

CHAPTER OVERVIEW

4: MASS ANALYZERS

After ions are formed in the source region they are accelerated into the mass analyzer by an electric field. The mass analyzer separates these ions according to their m/z value. Each analyzer design has very different operating characteristics and the selection of an instrument involves important tradeoffs. The selection of a mass analyzer depends up on the resolution, (1) mass range, scan rate and detection limits required for an application.

- Resolution in mass spectrometry refers to the separation of two ions where $R = m/\Delta m$. These terms are defined several different ways. The most common are the 10% valley definition "Let two peaks of equal height in a mass spectrum at masses m and Δm be separated by a valley that at its lowest point is just 10% of the height of either peak." and the peak width definition "For a single peak made up of singly charged ions at mass m in a mass spectrum, the resolution may be expressed as $m/\Delta m$, where Δm is the width of the peak at a height that is a specified fraction of the maximum peak height. It is recommended that one of three values 50%, 5% or 0.5% be used."(2)
- Mass range refers to the highest mass to charge ratio transmitted by the mass spectrometer.
- The scan rate of a mass spectrometer refers to how fast it scans a mass spectrum. This is important for chromatography applications where the entire mass spectrum must be scanned faster than the elution time of the chromatographic peak. Ideally, a minimum of ten complete mass spectra are acquired for a single chromatographic peak

Analyzers are typically described as either continuous or pulsed. Continuous analyzers include quadrupole filters and magnetic sectors. These analyzers are similar to a filter or monochromator used for optical spectroscopy. They transmit a single selected m/z to the detector and the mass spectrum is obtained by scanning the analyzer so that different mass to charge ratio ions are detected. While a certain m/z is selected, any ions at other m/z ratios are lost, reducing the S/N for continuous analyzers. Single Ion Monitoring(SIM) enhances the S/N by setting the mass spectrometer at the m/z for an ion of interest. Since the instrument is not scanned the S/N improves, but any information about other ions is lost. Pulsed mass analyzers are the other major class of mass analyzer. These are less common but they have some distinct advantages. These instruments collect an entire mass spectrum from a single pulse of ions. This results in a signal to noise advantage similar to Fourier transform or multichannel spectroscopic techniques. Pulsed analyzers include time-of-flight, ion cyclotron resonance, and quadrupole ion trap mass spectrometers.

[4.1: Quadrupole](#)

[4.2: Magnetic Sector](#)

[4.3: Electric Sector/Double Focusing Mass Spectrometers](#)

[4.4: Time-of-Flight](#)

[4.5: Quadrupole Ion Trap](#)

[4.6: Ion Cyclotron Resonance](#)

[4.7: Self-Test #2](#)

References

1. Price, P. J. Am. Soc. Mass Spectrum., **1991**, 2, 336-348.
2. Buchanan, M.V.; Hettich, R.L. Anal. Chem. **1993**, 65, 245A-259A.

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