Research Development Fund – Fall 2023

Application Title: New MALDI-TOF/TOF Mass spectrometer with tandem mass spectrometry feature

Lead contact for RDF Application:

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Key Participating Units: College of Arts and Sciences, College of Engineering, College of Agriculture & Life Sciences, School of Veterinary Medicine & Biomedical Sciences

RDF Amount Requested ($): $482,266.7

Executive Summary

The objective of this application is to acquire a state-of-the-art Bruker MALDI-TOF/TOF mass spectrometer, advancing Texas A&M's core research infrastructure for structural characterization of small organic molecules and macromolecules including polymers, dendrimers, oligonucleotides, carbohydrates, peptides, and proteins. Specific research enhancement goals of this proposal include (1) replacing a 12-year-old, unreliable MALDI-TOF instrument with a new MALDI-TOF/TOF instrument, offering enhanced sensitivity and superior spectral resolution; (2) Introducing the valuable tandem TOF (TOF/TOF) feature, revealing structural insights into complex and unknown molecules, and (3) elevating the potential to secure extramural research funding by raising research quality and output.

The Chemistry Mass Spectrometry Facility (CHEM MS Facility) at TAMU operated by expert scientists from the Chemistry Department, maintains advanced mass spectrometers. Their expertise ensures the provision of precise results with rapid turnaround times, sustains the equipment and has established the facility's outstanding reputation, driving substantial research output. The CHEM MS Facility currently utilizes the MALDI-TOF mass spectrometer (Microflex LRF, Bruker) to serve a diverse range of users, particularly in the characterization of macromolecules. This instrument excels in analyzing large and labile macromolecules due to its combination of MALDI soft ionization and TOF mass analysis. However, the existing MALDI-TOF instrument faces several limitations. Most notably, the instrument is prone to high-voltage arcing, leading to a compromise in mass accuracy or, in some cases, rendering it non-operational. Additionally, it suffers from low resolution and sensitivity. Compounding these issues is the fact that the instrument was 12 years old and has reached its intended retirement age. A major breakdown of this instrument would halt research progress across multiple research groups and jeopardize external funding. The proposed MALDI-TOF/TOF (ultrafleXtreme, Bruker) system not only addresses these limitations but also introduces significant enhancements to analytical capabilities. The new instrument offers a resolution exceeding 40,000 m/Δm and a mass variation lower than 2 ppm, significantly enhancing data quality. Moreover, it introduces new features such as tandem TOF and extremely high sensitivity, providing valuable insights into complex samples, unknown structures, and trace compounds.

The acquisition of the ultrafleXtreme MALDI-TOF will greatly benefit a wide array of researchers, spanning chemistry, biochemistry, material science, biomedical engineering, and plant and animal science. This proposal has garnered substantial interest, with over 30 PIs expressing a keen desire to utilize the new instrument. More importantly, around 20 PIs, 2 departments, and the College of Arts and Sciences commit funds to support the instrument purchase. This widespread interest and faculty support underscore the instrument's crucial role in advancing scientific research across multiple disciplines. Notably, the unique combination of MALDI and TOF/TOF capabilities is currently absent at TAMU. Adding such an instrument will enable and expedite sophisticated experiments, increasing the chances of securing external grants across multiple departments. Any research endeavor requiring the analysis of intricate macromolecules, whether known or unknown, will significantly benefit from this proposed instrument.