

INTRODUCTION

The detection of drugs plays an important role in many areas of society. In particular, the ability to detect and identify illicit drugs can assist law enforcement and other organizations in tracking and monitoring drug related activities. However, techniques that can be used outside the laboratory settings are often inefficient and non-specific. Gas Chromatography Mass Spectrometry (GC/MS) provides the most definitive results. With GC/MS, each compound, upon separation, ionization and detection, produces a retention time and mass spectrometric pattern (similar to fingerprinting or a signature) that are unique to the compound. Historically, the use of GC/MS systems has been limited by accessibility, cost and mobility.

Both the Griffin™ 400 and Griffin™ 450, based on compact Cylindrical Ion Trap (CIT) technology^{1,2}, possess the capability and specificity mentioned above, while also providing for sufficient mobility and cost-efficiency. This application note illustrates the detection, identification and quantitation of commonly abused drugs — methamphetamine, cocaine and heroin.

INSTRUMENTATION

- Griffin 450
- Griffin System Software

Gas Chromatograph and Conditions

Temperature Program: 60°C hold for 0.88 minutes, then heat at 50°C/minute to 250°C then heat at 10°C/minute to 290°C and hold for 4 minutes	
Column	0.25 mm x 30 m RTX-5 ms capillary
Injections	1 µL, splitless for 0.68 minutes, 265°C
Carrier Gas	Helium, 1 mL/minute
Sample	Mixture of methamphetamine, cocaine and heroin at 250 µg/mL each in acetonitrile. Working samples are diluted with methylene chloride.

Mass Spectrometer and Conditions

Automatic Level Control (ALC) enabled with maximum ionization time at 150 ms	
Filament Emission Current	10 µA
Mass Scan Range	m/z 50-425
Ion Trap Temp	150°C
Transfer Line Temp	200°C

DATA ANALYSIS

Database Search - NIST, Griffin or User-Defined

Quantitation and Qualifier Ions

Methamphetamine	m/z 58, 91
Cocaine	m/z 82, 105, 182, 303
Heroin	m/z 204, 215, 268, 310, 327, 369

RESULTS / DISCUSSION

SEPARATION AND DETECTION

A short analysis time of less than 12 minutes is achieved using the high temperature ramping rate offered by the Griffin 450. Figure 1 shows the Total Ion Chromatogram (TIC) and Reconstructed Ion Chromatogram (RIC) at 10 ng injection on column.

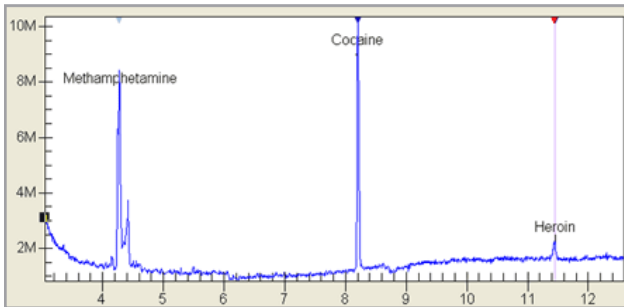


Figure 1: TIC Chromatogram (blue) and RIC Chromatogram (red) at 10 ng injected: Methamphetamine RIC (m/z 58), Cocaine RIC (m/z 82) and Heroin RIC (m/z 327)

The mass spectrum of each analyte detected resembles that in the NIST library, which provides the basis for identification of the drugs detected. Figure 2 shows the typical electron ionization (EI) mass spectra obtained with the Griffin 450 in comparison to those in the NIST library. For methamphetamine at higher concentration levels, the presence of the m/z 150 ion is due to the formation of MH⁺ from a chemical ionization mechanism. This ion, while interfering with the database searching, can be an effective qualifier ion, providing additional confirmation.

CALIBRATION

- Calibration was performed at 0.25, 0.5, 1, 2.5, 5, 10 and 25 ng/μL levels for Methamphetamine.
- Calibration was performed at 0.1, 0.25, 0.5, 1, 2.5, 5, 10 and 25 ng/μL levels for Cocaine.
- Calibration was performed at 2.5, 5, 10, 25 and 50 ng/μL levels for Heroin.

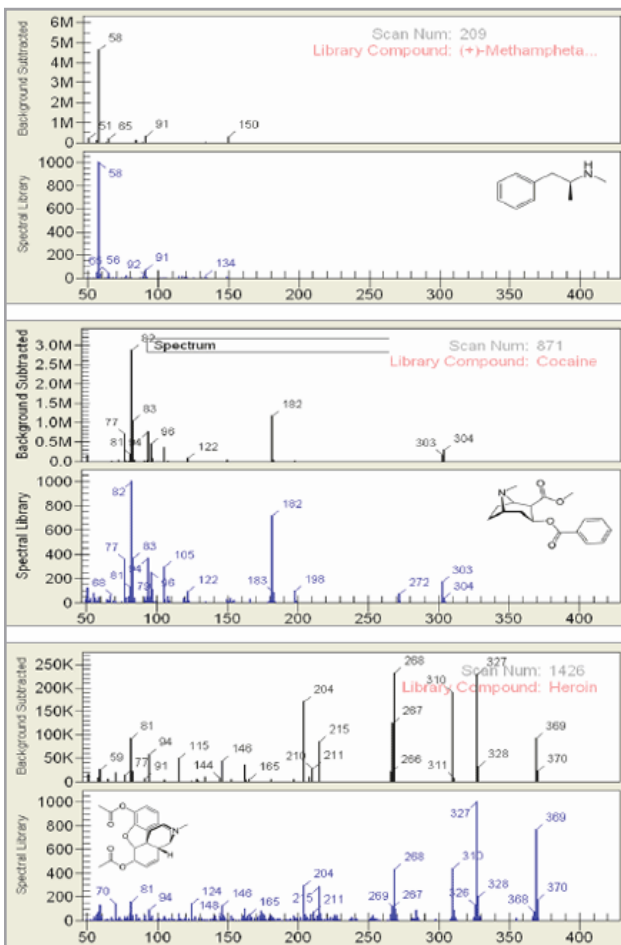
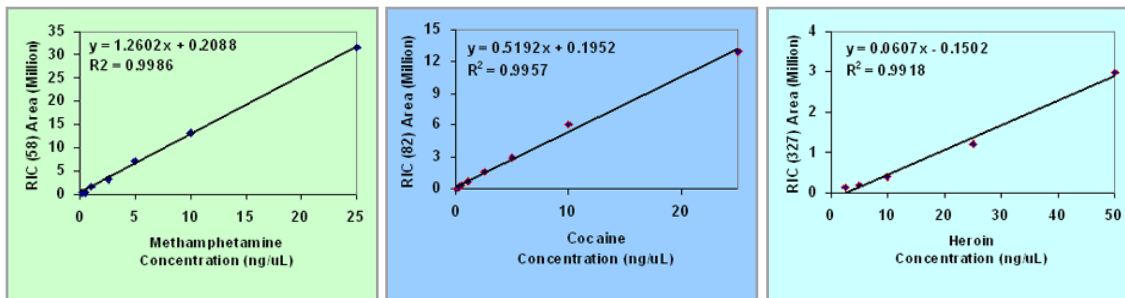


Figure 2: EI MS Spectrum of methamphetamine, cocaine and heroin at 10 ng injected. The top trace in each graph is the result from Griffin 450 and the bottom trace for the NIST Library

DETECTION LIMIT

For quantitation purposes using single ion RIC, detection limits are 250 pg, 250 pg and 5000 pg for methamphetamine, cocaine and heroin on column, respectively.



REPRODUCIBILITY

The reproducibility is presented as relative standard deviations calculated for replicate analyses for each compound. Peak area Relative Standard Deviation (RSD) values are 9.8%, 9.1% and 10.3% for methamphetamine, cocaine and heroin respectively, measured by the quant ion RIC area from four 10 ng injections. Retention time RSD is generally less than 0.15% for the three compounds.

Injections	Methamphetamine		Cocaine		Heroin	
	PA RIC (m/z 58)	RT (min.)	PA RIC (m/z 82)	RT (min.)	PA RIC (m/z 327)	RT (min.)
1	14.28	4.26	6.64	8.21	0.439	11.42
2	16.14	4.26	8.21	8.20	0.558	11.41
3	18.19	4.27	7.35	8.20	0.486	11.38
4	16.45	4.27	7.05	8.22	0.528	11.41
Average	16.27	4.265	7.31	8.208	0.503	11.405
Std. Deviation	1.60	0.006	0.67	0.010	0.052	0.017
RSD (%)	9.8	0.14	9.1	0.12	10.3	0.15

Table 1: Peak Area (PA) and Retention Time (RT) reproducibility of the method for 10 ng injections

CONCLUSIONS

The Griffin 450 can be used for the detection and identification of illicit drugs, such as methamphetamine, cocaine and heroin in a single run.

These data represent typical results.

References

1. Wells, J.M.; Badman, E.R.; Cooks, R.G. Anal. Chem. 1998, 70, 438-444.
2. Patterson, G.E.; Guymon, A.J.; Riter, L.S.; Everly, M.; Griep-Raming, J.; Laughlin, B.C.; Ouyang, Z.; Cooks, R.G. Anal. Chem. 2002, 74, 6145-6153.

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