

Development of a Novel Particle Mass Spectrometer for Online Measurements of Refractory Sulfate Aerosols

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Sulfate aerosols are ubiquitous in the atmosphere. Ammonium sulfate (AS) is generally the dominant form of sulfate aerosols in urban air, whereas potassium sulfate (PS), sodium sulfate (SS), magnesium sulfate (MS), and calcium sulfate (CS) may have large contributions in remote areas. Currently available methods for online measurements of sulfate aerosols, which are based on ion-chromatography (IC) or thermal desorption aerosol mass spectrometry, cannot separately quantify nonrefractory and refractory sulfate compounds. We have developed a new particle mass spectrometer to measure nonrefractory and refractory sulfate compounds based on a laser-induced, high-temperature thermal desorption method (hereafter referred to as HT-LDMS). Aerosol particles are introduced into a vacuum chamber via an aerodynamic lens unit, and are collected on a U-shaped graphite target (graphite collector). A focused CO₂ laser coupled with the graphite collector enables high desorption temperature (black-body equivalent temperature of ~950°C) for detecting AS, PS, SS, and MS aerosols. The gas molecules evolved from these compounds are detected using a quadrupole mass spectrometer. The performance of the HT-LDMS has been tested in the laboratory. Preliminary data indicate that the HT-LDMS can separately quantify AS, PS, SS, and MS particles.

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