Overview

- The performance and optimization of a Structures for Lossless Ion Manipulations (SLIM) printed circuit board-based ion mobility mass spectrometry system is presented.
- High sensitivity has been demonstrated, enabling lossless ion mobility and mass spectrometric measurements.
- Ions can be moved in linear paths or turned 90° in various SLIM segments.

Introduction

- Ion Mobility Spectrometry/Mass Spectrometry (IMS/MS) is a powerful separations technique that separates gas phase ions by shape/charge and mass/charge ratios.
- High IMS resolving power coupled to high sensitivity IMS/MS measurements allows for increased peak capacity and improved separations of conformer and isomer ions, and also enabling enhanced signal-to-noise high-throughput measurements of complex e.g. global panomics systems.
- IMS resolving power can be improved by several methods for a given ion pulse length and ion charge: 1. Increasing pressure and electric field while optimizing E/N; 2. Decreasing temperature; 3. Increasing drift cell length.
- Practical considerations make increasing pressure and decreasing temperature while maintaining lossless transmission difficult.
- Clemmer et al. have demonstrated >10000 resolving power by using a "mobility cyclotron" and multiple injections by increasing the effective drift cell length to 182.86 m.

Results

- SLIM geometries included six linear segments and three linear segments followed by a T segment followed by two additional linear segments.
- SLIM segments utilize 190° out of phase RF on neighboring RF electrodes to provide pseudopotential wells for lossless ion transmission.
- SLIM geometries included six linear segment and three linear segments followed by a T segment followed by two additional linear segments.
- IMS/MS measurements allows for increased peak capacity and improved separations of conformer and isomer ions, and also enabling enhanced signal-to-noise high-throughput measurements of complex e.g. global panomics systems.
- IMS resolving power can be improved by several methods for a given ion pulse length and ion charge: 1. Increasing pressure and electric field while optimizing E/N; 2. Decreasing temperature; 3. Increasing drift cell length.
- Practical considerations make increasing pressure and decreasing temperature while maintaining lossless transmission difficult.
- Clemmer et al. have demonstrated >10000 resolving power by using a "mobility cyclotron" and multiple injections by increasing the effective drift cell length to 182.86 m.
- Development of linear and T segments with printed circuit board (PCB) technology allows for development of a PCB rectangular continuous drift cell that possesses accurately shaped lossless ion manipulations with high sensitivity.

Conclusions

- Ion intensities and arrival time distributions have been measured using linear and 90° turn geometries.
- Intensity and IMS resolving power differences between linear and 90° turn geometries are not significant.
- The turn requires greater confining RF amplitude and guard biases for ions to turn with high sensitivity.
- IMS performance comparable to conventional drift tubes achieved in SLIM.

Methods

- SLIM Device
- Sample Inlet
- Ion Gate
- N2 Inlet
- Rear Ion Funnel
- Short Quadrupole
- Reflectron
- Detector
- DC Quadrupole
- Pusher
- Agilent TOFMS
- Ion Funnel Trap

Introduction

- Ion Mobility Spectrometry/Mass Spectrometry (IMS/MS) is a powerful separations technique that separates gas phase ions by shape/charge and mass/charge ratios.
- High IMS resolving power coupled to high sensitivity IMS/MS measurements allows for increased peak capacity and improved separations of conformer and isomer ions, and also enabling enhanced signal-to-noise high-throughput measurements of complex e.g. global panomics systems.
- IMS resolving power can be improved by several methods for a given ion pulse length and ion charge: 1. Increasing pressure and electric field while optimizing E/N; 2. Decreasing temperature; 3. Increasing drift cell length.
- Practical considerations make increasing pressure and decreasing temperature while maintaining lossless transmission difficult.
- Clemmer et al. have demonstrated >10000 resolving power by using a "mobility cyclotron" and multiple injections by increasing the effective drift cell length to 182.86 m.

Results

- SLIM segments utilize 190° out of phase RF on neighboring RF electrodes to provide pseudopotential wells for lossless ion transmission.
- SLIM geometries included six linear segment and three linear segments followed by a T segment followed by two additional linear segments.
- IMS/MS measurements allows for increased peak capacity and improved separations of conformer and isomer ions, and also enabling enhanced signal-to-noise high-throughput measurements of complex e.g. global panomics systems.
- IMS resolving power can be improved by several methods for a given ion pulse length and ion charge: 1. Increasing pressure and electric field while optimizing E/N; 2. Decreasing temperature; 3. Increasing drift cell length.
- Practical considerations make increasing pressure and decreasing temperature while maintaining lossless transmission difficult.
- Clemmer et al. have demonstrated >10000 resolving power by using a "mobility cyclotron" and multiple injections by increasing the effective drift cell length to 182.86 m.

Conclusions

- Ion intensities and arrival time distributions have been measured using linear and 90° turn geometries.
- Intensity and IMS resolving power differences between linear and 90° turn geometries are not significant.
- The turn requires greater confining RF amplitude and guard biases for ions to turn with high sensitivity.
- IMS performance comparable to conventional drift tubes achieved in SLIM.