

REAL-TIME MEASUREMENT OF THE MASS AND COMPOSITION OF PARTICLES

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Two areas of scientific research are beginning to merge. Over the past decade, aerosol science has strived to characterize smaller and smaller particles while the field of mass spectrometry has strived to characterize larger and larger molecules. Consequently, aerosol scientists and mass spectrometrists are beginning to think in both units of size (or diameter) and molecular mass. The merging of the two worlds will be completed with the design of a mass spectrometer with essentially infinite mass range ($m/z=10^0$ - 10^{16} Da or 0.1- 10^5 nm).

Quadrupole traps have been used to contain any particle size from atoms to hundreds of micrometers merely by adjusting the amplitude and frequency of the potential applied across the electrodes. The physics of the ion trap permit storing or ejecting charged species by changing the frequency. Fortunately, recent advances in field effect transistor (FET) technology permit the generation of high voltage potentials (> 1000 V) at frequencies greater than one megahertz. Digital potential generation permits trapping and ejecting charged species over the essentially infinite mass range described above. Just as importantly, it allows instantaneous changes in the potential to be applied permitting tandem mass spectrometry over the entire range as well.

However, there are two major hurdles that must be overcome in order to capitalize on the advance in FET technology to produce a mass spectrometer with infinite mass range. First, the inertia of the particles gained as they are moved from an atmospheric pressure environment to the vacuum must be removed so that the charged species may be trapped. This inertia is roughly proportional to the particle mass and therefore has an infinite range as well. Second, the particles have to be detected as they exit the ion trap. Consequently, a detector that is effective over this entire mass range is required as well.

We will discuss how to solve these problems to produce an ion trap mass spectrometer with infinite mass range capable of real-time particle analysis.

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