

B33 Sample Introduction Studies for Direct Analysis in Real-Time (DART[®]) Systems

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After attending this presentation, attendees will better understand the sample introduction methods currently available for DART[®] systems and designs with improved performance characteristics. Fundamental aspects of the DART[®] source ionization and optimization will be reviewed along with steps taken during the optimization of key instrumental parameters. Several examples of applications will be provided, including the analysis of trace drug residues on clothing.

This presentation will impact the forensic science community by providing a sound fundamental description of currently available methods for sample introduction into DART[®] systems. While DIP-ItTM glass tips and QuickStripTM cards provide rapid analysis options for some types of samples, additional options based on membranes and adhesive tapes will be presented. The potential advantages that these options offer for several types of samples, including drug residue on clothing and skin, will be described.

Sample introduction methods for DART[®] systems include DIP-It[™] glass tips which are dipped into liquid solutions and QuickStrip[™] cards which consist of a metal wire mesh that can be placed into powder with some sample adhering to the mesh.¹ Custom sample holders have been made from cotton tip swabs with introduction on a motorized rail system.² Results from these devices indicate that analyte signal is generally obtained from the edges of the device where ionized gasses can interact with the sample and the resulting analyte ions are allowed to flow unimpeded into the mass spectrometer. In fact, a cotton swab placed in front of the inlet may result in negligible signal due to blockage of the analyte ions.² The present work involves the design of materials with large edge surface areas and geometries conducive to high gas flow rates. Initial material screening studies will be presented that include monitoring of background ions generated by the DART[®] source ions under various conditions (discharge needle voltage, gas steam temperatures, etc.). Studies were performed using a Simplified Voltage and Pressure (SVP) ion source interfaced to a Linear Trap Quadropole (LTQ) XL[™] linear ion trap mass spectrometer with data analysis using the Thermo Xcalibur[™] software. Custom holders were constructed and placed inline between the DART[®] source outlet and the ceramic tube leading to the Vapur[™] flange before the inlet to the mass spectrometer. Materials were identified that could readily transfer drug residues from clothing and skin for analysis. The new designs and materials allow facile transfer of trace residues for rapid analysis. The methods represent a substantial improvement to the uncontrolled "wanding" of a sample held by tweezers in front of the mass spectrometer inlet.

Reference(s):

- Musselman, Brian D. "Membrane for holding samples for use with surface ionization technology." U.S. Patent No. 8,481,922.
 9 Jul. 2013.
- 2. Grange Andrew H., Sovocool G. Wayne. Detection of illicit drugs on surfaces using direct analysis in real time (DART[®]) timeof-flight mass spectrometry. *Rapid Communications in Mass Spectrometry* 25.9 (2011): 1271-1281.

DART[®], Drug Analysis, Sample Preparation