PA38) Development of Quantitative Method for the Elements in Individual Micro Droplet

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1. Introduction

Interaction between micro droplet (e.g., fog and cloud droplets) and materials is a complex multiphase process which can lead to corrosion and dissolution, as well as, during evaporation, to the deposition of dissolved salts. In addition to having solute concentration differences that arise from differences in the composition of the condensation nuclei, droplets scavenge soluble gases like nitric acid and ammonia and act as a medium for various aqueous phase reactions, including the oxidation of absorbed SO_2 to sulfate. To know the chemical properties of single droplet is an essential prerequisite for understanding these complex physicochemical reactions in the atmosphere.

Here, we report the preliminary results of the quantitative analysis of the elemental components in a micro droplet by the fixation and synchrotron radiation techniques.

2. Methods

Droplets, unlike dust particles, are unstable. Any contact with a solid surface or another droplet makes the droplet disappear as an entity. Therefore, in the present study, for the fixation of micro droplets artificially dispensed by the Microdrop (MD-E-201, GmbH Co.) α-cyanoacrylate vapor was used (Kasahara et al., 2000) (see Fig. 1).

Individually fixed droplets which contain known concentration of target analyte were also irradiated by the X-ray microbeam at SPring-8 BL-37XU. This analytical method has been successfully used to carry out the reconstruction of elemental map and the quantification analysis for multiple elements with femto gram level sensitivity (Ma et al., 2004).

3. Results and Discussion

It was possible to carry out visual reconstruction of elemental maps for double components (K and Cl) in an artificial individual droplet (see Fig. 1). The multielemental peaks corresponding to X-ray energy were also successfully resolved (see Fig. 2). Further trying to yield quantitative measures of elemental mass within individual natural droplets is summarized in Fig. 2. The chemical content of solute of individual micro droplets, which was definitely clarified in this study, can provide important information for the evaluation of droplet forming and pollutant scavenging.

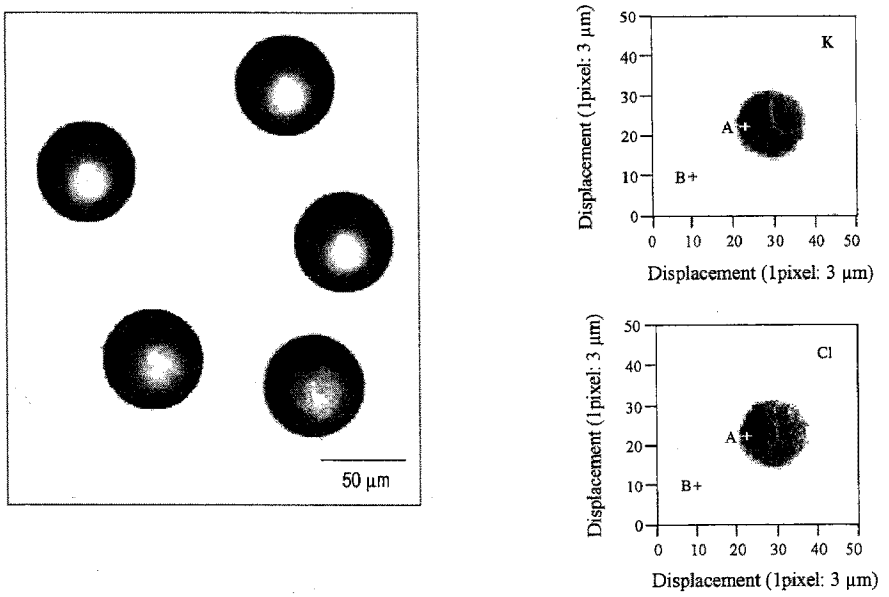

Fig. 1. Fixed artificial micro liquid droplets by the vapor of α-cyanoacrylate monomer(left) and XRF elemental maps of K and Cl in a droplet generated by 10 ppm KCl solution(right). A 10 keV X-ray microbeam with 5 μm diameter was scanned on 150x150 μm^2.

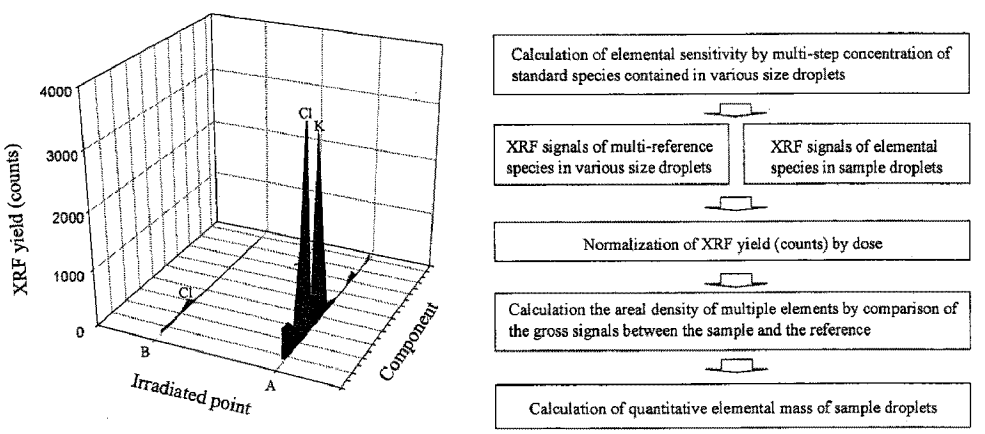

Fig. 2. The XRF yield of Cl and K at two irradiated points(sample and blank) in right of Fig. 1(left) and further trying to yield quantitative measures of elemental mass in the natural individual droplets(right).

References

Kasahara, M., S. Akashi, C.-J. Ma, S. Tohno, and Y. Ohnishi (2000) Physicochemical characteristics of individual fog droplets and raindrops, Environ. Conserv. Eng., Japan, 29, 822-827 (in Japanese).

Ma, C.-J., S. Tohno, M. Kasahara, and S. Hayakawa (2004) The nature of individual solid particles retained in size-resolved raindrops fallen in Asian dust storm event during ACE-Asia, Japan, Atmos. Environ., 38, 2951-2964.