



### **B16 Semi-Quantitation of Trace Drug Residues on Fabric by Direct Analysis in Real-Time (DART®)**

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After attending this presentation, attendees will better understand the sample introduction methods currently available for DART® systems and the recent progress toward obtaining semi-quantitative results for drug residues on fabrics. Fundamental aspects of the DART® source ionization and signal optimization will be reviewed along with options for extraction of drug residue from a variety of fabrics. Several examples of applications will be provided, including the analysis of trace amounts of methamphetamine and cocaine.

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-It™ glass tips and QuickStrip™ cards provide rapid analysis options for some types of samples, additional options based on membranes and paper disks will be presented. The potential advantages these options offer for several types of samples, including drug residue on clothing, floor coverings, and upholstery, will be described.

The general approach is to add an internal standard solution to cloth and re-absorb the solution using an absorbent material in the shape of a disk. The amount of internal standard solution added to the fabric is matched to the diameter of the absorbent disk to maximize recovery of traces of drug that dissolve in this applied internal standard solution. Initial screening studies were performed with ink-jet printer paper, cellulosic membrane material and glass fiber membranes. Conditions were developed that resulted in reasonable recovery with all types of absorbent disks. After re-absorption, the disks were allowed to dry and were placed between the DART® source and the mass spectrometer entrance. For rapid analysis in the DART® instrument, the disks must allow interaction of the energized gas from the DART® source with the extracted trace drug residue and internal standard. So, prior to use, a portion of the disk was removed using a hole punch or a craft cutter to allow gas to flow through the membrane. Removal of 20%-40% of the disk had a minimal effect on the amount of drug and internal standard recovered, but greatly enhanced the magnitude of the DART® signal. Also, the patterned membrane disks gave signal intensities that were much greater than found with the commercially available sample introduction systems, namely the DIP-It™ glass tips, which are dipped into liquid solutions, and QuickStrip™ cards, which consist of a metal wire mesh.<sup>1</sup> Presumably, the surface area of the patterned membrane is much larger than the surface area of either the glass tip or wire mesh, allowing ionization of much more drug and internal standard.

Comparison of the peak heights of protonated-parent ions associated with several drugs of interest (i.e., methamphetamine and cocaine) with the peak height of the internal standard allowed quantitation of the amount of drug traces in cotton fabric at the five-microgram level. Studies were performed using a Simplified Voltage and Pressure (SVP) ion source interfaced to an 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. Key operating parameters, including the DART® source temperature, were characterized over the range of 200°C-500°C.

In summary, the extraction of drug residues from fabric with patterned absorbent disks in addition to the use of an internal standard in the extraction solution is a promising approach for semi-quantitation of small amounts of drug residue in a variety of fabrics.

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### Reference(s):

1. Musselman, Brian D. Membrane for holding samples for use with surface ionization technology. U.S. Patent No. 8,481,922. 9 Jul. 2013.
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### DART®, Drug Analysis, Trace Analysis