

A high-voltage pulsed power supply for on-site mass spectrometry in future solar system explorations

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Isotope-ratio mass spectrometric analyses have been frequently utilized in laboratories for not only the earth planetary science but also other scientific and industrial fields. In the planetary science, such mass analyses of meteorites and returned samples provide detailed information regarding the origin and evolution. Recently on-site measurements by lander and rover missions including high-resolution mass spectrometry have opened the door to a new era of the planetary science. We argue that the on-site mass analysis is capable of directly determining the age of bodies and asteroids and the presence of water. For Japanese future lander and rover missions, we are now developing high-resolution mass spectrometers. Although high-performance mass spectrometers occupy the much room of laboratories, it is possible to develop the mass spectrometers for space applications because the key components including ion optics and electronics are in principle fabricated within the acceptable ranges in terms of the size, weight, and power consumption. In addition, we have already developed several spaceborne mass analyzers for the space plasma observation and have succeeded in mass analyses in space. After conducting the concept design of the mass spectrometers for landers and rovers, we conclude that the feasibilities are enough for the ion optics and almost all the components of the electronics. However, we have estimated relatively low feasibility for the high-voltage pulsed power supply which mostly determine the performance of the time-of-flight mass spectrometers. The laboratory high-voltage pulsed power supplies contain a 'black box' module as the key component that consumes much power. Therefore, we have started reconstructing a high-voltage pulsed power supply for spaceborne time-of-flight mass spectrometers. We have developed evaluation boards of the high-voltage pulsed power supply for reflectron-type multi-turn-type mass spectrometers, which is planned to be utilized in future Japanese landing missions. In this presentation, we will report the instrumentation and test results.

Keywords: High-voltage pulsed power supply, Mass spectrometry, Isotope