Development of new stigmatic imaging mass spectrometer and its application to metal cation distribution in fish

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Measurement methods of spatial distribution of molecules such as proteins and drugs at cellular-scale are required in many fields. Recently, scanning type imaging mass spectrometry (IMS) with matrix-assisted laser desorption/ionization (MALDI) is intensively used for biomolecular analysis. However, the spatial resolution of scanning MALDI-IMS is limited by to about 10 - 100 μm and inadequate for cellular-scale observation. Therefore, we are developing a stigmatic MALDI imaging mass spectrometer for higher spatial resolution. The experimental apparatus consists of a MALDI ion source, a multi-turn time-of-flight mass spectrometer (MULTUM) and a time and position sensitive delay line detector. Ion distributions at the sample plate are magnified and projected with the ion optical lens system onto the detector. The ion optical system of MULTUM satisfies the perfect spatial and temporal focusing condition, so that the spatial distributions of ions conserved after circulation. Our evaluation experiment demonstrated that both the spatial resolution of 1 micro-meter and the mass resolving power of 10000 were simultaneously achieved. We applied this new apparatus to several practical applications, for example observation of the distribution of accumulated metal cations in fish. We used medaka (Oryzias latipes) as samples for observing the bioaccumulation of Sr and Cs. Medaka were raised for two weeks in water containing 0.001 mol/L SrCl₂ and 0.05 mol/L CsI. Distributions of Cs and Sr in a sliced section of medaka are obtained with a micrometer-scale spatial resolution.

Biography

Jun Aoki has completed his PhD from Kyoto University. He is the Assistant Professor of Osaka University. His field of expertise is imaging mass spectrometry. He prized the Mass Spectrometry of Japan Research Award in 2012.

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