2IM.9

Design and Development of a Field-Portable Tandem Raman and Elemental Aerosol Spectrometer (TREAS) for Near Real-time Aerosol Measurement. Nicholas Pugh, ORTHODOXIA ZERVAKI, Kabir Rishi, Pramod Kulkarni, *Centers for Disease Control and Prevention, NIOSH*

We present design and development of a hand-portable, battery-operated Tandem Raman and Elemental Aerosol Spectrometer (TREAS) for the near real-time quantification of atomic and molecular speciation of workplace aerosols. The instrument uses an automated cyclical "collect-analyze-ablate" scheme, where aerosol is first sampled onto a rotating electrode as a dry spot sample, followed by its non-destructive molecular analysis using laser Raman Spectroscopy (RS). The dry spot sample is then ablated by a series of pulsed spark plasma discharges and the elemental quantification is obtained using spark emission spectroscopy (SES). The scheme allows time resolution of a few to several minutes. Laboratory experiments were conducted to evaluate the instrument's time-resolution, limits of detection (LODs), uncertainty, and dynamic range for common workplace aerosols such as respirable crystalline silica (RCS) and titanium dioxide (TiO_2). The mass LODs for RCS were approximately 306 (±14) ng, and 88 (±11) ng using RS and SES, respectively, while for TiO_2, they were 10 (±0.4) ng, and 28 (±2) ng using RS and SES, respectively. These LODs were lower than those achieved by the standardized X-ray diffraction method (3-10 µg) for particulate samples. Ability of TREAS to speciate α-quartz and rutile TiO_2, even in the presence of interferants like those found in fracking sand dust and aerosols generated during the grinding of engineered stone countertops, was assessed using laboratory test aerosols. The tandem molecular and atomic emission measurements in TREAS can allow both elemental identification and differentiation between different oxidation states, such as chromium (VI and III) in welding fumes. The ability of TREAS to measure in near-real time was demonstrated by continuously measuring transient aerosol concentrations. The study demonstrates the potential of TREAS to offer on-site, near real-time quantification with high specificity and sensitivity for many occupationally relevant aerosols.

2IM.10

Quantifying the Contributions from Multiply Charged Particles to Improve Calibration Procedures for the ACSM. Ernie R. Lewis, Arthur J. Sedlacek, Ogochukwu Enekwizu, Maria Zawadowicz, AMIE DOBRACKI, *Brookhaven National Laboratory*

The Aerosol Chemical Speciation Monitor (ACSM, Aerodyne Inc.) measures non-refractory submicron aerosol mass concentrations. Calibration of the ACSM typically involves aerosolizing an ammonium nitrate solution and selecting particles with a 300 nm electrical mobility diameter using a differential mobility analyzer (DMA). It is commonly reported that there is minimal contribution from multiply charged particles of the same diameter when an ammonium nitrate solution with a concentration between 0.005 and 0.018 M is used. However, at these conditions, our findings reveal that these multiply charged particles contribute between 20-40 % of the measured nitrate mass. To address the contribution from multiply charged particles, we employed a Centrifugal Particle Mass Analyzer (CPMA; Cambustion) in conjunction with the DMA to isolate singly charged particles based on both their electrical mobility diameter and mass. Our results reveal that the ACSM sampling efficiency at electrical mobility diameters of 100, 200, and 400 nm is substantially less than 100 % when both the DMA and CPMA are used, based on a sampling efficiency of 100 % for ammonium nitrate particles selected only by the DMA at 300 nm electrical mobility diameter. We propose a simple protocol for correcting the bias introduced by multiply charged particles during laboratory experiments and field measurements when a CPMA is not available.