Dependence of cloud condensation nuclei activity of atmospheric particles on the size and the mixing state

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Cloud condensation nuclei (CCN) activity of an atmospheric aerosol particle depends on the size and the chemical composition of the particle. Therefore, the size segregated chemical composition is required for the qualitative assessment of the CCN activity of internally mixed particles. On the other hand, when aerosol particles are externally mixed, the chemical composition of individual particle is required to understand its CCN activity. Nevertheless, in most of the studies on CCN activity of atmospheric particles have assumed that they are internally mixed, and little attention was paid for the dependence of CCN activity on the mixing state of aerosol particles. In this study, we performed a simultaneous measurement of CCN activity (number fraction of CCN active particles) and mixing state of size-selected particles using a CCN counter and a volatility tandem DMA (VTDMA). We selected 30, 40, 60, 80, 100, 150, and 200 nm particles. The supersaturation of the CCN counter was set at 0.3, 0.5, and 0.8 %. The heater temperature of the VTDMA was set to 400 degree C. The observation was conducted during January 24, 2007 - February 2 at the campus of the Research Center for Advanced Science and Technology, the University of Tokyo.

The number size distribution of non-volatile cores observed by VTDMA was bimodal. One was less-volatile mode and the other was more-volatile mode. The size of non-volatile cores in less-volatile mode was similar to its original diameter, while more-volatile particles were mainly composed by volatile components at 400 degree C. Previous studies have showed that the main non-volatile component at 400 degree C in urban air is black carbon. Therefore, the main component of less-volatile particles can be assumed as black carbon. The number fraction of less-volatile particles had the maximum in the morning of working day. This is possibly due to the emission of black carbon by the traffic rush. Number fraction of CCN inactive particles at 0.6 and 0.9 % of supersaturations showed the similar variation with that of less-volatile particles. The critical supersaturation of black carbon particle is quite high. Therefore, this phenomena shows that the change of mixing state caused by the traffic rush affects the CCN activity of aerosol particles in the urban air.