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Nanoshell Co-Matrix for Protein/Peptide Characterization in Mass Spectrometry

In the last decade, desorption/ionization mass spectrometry (DIMS) has gained much attention in clinical diagnostic applications because of its high accuracy and high-throughput screening capabilities. However, the use of chemical matrices introduces inherent limitations resulting data quality issues (low sensitivity, poor reproducibility, etc.). To overcome these limitations, nanostructured materials were developed to replace chemical matrices. The high-energy laser absorptions of these materials greatly enhance the efficiency of analyte desorption and ionization, but their high affinity for hydrocarbons and other ambient species generates background interference in the low end of the mass spectrum. New methods are needed to overcome these problems.

Prof. Tony Hu, at Arizona State University, and his collaborator at Houston Methodist, have developed a novel nanoshell platform for enhanced laser desorption/ionization of analytes in biological fluids. The optical and surface properties of these nanoshells can be tailored to generate appropriate particles having high energy absorption across the spectrum of the UV laser employed. This enables the nanoparticles to act as a co-matrix, enhancing analyte desorption/ionization and subsequently detection sensitivity. Nonspecific binding of species in biological fluids can be essentially eliminated for further enhanced MS signals. Proof of concept studies have been completed and sub-femtomolar concentrations of target analytes were detected.

This novel nanotechnology platform offers scalability, precision, and reproducibility for greater translation into clinical applications with enhanced sensitivity.

Potential Applications

- Co-matrix to enhance analyte desorption/ionization in mass spectrometry
  - Clinical diagnostics
  - Screening
  - Studying drug metabolism
  - Research

Benefits and Advantages

- High surface area for laser absorption
- Efficient transfer of energy to maximize peptide detection
- Can be optimized to detect targets at a 0.1 fmol limit
- Provides platform for preserving serum protein/peptide markers for long-term storage and subsequent MS analysis
- The nanoshells have a robust construction and can be manufactured in large quantities at very low cost ($3/test)
- Significantly reduces nonspecific recognition to reduce the rate of clinical false-positives

For more information about the inventor(s) and their research, please see Dr. Hu's departmental webpage