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PA54) Creating the 3-D Elemental Map of a Raindrop by CT Scan

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1. INTRODUCTION

To understand the scavenging mechanism of air pollutants by rain, it is strongly required the study of individual raindrops such as inner structure and mixing state of chemical species. In the present study, an attempt was proposed to visualize the three-dimensional chemical inner-structure of a single raindrop using XRF tomography as like a computed tomography(CT) scan. In here, the preliminary and expected outcomes are briefly introduced.

2. METHODS

For the purpose of size-classified raindrop sampling, a raindrop-sampling device made by the author's own design(Ma et al., 2004) was employed. This unique raindrop collector consists of a dewar vacuum flask filled with liquid nitrogen, five-stage stainless steel sieves with different mesh size(2.36mm, 1.7mm, 1.0mm, 0.71mm, 0.5mm), and back-up stage. Fallen raindrops into the liquid nitrogen were frozen and they sink to lower sieves owing to their higher density.

For the elemental quantification and mapping of the pollutants retained in raindrops, the XRF microbeam system equipped at Super Photon ring 8GeV(SPring-8) BL-37XU(Ma et al., 2004) was applied(see Fig. 2). In a vacuum specimen cell, as shown in Fig. 2, a single frozen rain- drop on a cooling rotation stage is rotated 360 degrees around the 10keV X-ray microbeam.

3. RESULTS AND DISCUSSION

At present stage, the plan of visualization of a flatten raindrop, which is preserved in the collodion film(Ma et al., 2003) as a replica, worked pretty well. As the second step, building up the separated maps of each sliceinto the 3-D spherical shape is going ahead. It will be possible to get the X-ray tomography images and XRF spectra of the raindrop's each slice planes. Finally, three-dimensional chemical inner-structure of a single raindrop will be visualized. Consequently, this novel attempt is expected to give new and great information about drop formation processes, rainout, and washout mechanisms. Above all, when this trial achieves success, the results obtained from field studies make certain of the truth that the wet removal processes is one of final dissipation mechanisms of ambient particles including the Asian dust particles.

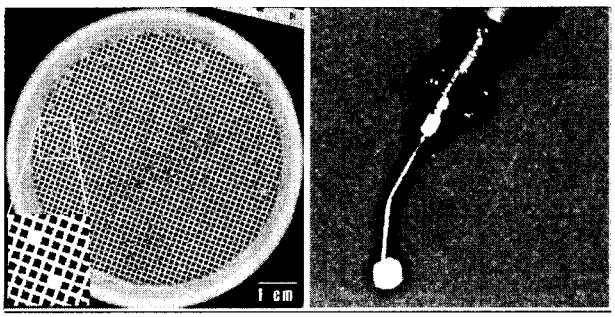

Fig. 1. Individual frozen raindrops collected on a mesh stage(1.7mm mesh size)(left) and the handling of a frozen raindrop using a vacuum pipette(right).

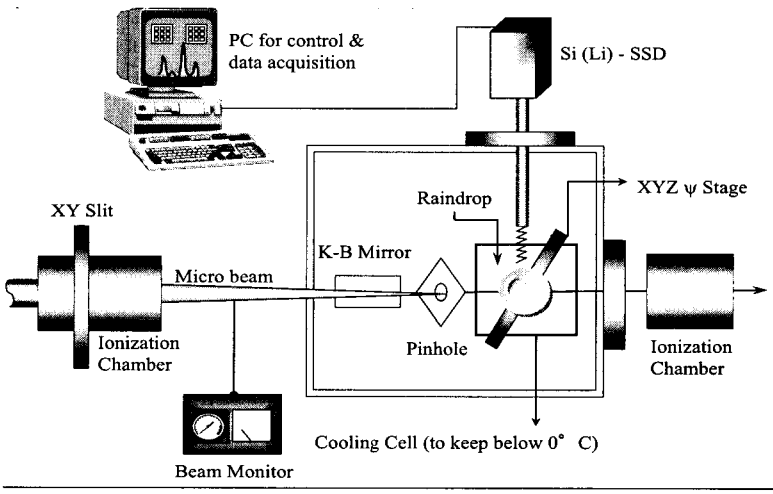

Fig. 2. Schematic illustration of the experimental setup for the XRF microprobe at SPring-8 for the 3-D visualization of element distribution in a single raindrop.

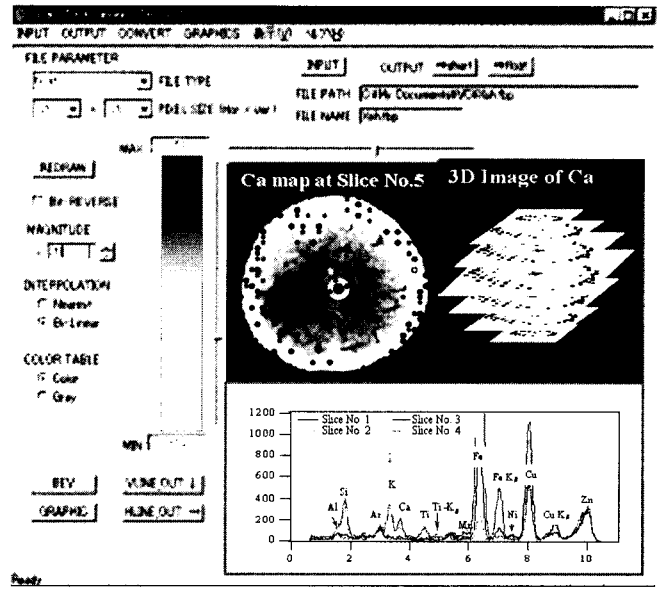

Fig. 3. A really good finished 3-D Ca image by the cinematic techniques. It's just a probable outcome.

REFERENCES

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