Analog-to-Digital Conversion of IMS-TOF MS signals enhances both spectral dynamic range and mass measurement accuracy

**Introduction**

Despite the strong analytical presence of ion mobility spectrometry (IMS) as a stand-alone gas phase separation technique, the levels of precision and accuracy of each separation may be significantly augmented by using a mass spectrometer (MS) as a detection system. A wide range of mass spectrometric systems have been interfaced with IMS; however, the speed of a time-of-flight mass spectrometer (TOF MS) is uniquely suited to examine the varying ion populations exiting and IMS drift cell. Recent advances in ion trapping external to the IMS drift cell have allowed ions to achieve significantly higher charge density to be injected into the IMS drift cell. 3

**Methods**

Proteolytic digestions of bovine serum albumin (BSA) were conducted using sequencing grade trypsin. After digestion, the concentration of each sample was determined using a Bradford assay. Prior to each IMS experiment, ions produced by the electrospray source were allowed to accumulate in the IMS-TOF MS system for 4 ms before being released into the IMS drift cell over the period of 200 µs.

To accurately compare the three different acquisition methods, the full scale of the ADC was 50 mV and the offset for ADC acquisition held at -30 mV. The same offset settings were derived from IMS-TOF MS systems equipped with TOF-MS (Agilent Technologies Inc., Santa Clara, CA). The spectra for each IMS-TOF MS dataset were deisotoped using a modified TDR-SPECTRUM algorithm contained in the data analysis software package Decon2LS developed at PNNL.

**Results**

By incorporating analog-to-digital (ADC) recording techniques, the levels of precision and accuracy of each separation may be significantly augmented by using a mass spectrometer (MS) as a detection system. A wide range of mass spectrometric systems have been interfaced with IMS; however, the speed of a time-of-flight mass spectrometer (TOF MS) is uniquely suited to examine the varying ion populations exiting and IMS drift cell.

**Conclusions**

- Despite providing higher degrees of resolution, traditional ion counting mechanisms such as TDC severely limit the quality of information that may be derived from IMS-TOF MS systems equipped with TDC.
- Because multiple ion events may be recorded per spectrum using ADC, a greater mass range may be observed and data is more readily compared to TDC-based systems.
- The combination of enhanced MMA and dynamic range afforded by ADC acquisition allows a significantly larger number of peptides to be observed for complex samples.
- Combining improvements in both MMA and dynamic range, ADC acquisition increases the number of peptides confidently identified by more than 30%.
- Given the importance of MMA to proteomics, ADC acquisition has the potential to reveal the full extent of peptides observed in complex samples.

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9353 combined with an Ortec 935 constant fraction discriminator (CFD). All acquisition cards were interfaced to a custom software package written in C# written in IGOR Pro (Wavemetrics, Lake Oswego, OR).

**References**