



Identification by single-particle soot photometer of black carbon particles attached to other particles: Experimental basis and ambient measurements

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Black carbon (BC) aerosols, which are strong contributors to positive radiative forcing, are found in the atmosphere as bare BC or as internal mixtures of BC with non-BC compounds (mixed BC-containing particles). Mixed BC-containing particles can be broadly classified into two morphological types: bare BC on the surface of non-BC particles (“attached type”), or BC embedded within or coated by non-BC compounds (“coated type”). For the same amount of mixed non-BC compounds, enhancements of the mass absorption cross section of BC by the coated type are much larger than those of the attached type. Consequently, identification of the two morphological types in mixed BC-containing particles is important for understanding the impact of BC on climate. We develop a new algorithm to classify mixed BC-containing particles into attached and coated types by using the single-particle soot photometer (SP2), based on laboratory experiments generating and detecting mixed BC-containing particles of known morphological types. Our algorithm allows users to choose an optimal set of operational parameters, depending on their purpose and instrumental conditions. We applied the algorithm to identify the morphology of mixed BC-containing particles with a BC mass of ~ 8.0 fg (i.e. mass equivalent diameter of ~ 200 nm) for fresh urban air in Tokyo and East Asian outflows.