Mass spectrometric imaging technique makes diagnosis easier and smarter

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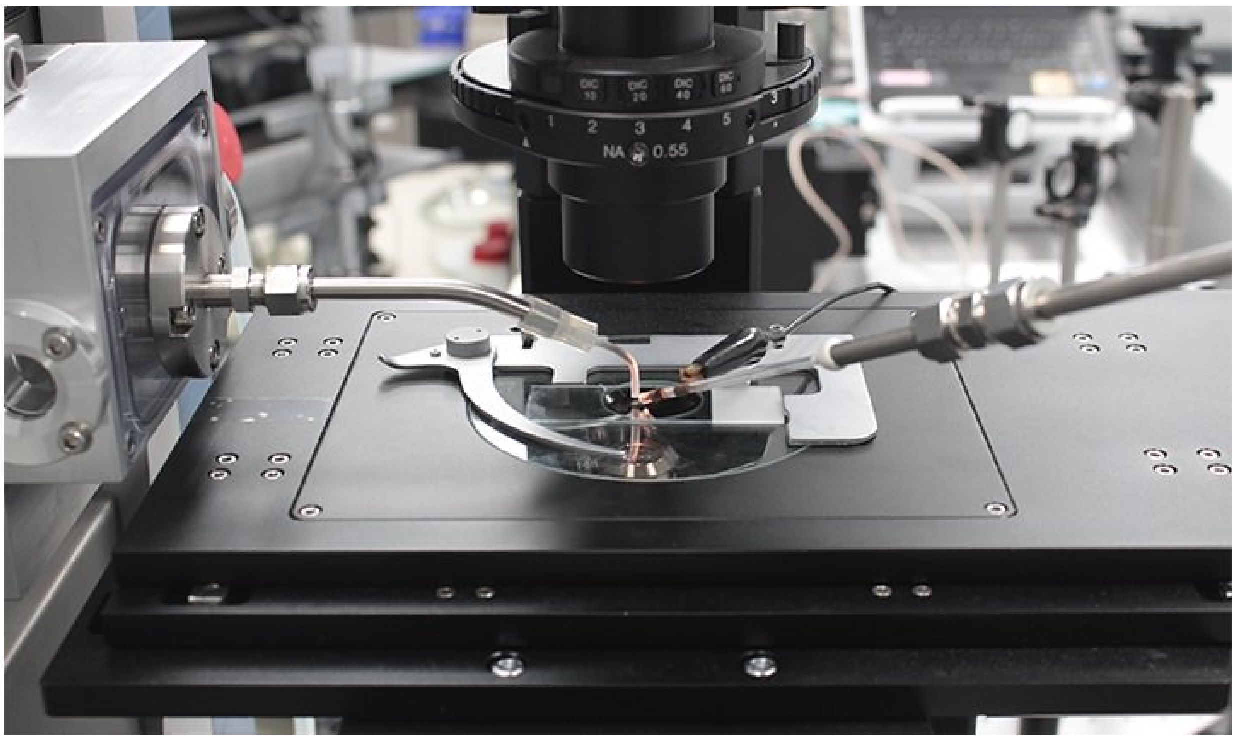

High resolution atmospheric pressure mass spectrometry imaging system. Credit: Daegu Gyeongbuk Institute of Science and Technology (DGIST)

A research team at DGIST has recently developed a technology to acquire high-resolution mass spectrometry imaging in micrometer sized, live biological samples without chemical pretreatment in the general atmospheric pressure environment.

This achievement has been led by Professor Dae Won Moon and Dr. Jae Young Kim from the department of New Biology at DGIST. Mass spectrometry imaging system is a technology to measure how much of a substance exists in a certain region as it acquires biomolecular information of tissues and cells. It also acquires the spatial distribution of biomolecules through the measurement of the mass of biomolecules by desorbing biomolecules from tissues and cells.

Researchers typically use an ion beam desorption system or a laser desorption method in which biomolecule samples are separated in a vacuum state to obtain a high-resolution mass spectrometric imagery. However, in order to accurately analyze the sample by placing it in a vacuum chamber, pretreatment processes such as cutting the frozen samples or chemical treatment were required. In the process, side effects occurred, such as damaging the samples or loss of molecular information.

Although research on mass spectrometry and mass spectrometry imaging methods in the atmospheric pressure environment have been carried out around the world, they have not been directly applied in biomedical science and medicine due to the performance limitation of ionizing biological samples under atmospheric pressure,

In the study, the research team used a femtosecond laser to desorb biomolecules from biological samples and a plasma jet to ionize biomolecules and analyzed mass spectrometry of biological samples at the same time. Furthermore, the researchers spread gold nanoparticles on a biological sample by utilizing the endocytosis of live tissues, and changed the light absorption properties of biological samples so that biomolecule desorption can easily occur with low laser power.

In order to solve engineering problems that may occur during atmospheric pressure ionization, they added an ion transmission device, a laser focusing lens, a 2-D scanning stage, and a signal synchronization circuit between devices and completed the system.

Using this system, about 250 biomolecule substances were extracted from hippocampal tissue sections of mouse brain, and mass spectrometry imaging with resolution of 3 μm or less was obtained from 10 biomolecule materials. In addition, adjacent tissue sections taken from the same rats were used to determine the effectiveness of the drug at the biopsy level.

Through the findings of this study, it is expected that the reliability of new drug development can be improved and the sacrifice of laboratory animals can be reduced by using a mass spectrometry imaging system as an organization-based drug screening technology.

Professor Moon said, "You can acquire a large amount of undamaged biomolecule information from biological samples that have metabolic activity. At the same time, you can visualize it in high-resolution. Therefore, this technology will significantly contribute to molecular biology research." He also added "We will carry out further studies to widen the molecular weight range that are detectable in the sample and utilize them in the field of medical diagnosis such as development of new drug screening and mass spectrometric endoscopy."

More information: Jae Young Kim et al, Atmospheric pressure mass spectrometric imaging of live hippocampal tissue slices with subcellular spatial resolution, *Nature Communications* (2017). DOI: 10.1038/s41467-017-02216-6

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