



Surface Chemical Composition of Size-fractionated Urban Walkway Aerosols Determined by XPS and ToF-SIMS

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In this study, aerosol particles with sizes ranging from 0.056 to 10 μm were collected using a ten-stage impactor sampler (MOUDITM) from a busy walkway of Hong Kong. The aerosol samples of each stage were examined with X-ray photoelectron spectroscopy (XPS). Size dependent distributions of the detected six key elements (N, S, Ca, Si, O, and C) were revealed together with the chemical states of N, S and C.

The results indicated that aliphatic hydrocarbons were the dominant species on the surface of all particles while a small portion of graphitic carbon (due to elemental and aromatic hydrocarbons) was also detected on the surface of the particles with sizes ranging from 0.056 to 0.32 μm . Organic oxygen- and nitrogen-containing surface groups as well as sulfates were more abundant on the surface of the particles with sizes ranging from 0.32 to 1 μm . Organic oxygen- and nitrogen-containing surface groups as well as sulfates were more abundant on the surface of the particles with sizes ranging from 0.32 to 1 μm . Inorganic salts and nitrates were found in coarse-mode particles. Time-of-flight secondary ion mass spectrometry (ToF-SIMS) was used for detailed surface and near surface composition analysis. Principal component analysis (PCA) of the ToF-SIMS spectra confirmed the XPS results that aromatic hydrocarbons were associated with the nucleation-mode particles. Aliphatic hydrocarbons with O- and N-containing functional groups were associated with accumulation-mode particles and inorganic salts were related to the coarse-mode particles. Depth-profiling experiments were performed on three specific sets of samples (nucleation-, accumulation- and coarse-mode particles) to study their near-surface structures. It showed that organic compounds were concentrated on the very top surface of the coarse-mode particles with inorganics in the core. The accumulation-mode particles had thick coatings of diverse organic compositions. The nucleation-mode particles, which contained graphitic carbon in the core, were partially coated with aliphatic/aromatic hydrocarbons on the surface.

This study confirms that the surface chemical compositions of aerosols were size dependent and quite different among the particles of the three modes.

Key words: size-segregated, aerosol particles, surface properties, XPS, ToF-SIMS

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