Skysong Innovations
Advancing the Arizona State University Knowledge Enterprise

1475 N. Scottsdale Road, Suite 200
Scottsdale, AZ 85287-3538
Phone: 480 884 1996 Fax: 480 884 1984

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Inventors

Alexandra Ros
Jorvani Cruz Villarreal
Ana Egatz-Gomez
Todd Sandrin
Paul Coleman

Contact

Jovan Heusser
jovan.heusser@skysonginnovations.com

Laser Capture Microdissection (LCM) Microfluidic Platform for Single-Cell Proteomic Analysis

Single-cell proteomics is an emerging field for proteomic analyses of individual cells. Single-cell genomic analyses have greatly expanded our understanding of cell heterogeneity and disease progression; however, protein identification and quantitative cell-to-cell variation provide a deeper level of understanding of the biological regulators in the cell. This is particularly relevant in diseases such as Alzheimer's (AD), where certain peptides and proteins contribute to neurotoxicity and pathogenesis, so understanding their abundance could help in the development of better diagnostics and therapeutics. While there are proteomic tools for cell ensembles, because of low protein quantities in singles cells and the complexity of the proteome, quantitative protein analysis at the single-cell level remains a challenge.

Researchers at Arizona State University have developed a novel tool that enables the assessment of protein contents of small cell ensembles, eventually down to single cells, by combining laser capture microdissection with an integrated microfluidic platform that works in tandem with MALDI-TOF-MS. The microfluidic platform, termed MIMAS, allows for cell loading, sample processing and in situ mass spectrometry analysis all on-chip. This tool was used to assess cells dissected from archived human brain tissue and was applied for the detection of intracellular amyloid-β peptide, a hallmark of AD.

This tool is a microfluidic immunoassay for in situ mass spectrometry analysis of intracellular proteins to advance the understanding of biological phenomena for clinical and biological research.

Potential Applications

- Proteomic analysis of cell ensembles eventually down to single cells
  - Therapeutics
  - Diagnostics
  - Biomarker characterization

- Research

Benefits and Advantages

- Enables selective dissection of individual cells from tissue
- The integrated microfluidic platform enables cell loading, sample processing and in situ MS characterization all on-chip
- Has demonstrated the detection of Aβ species in situ from as few as 20 cells
- LCM-MIMAS could become a powerful tool to elucidate the origin of AD and other diseases through the novel, sensitive capabilities to identify Aβ species and other crucial disease proteins within small cell populations
- Potential advantages in resolution, time of analysis, specific disease model to be studied and when tissue is a limiting factor

For more information about this opportunity, please see

Cruz Villarreal et al – Anal Bioanal Chem - 2022

Cruz Villarreal et al – Anal. Chem. - 2023

Cruz Villarreal – Dissertation Preview - 2022

For more information about the inventor(s) and their research, please see

Dr. Ros' departmental webpage

Dr. Sandrin's laboratory webpage

Dr. Coleman's departmental webpage