Application of an Inexpensive Spark-Induced Breakdown Spectroscopy Instrument for Measurements of Atmospheric Metal Particles

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Abstract

Hazardous air pollutants, also known as air toxics, are defined by the US EPA as pollutants that are known or suspected to cause cancer and other serious health issues. Although technologies to screen for toxic compounds, such as benzene, toluene and many criteria pollutants are available, the same level of efficacy for community monitoring is not available for toxic metals. To fill this gap, we have recently developed an inexpensive spark-induced breakdown spectroscopy instrument for detecting and quantifying toxic metal pollutants in the atmosphere (dubbed toxic-metal aerosol real time analyzer, TARTA). Compared to conventional instruments used to analyze elemental compositions (such as X-ray fluorescence (XRF) and inductively coupled plasma mass spectrometry (ICP-MS)), our instrument allows near real-time measurements and does not require complex sample preparation. In this work, TARTA is evaluated on its ability to measure metal emissions of total suspended particles (TSP) and PM2.5 from different environments, including the emissions of vehicles traveling through the Caldecott tunnel and the agricultural emissions from a rural background site in Davis, CA. Besides the application of this new technique, we collected particle samples (both TSP and PM 2.5) on Teflon filters for XRF analysis of trace metals. The analytical results obtained by XRF allow for the evaluation of accuracy and sensitivity of the TARTA instrument. In this talk, we will report the temporal profile of elemental species and the correlations among elements. For example, our preliminary analysis of the emissions from the rural site suggests relatively strong emissions of Ca, Na, Mg, K, and CN bond, which may be associated with the local emissions of soil dust and amines. From the tunnel measurements, we will discuss the influence of traffic volume and vehicle categories (light-duty and heavy-duty vehicles) on the concentration of metal particles near roadway, which affects many communities. In conclusion, the two field studies indicate that TARTA is a promising technique for field measurements of toxic metals in environmental justice, industrial and urban applications.

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