

**An Aerosol Mass
Spectrometer:
Instrument
Development, Data
Analysis Techniques
and Quantitative
Atmospheric Particulate
Measurements**

A thesis submitted to UMIST for the degree of
Doctor of Philosophy

2004

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No portion of the work referred to in the thesis has been submitted in support of an application for another degree or qualification of this or any other university, or other institution of learning.

Abstract

The Aerodyne Aerosol Mass Spectrometer (AMS) is a new scientific instrument designed to study the size and composition of submicron particles. Ambient particles represent an important but relatively poorly understood aspect of our atmosphere, as they impact on many issues ranging from human health to global climate. Our understanding of aerosols has so far been limited by the instrumentation available to study them and the AMS represents a significant advance in this field. It uses aerodynamic sizing, thermal vapourisation and quadrupole mass spectrometry to deliver quantitative composition data on the non-refractory fraction of particulates with high size and time resolutions. Work to develop the AMS is presented in this thesis, in particular the hardware modifications that were made to improve instrument sensitivity, accuracy and data reliability and the development of a standard suite of analysis tools designed to process the data produced. These tools allow the raw data from any measurement to be processed quickly and reliably and take into account all the necessary calibrations and corrections needed to generate quantitative results. Validation work is also presented, which demonstrates that the instrument is capable of deriving the chemical mass concentrations and mass spectra that are the same as those delivered by comparable instrumentation. The findings from various atmospheric sampling studies are also presented. These took place in various environments around the world and ranged from polluted urban settings to clean, remote coastal areas. The dynamic behaviour of these aerosols on short timescales was measured and quantitatively compared with various other continuous measurements, such as meteorological conditions, carbon monoxide, oxides of nitrogen and volatile organic carbon. During urban sampling, the AMS was able to clearly discriminate and quantify the small (<200 nm), organic particles emitted locally from traffic sources from the larger (300-800 nm) mixed organic/inorganic accumulation mode particles, which appeared to be dominated by regional sources and was of a nature similar to those seen in the more remote areas. The particulate organic fraction was also investigated in detail using the mass spectral data. The traffic emissions appeared to be composed of long aliphatic chains, consistent with lubricating oils, while the accumulation mode material exhibited higher degrees of oxidation, showing evidence for the presence of polyacid functional groups.

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