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Laser trapping and Raman spectroscopy of a single black carbon in air

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[Introduction] Aerosol affects the global and regional temperature and climate changes. Black carbon generated by incomplete combustion of fossil fuel and biomass makes a contribution to perturbing the radiative balance and acts also cloud condensation nuclei (CCN). Because the optical and hygroscopic property of black carbon strongly depends on the size and morphology of black carbon, it is very important to investigate individually. Noncontact levitation of a single micrometer- sized water droplet can be achieved by laser trapping method. Therefore, laser trapping method is a powerful means to study on aerosol chemistry. However, in the case of light absorbing particles such as black carbon, it is difficult to trap in the air because the force caused by heat is orders of magnitude larger than of radiation pressure. In this study, in order to reveal the effects of black carbon in the atmosphere, the new optical trapping method for black carbon is constructed. Additionally, to observe the surface condition and structural, Raman spectrum was measured.

[Experimental] The commercial acetylene carbon black was used for the sample. Fig.1 shows the experimental system for laser trapping of a single black carbon. A continuous annular trap was created by a 532-nm laser beam from a diode pumped solid state (DPSS) laser through an axicon and an objective lens (×60, N.A. = 0.7). Black carbon was introduced into the annular trap by using a micromanipulator (NARISHIGE, MMO-203).

[Result and discussion]We succeeded in laser trapping of a single black carbon (2-25 μm) in air by means of the above described optical system (Fig.2). Furthermore, Raman spectra of black carbon in air were successfully observed.

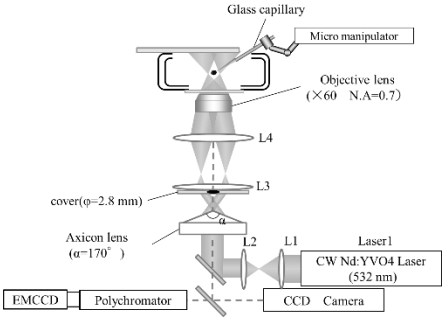

Figure 2: Experimental system for laser trapping of a single black carbon

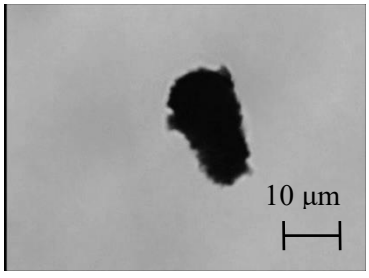

Figure 1: Black carbon in air