Determination of Isotope Ratios in Airborne Particles from Single-Particle Laser Ablation Mass Spectrometry

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Novel Aspect: Determination of isotopic elemental ratios using real-time single-particle ion trap mass spectrometry.

Introduction: Isotopic ratios of elements in aerosols have typically been determined on bulk samples collected over a period of time. While standard isotope ratio mass spectrometry techniques have shown high accuracy for bulk samples, information about ratios in specific particle types is lost. The analysis of aerosols in real-time has been performed by single-particle laser ablation mass spectrometry. Initial studies into the determination of isotope ratios using laser ablation single-particle mass spectrometry are presented here.

Methods: The aerosols used were laboratory-generated by nebulization followed by passage through a heater and condenser to remove solvent. Particles entered the mass spectrometer through a limiting orifice and pass through an aerodynamic lens system that collimates the particles into a tight beam for passage into the main vacuum chamber. Individual particles were sized by light scattering-based time-of-flight. The detected particles were irradiated with a focused laser when the particle reached the center of the ion trap. For the analysis of higher mass elements such as lead, the rf voltage on the ring electrode was set at a voltage where ions with masses below 150 m/z are unstable and immediately ejected. Scan speed (amu/ms) was decreased to increase isotopic separation.

Preliminary Results: Isotope ratios determined through laser ablation single-particle mass spectrometry will be presented. NIST standards, such as Montana Soil SRM 2710 and Urban Particulate Matter SRM 1648, were used as analytes since their composition has been well-documented. A Nd:YAG (266/532/1064 nm) is used as the ionization laser. The effect of ionization fluence and wavelength on the isotope ratio will be presented. In addition, the variation of isotope ratios with particle origin will be described.

KEYWORDS: Aerosol Mass Spectrometry, Isotopic Ratio, Elemental Analysis, Ion Trap, Real-Time Analysis

BRIEF: Determination of isotopic abundances of elements in particles through single-particle mass spectrometry.

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