Increasing the Resolving Power of DART

Introduction

The use of mass spectrometry for imaging chemicals on surfaces is a rapidly growing field of interest. DART, a surface ionization technology, uses a heated gas that flows through a relatively large diameter hole in the exit cap of the source. In this work we demonstrate higher resolution desorption ionization by changing the exit cap inside diameter. The interchangeable exit cap can be implemented without further modification of the DART source.

Experiment

For these experiments we fabricated a series of ceramic caps with different internal diameter holes. The results presented here document the difference between sampling with the new cap, where the exit hole diameter is 0.5mm, and the standard 2.5mm hole cap. The gas of the DART was helium heated to 250°C and the gas flow was held constant. A sample image was prepared by printing a series of lines on a stiff stock paper and exposing that sample to the DART. Line width and spacing were reduced across the image from left to right. The DART source was oriented at a 45 degree angle relative to the paper surface.

Improving Spatial Resolution

Results from the analysis of the sample (image shown in figure 1) are shown below. The TIC generated from the larger 2.5mm and the smaller 0.5mm caps are shown in figure 2.

The difference in spatial resolution is observed where the peaks are nearly baseline resolved. Sampling with the 0.5mm cap proved effective for discriminating lines only 2mm apart, while the 2.5mm cap was only able to resolve lines back to baseline down to 3.25mm apart.
Volatile Sample Testing

The next step in this experiment was to evaluate the performance of the small I.D. cap with volatile samples. For this we spotted several QuickStrip™ cards with codeine, a non-volatile, and MDMA, a volatile sample in alternating sample positions. These samples represent common drugs of abuse often analyzed by DART. Results of the analysis of two QuickStrips™ are shown in figure 3.

The result shows a significant improvement when using the new small I.D. cap given the absence of doublets and better peak shape for both chemicals in the 0.5mm data. The relative abundances of each drug are higher with the smaller I.D. cap.

There is no sample carry-over in either EIC and very good signal to noise values can be obtained from this data.

Discussion

Both the 2.5mm and 0.5mm caps are available from IonSense. Recommendations to help the user determine what cap will best fit their analysis are available at www.ionsense.com/caps.

Conclusions

There are a few common trends that happen when comparing the two caps:

- The larger I.D. cap ionizes more material and is useful for bulk analysis
- The smaller I.D. cap desorbs less material doubling the spatial resolution
- Both caps can generate similar sensitivity data
- The small cap typically yields a higher signal to noise value; primarily due to background reduction.