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Development of online aerosol composition analyzers based on mass spectrometry

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Recent advances in on-line mass spectrometric analyzers have largely improved our understanding of sources and processes of ambient aerosols. Specifically, Aerodyne aerosol mass spectrometers (AMS) have widely been used by many investigators under various environments. The AMS utilizes an aerodynamic lens to generate particle beams and collects particles by impaction on a heated vaporizer. The evolved gas is analyzed by electron impact ionization (EI) mass spectrometry. While the AMS is useful for quantitative analysis of non-refractory materials, the particle collection efficiency is typically less than unity and varies depending on chemical composition. This is because liquid particles can be collected at high efficiency, but solid particles tend to bounce off the surface. We have developed a new analyzer for the online measurement of aerosol composition: a particle trap laser desorption mass spectrometer (PT-LDMS). The main components of the PT-LDMS include an inlet assembly (critical orifice, aerodynamic lens, etc.), a particle trap enclosed by a quartz cell, a quadrupole mass spectrometer (QMS) with electron impact ionization, and a carbon dioxide laser. The particle trap consists of custom-made mesh layers, the structure of which was newly designed to reduce the loss of particles due to bounce. The laser is used to vaporize aerosol compounds captured on the particle trap. The evolved gas confined within the quartz cell is analyzed using the QMS to quantify the chemical composition of the particles. The concept of the particle trap and laboratory evaluation of the instrument will be presented.

Keywords: Aerosol Composition, Particle trap, Laser desorption, Mass spectrometer, Online measurement