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Foreword

Imaging mass spectrometry imaging

The "ideal" measurement from a heterogeneous, living biological system would include temporal and spatial information on all the chemical species present in that system. While currently there is no measurement process that can provide such multi-dimensional information, optical microscopy provides unmatched spatial information and mass spectrometry provides unparalleled chemical information. Thus, it is not surprising that there is significant interest in combining the spatial information provided by a microscope with the extensive chemical information content provided by mass spectrometry.

Mass spectrometric imaging partially has its origins in laser desorption/ionization (laser microprobe) approaches, which, in the 1970s, provided the ability to spatially focus a laser at a particular location and acquire a mass spectrum from the ions in the resulting plume. Of course, secondary ion mass spectrometric imaging, although having origins much earlier with Herzog and Viehböck, achieved many advances. However, limitations in the ionization sources prevented higher mass analytes from being detected, and limits in software/hardware capabilities made image acquisition painstaking. Nonetheless, by the early 1980s, multiple examples of both ionization sources being applied to biological tissues had been reported. With the introduction of MALDI in 1989, application of matrix-based imaging to a large variety of biomolecules soon followed, with imaged surfaces ranging from thin layer plates to biological tissues.

While the combination of imaging and mass spectrometry has a long history, it is a history of acceleration. The last few years have seen an explosion of technologies, protocols and applications. The major goal of this Special Issue is to highlight the current capabilities of mass spectrometry when adapted to imaging, and to hint at what the future holds. The 18 articles in this issue highlight a diverse suite of applications and instrumental approaches. One series of articles relates to organism development, neuroscience and disease; included are images ranging from several hundred points to more than 10-million spatially distinct points, with spatial resolutions ranging from hundreds of nanometers to hundreds of microns. The molecules imaged include metals, lipids, peptides and proteins, and the samples range from standards to tissues, blots and cells. Additional articles highlight instrumental improvements, software algorithms and statistical approaches for large data sets. One common feature is that every article contains at least one spatially resolved image!

As the exciting research described in this Special Issue and elsewhere continues to contribute to relating chemistry to biological function, there is little doubt that more organized efforts will further advance the subfield of analytical chemistry involved in combining microscopy and mass spectrometry. The importance of this investigative focus is increasingly being recognized as it is now included as a major topic at most of the larger analytical conferences held throughout the world. We certainly believe these technologies are having an impact and, in the decades to come, will be integral to describing organisms from a cellular perspective. Hopefully, after looking through this issue, you will agree.

And as our final comment, we sincerely thank all of the authors for their timely contributions to this Special Issue, and the anonymous reviewers for their efforts in making these articles such high quality publications.

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