

Chemistry Departmental Colloquium

New frontiers in preparative and imaging mass spectrometry

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Abstract:

Our research advances mass spectrometry instrumentation for precision materials fabrication with beams of mass selected ions and for high resolution spatial mapping in biological samples. Building on a deep mechanistic understanding of ion-surface chemistry, we developed custom ion deposition platforms that provide precise control over mass selected ion delivery and probe the reactivity of intact precursors and fragments. Recent high flux soft landing capabilities enable controlled multilayer architectures and synthesis from ion fragments, supporting rational design of functional interfaces using ions as building blocks and positioning ion soft landing as a selective strategy for energy storage, catalysis, and materials synthesis. In parallel, the development of nanospray desorption electrospray ionization (nano DESI) enables high resolution imaging of lipids, metabolites, proteins, carbohydrates, and drugs in biological and environmental samples with sub 10 μm spatial resolution. By integrating nano DESI with ion mobility spectrometry, tandem mass spectrometry, and rapid online derivatization, we have established isomer selective molecular imaging as a powerful technique for studying biochemical pathways and unraveling disease progression. Furthermore, the new microfluidic nano DESI probes accelerate translation and commercialization of this platform.



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