Measurement of adhesion force of individual aerosol particles by atomic force microscopy

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A new method was developed to quantitatively evaluate the adhesion force of individual aerosol particles. The method involves force-curve-mapping by atomic force microscopy. Firstly, adhesion force of particle surrogates (PSL, ammonium sulfate, quartz) were measured to evaluate the applicability of the new method on individual particles. Spatial distribution and representative adhesion force was successfully obtained. The force-curve-mapping method was then applied on actual ambient samples. The aged Asian dust particles following long-range transport were collected within Kanazawa University campus. The same dust particles were identified under both AFM and SEM-EDX and analyzed for their morphology, adhesion force distribution and elemental composition. It was found that the adhesion force of aged silicate Asian dust was greater than that of fresh dust collected near the source in China. It was suggested that the adhesion force of aged silicate dust increases and becomes comparable to those of inorganic salts (i.e. ammonium sulfate and sea salt particles). Ca-rich Asian dust exhibited even stronger adhesion force. The result revealed difference of adhesion forces between silicate and Ca-rich Asian dust following atmospheric processing during long-range transport. This study also spotted few carbonaceous particles with exceptionally high adhesion force, suggesting certain organic aerosols may be particularly adhesive. This work successfully demonstrated the importance of adhesion force measurement on individual particle basis, and applicability of force-curve-mapping method for characterizing adhesivity of internally mixed particles.

Keywords: Asian dust, Atomic Force Microscopy(AFM), adhesion force, long-range transport, deposition, aging

