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Mass Spectrometry & Purification Techniques

Commentary

Imaging Mass Spectrometry: Analytical Method for Determination of Biomarkers

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DESCRIPTION

A potential analytical method for determining and visualizing the spatial distribution of particular chemical compositions, such as biomarkers, metabolites, peptides/proteins, by their molecular weights, is known as Mass Spectrometry Imaging (MSI), sometimes known as Imaging Mass Spectrometry (IMS). Numerous analytes, including as metabolites, lipids, peptides, proteins, and glycans, can be spatially resolved and observed without labelling. Thus, MSI is a flexible technology with a variety of applications in clinical diagnostics and pathology, food science, forensics, natural goods, pharmaceutical research and development, plant sciences, spatial lipidomics and metabolomics, and whole-body analysis. To connect molecular profiles to tissue substructures or other properties, other imaging modalities, such as histology, can be used to overlay the molecular information obtained by MSI. For precise mass measurements, MSI in METRIC is carried out utilising Infrared Matrix-Assisted Laser Desorption Electrospray Ionization (IR-MALDESI) and a high resolving power mass spectrometer. Our data analysis pipeline is built on the free, open-source, vendor-neutral MSiReader software, which was created at NC State.

Measurements by imaging mass spectrometry

Regardless of the coating technique, IMS measurements should be carried out as soon as possible following matrix application. We must optimize the mass range, detector gain, and laser power because the process for obtaining a suitable spectrum in IMS measurements is nearly identical to that for conventional MALDI-MS experiments. There are two distinctions between MALDI-MS and MALDI-IMS in terms of mechanical settings. One distinction is that a two-dimensional zone must be chosen for analysis in IMS measurements. Additionally, because MALDI-IMS uses laser pulses to ionize molecules, the scan pitch, which determines the spatial resolution of the image, must be fixed. The size of the laser and mechanical movement control determine the scan pitch, or the interval between scans. Currently, a laser of around 25 m can be used to analyse with commercially available equipment.

Types of imaging mass spectrometry

MALDI Imaging: MALDI Imaging is a method that uses a matrix-assisted laser desorption ionisation process to identify intact molecules in a tissue section, such as amino acids, metabolites, medicines, lipids, and proteins. Mass spectrometry imaging by MALDI imaging, also known as the molecular histology approach, is the most sensitive and reliable method for concurrently detecting thousands of molecules.

LA-ICP-MS imaging: LA-ICP-MS imaging is a different method of mass spectrometry imaging. A tissue segment can contain elements that can be detected using a laser ablation inductively coupled plasma apparatus. When used in conjunction with MALDI imaging, LA-ICP MS imaging is an excellent tool for examining the distribution and quantification of elements like Iron, Copper, Calcium, and Zinc that are crucial for cell growth and homeostasis.

Imaging mass cytometry (Hyperion, Fluidigm technology): High multiplex Immuno staining is a technique used with the Hyperion Imaging System (uses antibodies coupled to stable metal isotopes). A tissue segment can be analysed using the Fluidigm Corp. technology with a resolution of 1 m. The ability to see more than 40 markers concurrently from a single slide is the main benefit of imaging mass cytometry over fluorescence microscopy. And because each metal isotope has a unique detection peak and does not overlap with other metal isotopes, there is essentially no noise in the data. The contrast between the markers of interest and the background is optimal for picture analysis because there is essentially no background noise.

Multimodal imaging mass spectrometry: The limitations of the single imaging MS technique can be overcome by multimodal imaging MS, which provides more information than just a single independent imaging modality. Depending on the application, imaging MS may not be as sensitive as a label-based imaging technique, have insufficient throughputs, be restricted by spatial resolution, lack an adequate field of view, or be unable to repeatedly perform temporal in situ analysis on a live subject.

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