

20 nm size particles, - inorganic compositions -

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Abstract

It is well known that nanoparticles of high number concentration exist in the atmosphere. In roadside atmosphere of Japan, bimodal size distribution with modal size diameters around 20 nm and 60–80 nm was observed. However, chemical compositions of the 20 nm size particles are not well known. Consequently, we have begun to study multi-probe chemical compositions of the 20 nm size particles, and the final purpose of this study is to clarify the chemical speciation of nanoparticles. Sampling of 20 nm size particles was conducted at Shinjuku in Tokyo during the period from 19–24 December 2005. The samples of 20 nm size particles were collected on a polycarbonate membrane filter (Nuclepore[®], 47 mm ϕ , no holes) using a Nanometer Aerosol Sampler (Model 3089, TSI Incorporated) with a Differential Mobility Analyzer (DMA Model 3085, TSI Incorporated). The elemental compositions, ionic species and particle shapes of these filter samples were determined and/or observed by PIXE, ion chromatography and SEM analysis. In PIXE analysis of each 20 nm size particles filter sample, six elements (Si, Ca, Cr, Fe, Ni and Zn) were determined in total, in which Si and Ca were found to be the major components. As for ionic species, the anions (F⁻, Cl⁻, NO₂⁻, Br⁻, NO₃⁻, PO₄³⁻ and SO₄²⁻) and the cations (Na⁺, NH₄⁺, K⁺, Mg²⁺ and Ca²⁺) were analyzed. The detected ionic species were only NO₂⁻ and NO₃⁻. With the aid of SEM analysis, soot particles were observed in the form of aggregated tiny particles with sizes less than 20 nm. Based on elemental and ionic species analyses and SEM images, the chemical compositions of inorganic 20 nm particles are elemental carbons with slight amount of elements such as Si and Ca and ionic species of NO₂⁻ and NO₃⁻.