Photoelectric Charging Technique for Ambient Aerosol Monitoring

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Aerosol particles are of importance for human health, urban environment, and global climate. Aerosol particles can be formed by both natural and anthropogenic processes. Examples include sea salts, road dust, unburned fuels, and others. Size and composition of particles determine their effects on health and role in the atmosphere. For example, salt particles are less toxic than those produced by combustion. Similarly, nanoparticles (less than 50nm) have different transport characteristics than larger particles. Nanoparticles such as those produced during combustion contribute significantly to health problems, as they penetrate deep into the lungs and may have carcinogenic effects. Ambient air contains a combination of toxic and nontoxic particles. Effective monitoring, from a health perspective requires us to distinguish between these particles.

Particle surface composition can be identified by a combination of photocharging and diffusion charging techniques. In photocharging, photons from an UV excimer lamp (KrCl, 222nm, Matter-Engineering) will ionize particles by ejecting electrons from particle surfaces. The efficiency of charging is determined by the surface composition of the particles, and is particularly efficient for particles with carbon compounds on the surface. The measurement of the ratio of diffusion charging to photocharging efficiencies can, therefore, be used to determine the surface composition of particles.

An electrostatic precipitator followed by a Po^{210} neutralizer, excimer lamp, and TSI Condensation Particle Counter (CPC) was used to determine the effectiveness of charging at various light intensities. Size distribution plots were then generated by scanning a predetermined voltage range using a differential mobility analyzer (DMA) and CPC. Particle diameters are calculated using a LabView scanning program (McKeever and Swift, 2003). The input air stream is first pumped through a Po^{210} neutralizer, then through the UV lamp, DMA, and finally to the CPC.

Preliminary results comparing measurements of photocharging to diffusion charging efficiency ratios for particles generated by candle burning and salt particles show that compositional information can be obtained using this method. Charging efficiency was determined to be a function of light intensity. This indicates that photocharging can be used in combination with diffusion charging to obtain

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information about particle composition and thus be used toward monitoring combustion-generated particles. Further testing using an aethalometer to compare total black carbon in the ambient air to photocharging measurement of carbon-containing particles will be conducted to quantify these results.