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Optical manipulation of aerosol droplets using a double-beam laser trapping technique

SHOJI ISHIZAKA

Hiroshima University

Presenting Author: ishizaka@hiroshima-u.ac.jp

Various types of aerosols composed of both inorganic and organic substances are present in the atmosphere. Therefore, the fundamental knowledge about thermodynamic properties of aqueous droplets containing several solutes is of great importance for predicting cloud droplet formations. Using the laser trapping technique coupled with Raman spectroscopy, the physical and chemical properties of aerosol droplets can be investigated in air [1, 2]. In this study, a double-beam laser trapping technique was used to levitate water droplets containing ammonium sulfate and succinic acid in air. By fusing them under constant relative humidity conditions, the thermodynamic properties of the multicomponent aqueous droplet were investigated.

A 532 nm laser beam from a diode-pumped solid-state laser was passed through a quarter-wave plate to convert linearly polarized light to circularly polarized light and then split into a transmitted and a reflected beam by using a polarizing beam splitter cube. To manipulate aerosol droplets in air, a dual-axis scanning galvano mirror system was installed in one of the two laser beam paths. Both laser beams were combined using another polarizing beam splitter, introduced coaxially into the inverted optical microscope (Olympus, IX73), and focused using an objective lens. Aerosol water droplets containing succinic acid (SA) or ammonium sulfate (AS) were generated using two ultrasonic nebulizers and sequentially introduced into the chamber that was placed on the stage of the inverted optical microscope. The AS and SA droplets were optically manipulated into contact each other and successfully coalesced together to form a multicomponent aerosol droplet.

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[2] Y. Tanaka, Y. Kohaku, and S. Ishizaka (2020), *Bunseki Kagaku*, **69**, 737-740.