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Single particle characterization using a light scattering module coupled to a time-of-flight aerosol mass spectrometer

E. S. Cross[1], T. B. Onasch[1,2], M. Canagaratna[2], J. T. Jayne[2], J. Kimmel[2,3], X.-Y. Yu[4], M. L. Alexander[4], D. R. Worsnop[2], and P. Davidovits[1]

[1]Chemistry Department, Boston College, Chestnut Hill, Massachusetts, USA
[2]Center for Aerosol and Cloud Chemistry, Aerodyne Research Inc., Billerica, Massachusetts, USA
[3]CIRES, University of Colorado, Boulder, Colorado, USA
[4]Pacific Northwest National Laboratory, Richland, Washington, USA

Abstract. We present the first single particle results obtained with an Aerodyne time-of-flight aerosol mass spectrometer coupled with a light scattering module (LS-ToF-AMS). The instrument was deployed at the T1 ground site approximately 40 km northeast of the Mexico City Metropolitan Area as part of the MILAGRO field study in March of 2006. The LS-ToF-AMS acquires both ensemble average and single particle data. Over a 75-h sampling period from 27–30 March 2006, 12 853 single particle mass spectra were optically-triggered and saved. The single particles were classified based on observed vaporization histories and measured chemical compositions. The single particle data is shown to provide insights on internal AMS collection efficiencies and ambient mixing state information that augments the ensemble data.

Detection of correlated light scattering and chemical ion signals allowed for a detailed examination of the vaporization/ionization process for single particles measured with the AMS instrument. Three particle vaporization event types were identified as a fraction of the total number of particles detected: (1) 23% with prompt vaporization, (2) 26% with delayed vaporization, and (3) 51% characterized as null. Internal consistency checks show that average single particle nonrefractory mass and chemical composition measurements were in reasonable agreement with ensemble measurements and suggest that delayed and null vaporization events are the dominant source of the nonunit collection efficiency of the AMS. Taken together, the simultaneous prompt single particle and aerosol ensemble measurements offer insight into the mixing state and atmospheric transformations of ambient aerosol particles.

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