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Mixing states of soot particles from transmission electron microscopy: their mixing state, size, shape, and composition

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Mixing state, size, shape, and composition of atmospheric aerosol particles influence their climate and health effects. Transmission electron microscopy (TEM) can magnify the particles and reveal the internal structures at a single particle scale. We study aerosol particles collected from urban mountain sites in Japan. In this study, we focused on soot particles and their mixing states, shape, size, and compositions of the coating materials, if any, since they absorb light and have great influence on the climate.

Together with scanning transmission electron microscopy (STEM), which is one of the technique of TEM, and energy dispersive X-ray spectroscopy (EDS), which measures the composition of interest within TEM, we analyze the compositions and mixing states of soot particles as well as elemental distribution within individual particles. We use the STEM-EDS system that automatically measures sizes, shape factors, and compositions of all aerosol particles within a field of view (˜300 particles). The results suggest that ˜75% of soot particles were coated (internal mixture) at the mountain site (remote area) and the larger aerosol particles include the more soot particles. At the mountain site, soot particles were mostly coated by ammonium sulfate. On the other hand, soot particles from urban site were coated by both organic aerosol and sulfate, and the ratio varied depending on the time of the day. These data are useful to understand the optical properties, atmospheric lifetime, and climate effects of soot particles and to improve climate modeling.

Keywords: aerosol, electron microscope