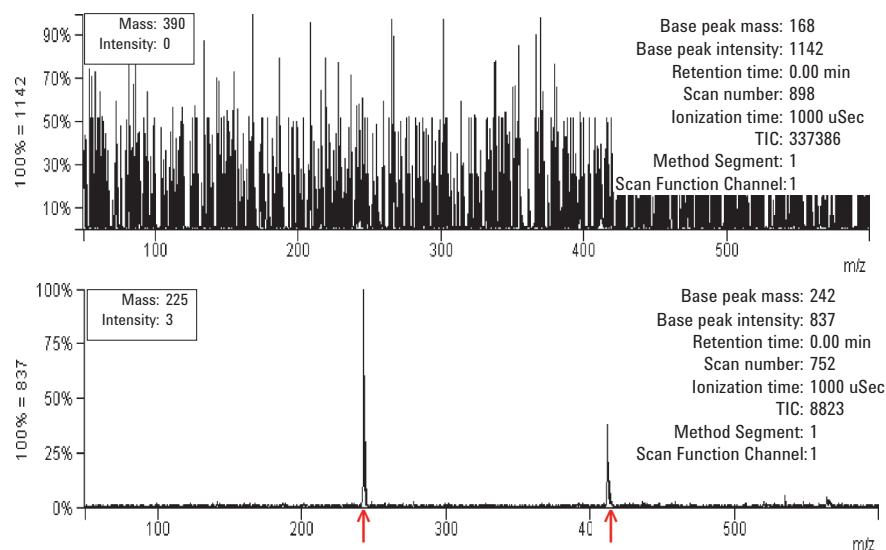


Figure 3. Background spectra with ion guide exit lens used as an ion gate (top) and ion deflector (bottom).

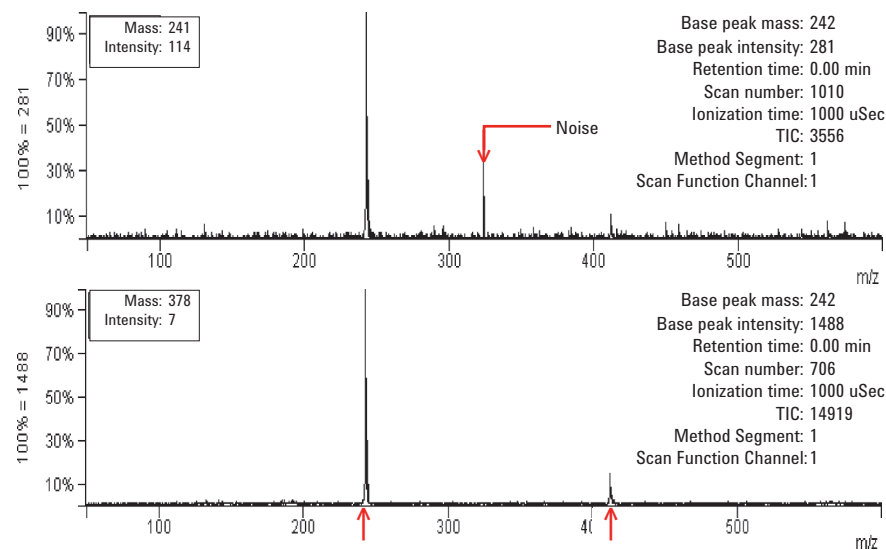


Figure 4. Top: Ion guide exit lens used as ion gate, drying gas 11 L/min. Bottom: Ion guide exit lens used as a deflector, drying gas 2L/min.

Figure 5 shows the very low background noise observed when monitoring the spectrum of a small peptide with the Agilent 500 Ion Trap system.

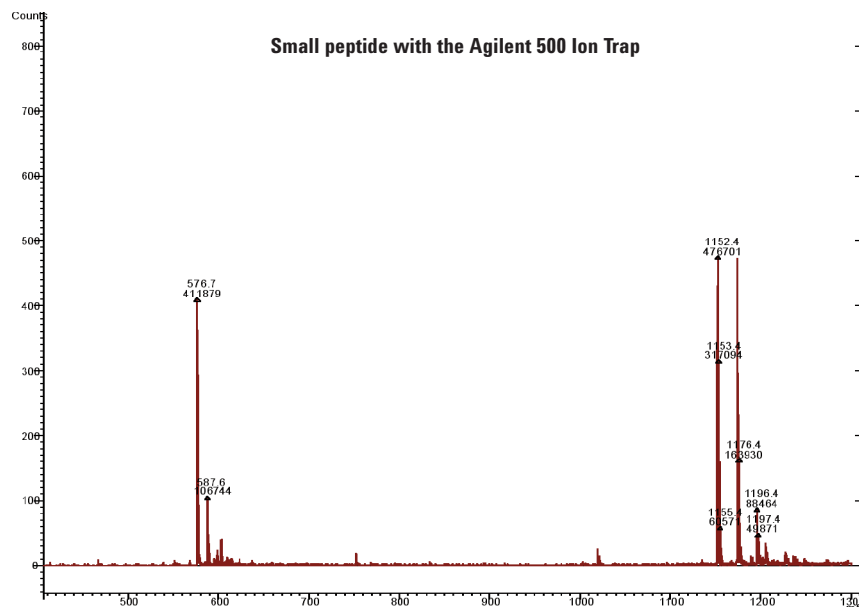


Figure 5. Very low background noise observed in full scan mode.
(Small peptide = Asn-Arg-Cys-Ser-Gln-Gly-Ser-Cys-Trp-Asn with a disulfide bridge connecting the two Cys (3-8))

Benefits

The ion optics of the Agilent 500 Ion Trap eliminate large noise spikes in the spectrum with normal voltage rates delivering better electrical reliability.

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