New MALDI MS Imaging Revolutionizes Disease Diagnosis

Ultra high-resolution protein fingerprinting of biopsy samples by MALDI MS imaging used for early-stage diagnostics and therapeutics

Background:
Matrix-Assisted Laser Desorption Ionization (MALDI) is an ionization technique often used for mass spectrometric (MS) analysis of large biomolecules, such as proteins. Direct MS analysis imaging of a tissue sample provides spatial and chemical information on hundreds of molecules at a time, correlating molecular composition and disease pathology, and ultimately leading to a diagnosis. However, without sample preparation technology, the resolution of MALDI MS imaging is in the range of 1 mm, which is inadequate for comprehensive protein profiling of small tissue or cellular samples. Moreover, sample preparation takes hours and expensive instrumentation is required, leading to irreproducible results and unreliable images.

The current invention overcomes these limitations with a novel MALDI sample preparation method that enables high-resolution protein profiling up to 1 µm. This technology increases spatial resolution by fifty times, while reducing sample preparation time and costs by a hundred times compared to existing processes. Accurate molecular landscape images of biopsy samples are rapidly produced using this innovative method, thus prompting rapid and accurate diagnosis of a wide range of diseases.

Summary:
- In this process, a sample for analysis by mass spectrometry is treated with a solution comprising both a solvent-based fixative and a MALDI matrix.
- These methods combine high tissue integrity through temperature controlled diffusion kinetics with simultaneous crystallization of matrix and analytes during sample preparation.
- When the tissue is fixed with cold solvent and in the presence of matrix, high resolution spatial mapping is produced for protein, lipid, sugar, and/or nucleic acid distribution.
- The simultaneous treatment of tissue samples with a fixative and matrix prevents proteins from moving or diffusing from their original location,

Advantages:
- This unique MALDI MS tissue preparation method for generates ultra-high resolution 2-D protein profiles for biopsy samples
- Preparing tissue samples of frozen tissue sections using this method prevents protein diffusion, yielding accurate and precise MALDI MS images.
- Provides inexpensive, expeditious, and reproducible methodologies for sample preparation that are compatible with histology protocols currently employed by pathologists for diagnosing diseases.
- By incorporating with existing MALDI mass spectrometry instrumentation and statistics method, this technology will prompt rapid and accurate diagnosis of a wide range of diseases as well as leads for new drugs to combat them.