Development of microbeam analysis system for single aerosol particles

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Abstract

Aerosol particles are characterized by physical and chemical factors such as size, volume and chemical composition, and carry information about source of origin and kind of generating process. Normally, the properties of aerosols are characterized as an average of a large number of particles by analyzing bulk samples and thereby averaging over many single particles. However, analysis of single aerosol particles is indispensable for source identification and for an understanding of the formation mechanism. Therefore, we have developed a microbeam analysis system to analyze the elemental composition of single aerosol particles as well as their density with 1μm spatial resolution. By combining PIXE with RBS, off-axis STIM and STIM methods, we are capable of analyzing all elements and determine the chemical composition of single aerosol particles. The system composed of two X-ray Si(Li) detectors for PIXE analysis, an annular Si surface barrier detector for RBS analysis and a Si-PIN photodiode for STIM analysis.

Aerosol particles are impacted on a thin polycarbonate film (～0.3μm). The thin polycarbonate film allows to measure protons scattered from the sample without spectral distortion by the backing in RBS and off-axis STIM measurements. Hydrogen, matrix elements and trace elements were measured by off-axis STIM, RBS and PIXE, respectively. Elemental composition of single aerosol particles was deduced from the spatial distribution of elements. The described system is a powerful tool for source identification and understanding of aerosol formation process.