Analysis of the Mixing State of Airborne Particles using a Tandem Combination of Laser-induced Fluorescence and Incandescence Techniques

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We have developed a novel system for real-time measurement of the mixing state of aerosol particles using a tandem combination of laser-induced fluorescence (LIF) and incandescence (LII) techniques. The tandem analysis system comprises two chambers connected in series; particles are analyzed with LIF in the first chamber and LII in the second chamber. We analyzed identical particles using the two methods as judged by the time intervals of detection in the two chambers. This system provides information on the mixing state of fluorescent compounds and black carbon in single particles. Ground-based measurements of ambient particles were performed in Tokyo during October 26–29, 2012. We analyzed 43,881 particles with optical diameters greater than 0.4 mm. The fractions of particles with fluorescent composition, black carbon, and both were 14.2%, 2.3%, and 0.3%, respectively, which indicates the presence of internal mixtures of black carbon and fluorescent species in the ambient air for the first time. Mixtures of biological materials (estimated from fluorescence patterns) and black carbon were also detected. The fluorescence patterns of single particles with and without black carbon were almost identical, suggesting that particles with both black carbon and fluorescent composition might be formed by aggregation in ambient air.

Keywords: Black carbon, Fluorescent particles, Mixing state

