

miniECRIS-MS: A Portable Mass Spectrometer Using a Plasma-based Ion Source

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We have been developing a mass spectrometer based on plasma ion source, ECRIS (Electron Cyclotron Resonance Ion Source). The ECRIS has advantages that derived from high vacuum plasma ion source such as 1) high ionization efficiency, 2) high stability and 3) low sample and plasma gas consumption rate, thus it can be applied to various analytical measurements (eg. quantification, isotope ratio analysis and structural analysis). Although ECRIS is known as a large-sized ion source in accelerator facility, we succeeded to miniaturize and mount it on a portable mass spectrometer (called "miniECRIS-MS") for detecting gas compounds¹. It contains a permanent magnet for ECRIS, ion optical system, quadrupole mass analyzer and so on. Its dimension is 900mm x 350mm x 600mm, which enables on-site detection.

In this poster session, we will present two topics as applications of miniECRIS-MS. First, detection of CWA (Chemical Warfare Agent) such as mustard gas and hydrogen cyanide; miniECRIS-MS can be used as a real-time monitoring system for homeland security (preventing acts of terrorism). In this case, the equipment was set up so that CWAs in atmospheric air was directly introduced into ECRIS without adsorption. And operating parameters were optimized for detecting specific elements or fragments in the CWA (eg. Cl for mustard gas). Finally, CWAs whose concentration was far lower than its lethal dosage (LCt50) were observed. The second application is an ongoing project, measurements of liquid samples. Comparing gas samples, liquid sample introduction into high vacuum plasma (ECRIS) is troublesome. However, it can offer great advantages over present analytical methods such as ICP-MS in terms of stability, initial/running costs, portability and for specific elements, sensitivity. The difficulty and solution for introducing liquid samples are discussed.

(1) T. Urabe et al., Spectrochim. Acta A, 120 (2014) 437-444.