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無機質量分析法を用いたマルチスケール元素イメージング
Multi-scale elemental mapping analysis for biochemical tissue samples using laser ablation-ICP-mass spectrometry

平田 岳史 [1*] ; 小原 聖也 [1] ; 向山 翔 [1] ; 服部 健太郎 [1] ; 坂田 周平 [1] ; 鈴木 敏弘 [2]
HIRATA, Takafumi[1*] ; OHARA, Seiya[1] ; MUKOYAMA, Sho[1] ; HATTORI, Kentaro[1] ; SAKATA, Shuhei[1] ; SUZUKI, Toshihiro[2]

[1] 国立大学法人京都大学, [2] 国立大学法人東京工業大学
[1]Kyoto University, [2]Tokyo Institute of Technology

Laser ablation sampling technique combined with ICP-mass spectrometry (LA-ICPMS) has become one of the most sensitive and versatile analytical tool for elemental imaging for minerals, fossils or various biological tissue samples. Laser sampling under the atmospheric pressure conditions can provide high analytical capability to accept large-sized samples ranging from 10 μm to 25 mm with the optimum spatial resolutions. With the 75 μm laser beam, from major elements (e.g., C, Na or Ca) to trace-elements (e.g., Ni, Se or Mo) can be monitored. With newly developed square-shaped laser beam can provide flat sample surface even after the laser ablation. After the survey scan using the square-shaped laser pit, elemental imaging with high-spatial resolution can be achieved by the laser ablation using the 5 ? 10 μm pit sizes without any additional sample preparation procedures. With the present analytical protocol, multiple elemental images with different spatial resolution can be obtained. Only the problem is that the determination of elemental concentrations from the sample. Element concentrations would be very important to estimate the absolute amount or rate of elemental metabolism within and among the organs. The quantitative elemental imaging, however, had been retarded by the heterogeneous sampling (variation in the sampling depth or volume), mainly due to the difference in the hardness or color of the samples. To overcome this, we have developed the soft-ablation sampling technique.

With the soft ablation technique, biochemical tissue samples, placed onto the glass substances, were preferentially ablated by the laser ablation under the highly controlled energy fluence (soft ablation). Hence, no laser ablation was made on the glass substrate, because the energy fluence employed for the laser ablation of the biochemical samples was significantly lower than the energy threshold for the glass materials. With the preferential and total ablation of only biochemical samples, we can manage to obtain the homogeneous depth and volume of the sampling.

To take a full advantage of the quantitative imagings, we have developed new software to obtain the imaging data from the repeated line profiling analysis. With the present software, possible correlation among the analytes can be easily evaluated from only the specific area, or lines. Moreover, possible contamination or secondary miving of the elements can also be tested. Another advantage of the present software is to accept almost all the time-profiling information achieved by various analytical techniques. Analytical features achieved by the combination of the LA-ICPMS technique and the present software will be demonstrated.

Keywords: laser ablation, ICP-mass spectrometry, Elemental Mapping, Multiple Scale, New Software