

## **Implementation of DART and DESI Ionization on a Fieldable Mass Spectrometer**

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Direct Analysis in Real Time (DART) and Desorption Electrospray Ionization (DESI) have been shown to have promise for detection of a wide variety of materials, including explosives and chemical warfare agents (CWAs), on “real-world” surfaces. In the work reported here, these two sources were coupled to a small, mobile, rugged tandem mass spectrometer having an atmospheric pressure ionization (API) inlet, to investigate the opportunity for using these methods for security and defense-related applications in the field.

A Griffin 400 mobile MS was modified to include an API inlet to allow testing with electrospray ionization (ESI), DART, and DESI. Commercial DART (IonSense, Inc.) and DESI (Prosolia, Inc.) sources were obtained from the manufacturers and mounted on the MS with minimal modifications. Explosive residues, including TNT and RDX, and CWA simulants, including dimethyl methylphosphonate and methyl salicylate, were detected by spotting solutions of the materials onto a variety of surfaces and allowing the solvent to dry. The residues were then subjected to DESI or DART ionization processes before mass analysis via MS and MS/MS.

A three-stage differential pumping system was designed to provide API capability for the Griffin 400 mobile MS. The system utilized small drag and hybrid turbodrag pumps, backed by diaphragm pumps, to evacuate the three vacuum stages to pressures of 700 mTorr, 10 mTorr, and  $5 \times 10^{-5}$  Torr respectively. This configuration allowed the full MS system to be packaged within the Griffin 400 chassis, measuring approximately 50 cm x 50 cm x 50 cm, with no external pumping required. For the preliminary studies reported here, the commercial versions of DART and DESI sources were mounted on the front of the instrument with mounting structures that allowed optimization of the source/inlet relative positions, angles, etc. Data were collected to determine the detection and identification capability for both sources using MS and MS/MS detection. The effects of relevant source variables, including ionization polarity, gas flow rate, temperature, and sample position relative to the ion source and ion sampling inlet, were studied to explore the applicability of both sources to use in field scenarios, where ease of use and minimization of consumables is desirable.