SIZE-RESOLVED CHEMICAL COMPOSITION OF AEROSOL VIA SINGLE-PARTICLE, REAL-TIME MASS SPECTROMETRY

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We will present results from measurements of single-particle size and chemical composition using the Brookhaven National Laboratory (BNL) Single Particle Mass Spectrometer (SPMS). We will also demonstrate our data analysis and visualization tools that provide an interactive interface between the user and the statistical analysis package.

SPMS is the ideal tool to address the combustion engine industry needs to characterize particulate emissions. It provides real-time detailed accounting of particle composition and size as a function of time and distance from the point of emission, making it possible to derive correlations between engine and fuel performance and aerosol properties.

The compositions of exhaust aerosol tend to be complex, containing inorganic compounds, elemental carbon, and a large number of organic compounds, many of which are semi-volatile. SPMS can readily distinguish between the three classes and quantify their presence.

Single-particle instruments use an ultraviolet laser to vaporize individual particles and produce ions for time-of-flight mass analysis. The vaporization ionization process, also known as ablation, is highly nonlinear and nonspecific. Organic compounds tend to be the most sensitive to the ablation process, producing a high degree of fragmentation that can vary drastically from one particle to the next. To resolve this problem, we at BNL have recently developed an experimental approach, in which particle evaporation is separated from ionization, thereby eliminating the inconsistent spectra and the nonlinear response. Moreover, we are in the process of introducing modifications that are designed to make possible a molecular-level analysis of the highly complex organic fraction.