Mixing state of soot with sulfate and organic material from Mexico City

Analysis of individual aerosol particles using transmission electron microscopy

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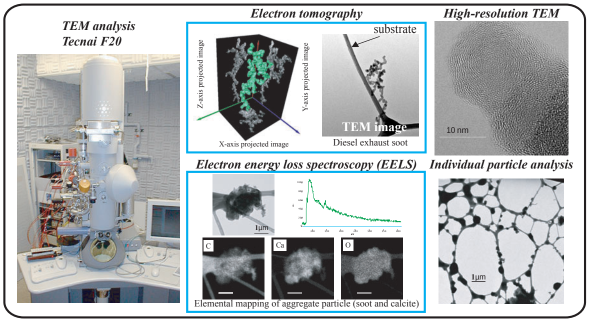
Abstract

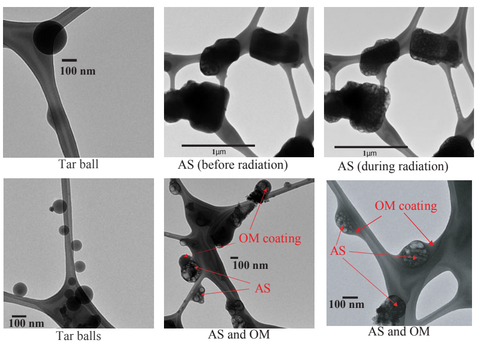
We focus on the chemical and morphological properties of aerosol particles, especially on the mixing state of soot with sulfate and organic material (OM) using transmission electron microscopy (TEM) **(Fig.1)**. Our goal is to understand the changes the particles undergo during aging **(Fig.6)**. During the MILAGRO project, using the NSF/NCAR C130 aircraft, we collected 30 samples from Mexico City (MC) during 10 research flights **(Fig.2)**. The samples range in age from less than one day to >2 days. We collected particles with aerodynamic diameters between 0.3 and 0.05 μm on TEM grids using an impactor sampler **(Fig.2)**. The samples were classified into those internal to the MC plume (in-MC) and external to the MC plume (ex-MC). More than 50% of the in-MC particles and 20% of the ex-MC particles consisted of soot covered by OM, many with sulfate **(Figs.4,5,7, and 8)**. 30% of in-MC and 70% of ex-MC particles were secondary organic aerosol (SOA), sulfate (mainly ammonium sulfate (AS)), or their mixtures **(Figs.3 and 8)**. 8% of in-MC and 4% of ex-MC particles were soot particles without coatings or attached SOA or AS **(Figs.7 and 8)**. About 1% of both samples consisted of tar balls **(Figs.3 and 8)**. These results suggest that OM plays an important role in the aging of soot particles in this region and could increase the ability of soot particles to act as CCN and light absorbers because of the hygroscopic character and lens effect of the organic coatings.

1. Transmission electron microscopy

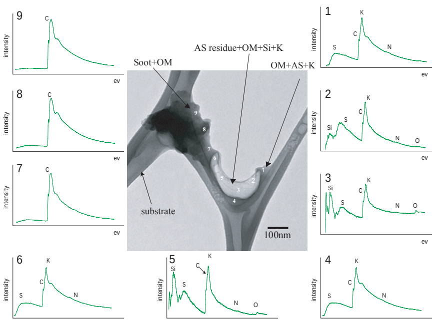


2. Sampling

3. Ammonium sulfate (AS), organic material (OM), and tar ball

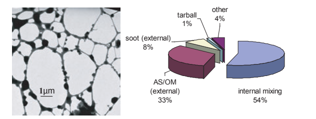


4. EELS of internally mixed particle



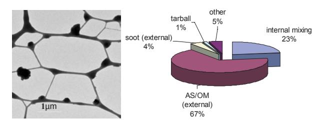
8. Number fractions of particles

(50-300 nm in aerodynamic diameter)



Particles internal to MC plume

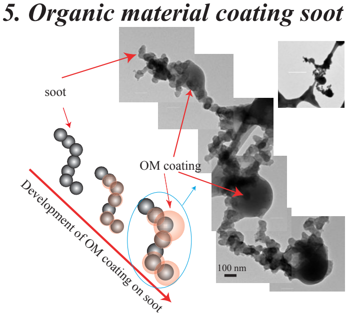
(8 samples, average of >3000 particles)



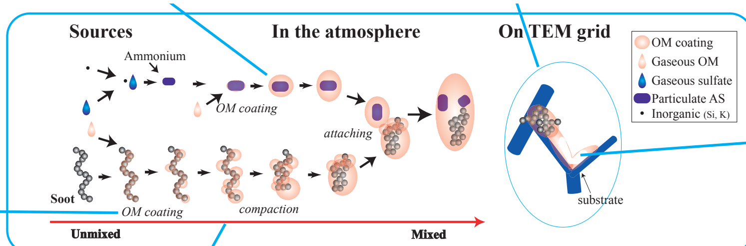
Particles external to MC plume

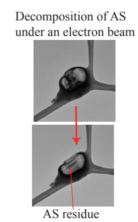
(12 samples, average of >4000 particles)

5. Organic material coating soot

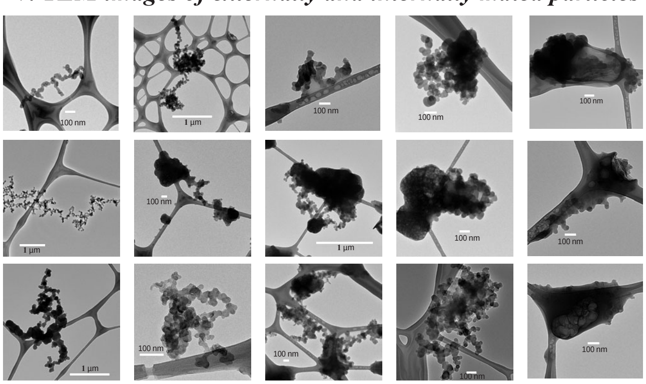


6. Presumed evolution of internally mixed particles





7. TEM images of externally and internally mixed particles



Chain-cluster External mixture ⟷ **Compacted Internal mixture**

Summary

1. *Organic material (OM) coats most soot and ammonium sulfate*
2. *Soot particles coated by OM/AS are dominant in MC plumes*

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