Application Note GCMS-07

Rapid analysis of solid and liquid samples by direct introduction with triple quadrupole GC-MS/MS

Abstract

A series of experiments were conducted to demonstrate the use of the Bruker ChromatoProbe (Figure 1) sample introduction device for the analysis of solids, liquids and slurries with Bruker GC-MS/MS systems. The versatility of the ChromatoProbe makes it ideal for a wide range of application areas, enabling investigation of compounds not normally considered amenable for GC-MS/MS analysis. In this study, the analysis of sanitary products, pesticide residues and forensics testing was conducted using the ChromatoProbe, covering a range of samples including tissue paper, hair, urine and plant tissue. The ChromatoProbe delivered straightforward sample injection with reduced preparation, while the EVOQ GC-TQ achieved superior measurements throughout.

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Keywords	Instrumentation and Software
Direct Introduction Analysis	EVOQ GC-TQ
Sanitary products	ChromatoProbe
Pesticide residues	
Forensics testing	

Introduction

Globally there is a push to better protect both consumers and the environment from the use of harmful chemicals. This has resulted in the introduction of stringent legislations for the monitoring of consumables, and in turn increased the pressures and demands on quality control (QC) laboratories. Lower detection limits and complex matrices require highly sensitive instruments. However, throughput time and ease of use remain key priorities for QC laboratories. Sample preparation and introduction are key components in increasing efficiency without compromising results.

The ChromatoProbe is an easy to use alternative to a standard injector, which enables the analysis of compounds not normally amenable by GC/MS. Samples are introduced into the injector via disposable micro-vials, and during sample introduction, the MS detector operates continuously, the vacuum is uninterrupted and the detector remains aligned. Sample delivery is controlled by adjusting the injector temperature and split flow ratios. The ChromatoProbe works to simplify GC-MS operation with increased uptime.

In this application note, the ChromatoProbe direct sample introduction device, with the EVOQ GC-TQ gas chromatography triple quadrupole mass spectrometer (GC-MS/MS), were tested for their suitability across three application areas, covering a range of samples.

Methods and discussion

Sanitary products: disposable handkerchiefs

The first study focused on the European Union (EU) Regulation 1223/2009 to ensure the safety of cosmetic products, including tissue products, for consumers and the environment. Manufacturers need to follow specific requirements in the production of products and any colorants, preservatives, UV-filters and perfumes must be explicitly authorised.[1]

Several types of perfumed and non-perfumed disposable handkerchiefs were collected from the retail market and were analyzed qualitatively using the Bruker ChromatoProbe. The ChromatoProbe delivered easy and fast screening almost with minimal sample preparation and no clean up. Figure 2 demonstrates the results achieved by this instrument set-up, showing allergenic and carcinogenic compounds could be easily detected.

Forensic screening: hair and urine

The second study demonstrated the use of the ChromatoProbe in forensic drug screening. Drug screening has become more sophisticated in recent years for forensics cases and abstinence monitoring, matching increasingly stringent international legislation. The ChromatoProbe has been used to analyse short pieces of hair from a cocaine user and a hair from a drug-free subject. The hair samples were cut to pieces suitable for a microvial; no clean-up was undertaken. The rerun of the same hair samples shows all the cocaine was extracted on the first run through the ChromatoProbe. A published study demonstrated the analysis of just 1 cm of a single hair (Figure 3).

The ChromatoProbe also proved to be effective in the analysis of other drugs. Figure 4 shows the fast determination of morphine and cocaine in urine without a chromatographic column but by using direct thermal desorption. The separation obtained was achieved by using the optimized programmable temperature vaporizing (PTV) temperature gradient. A quantitative approach is also possible by using internal standards and proper weighing.

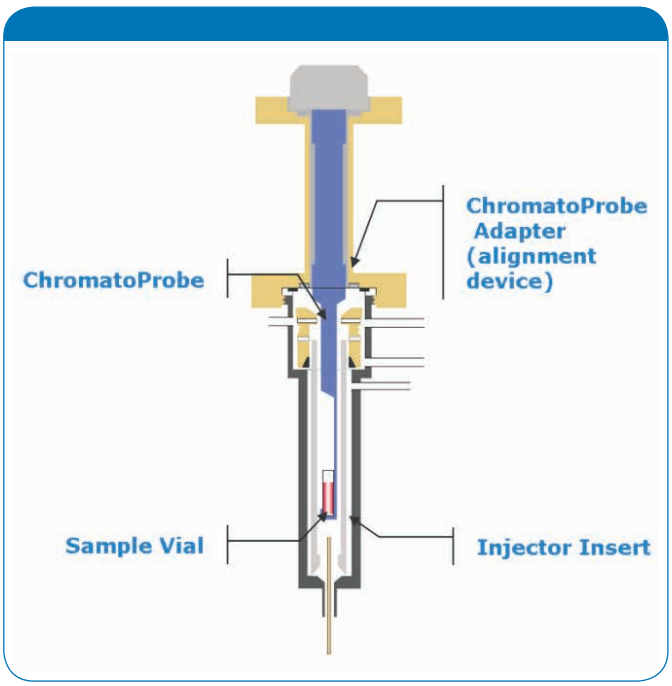

Figure 1: The Bruker ChromatoProbe

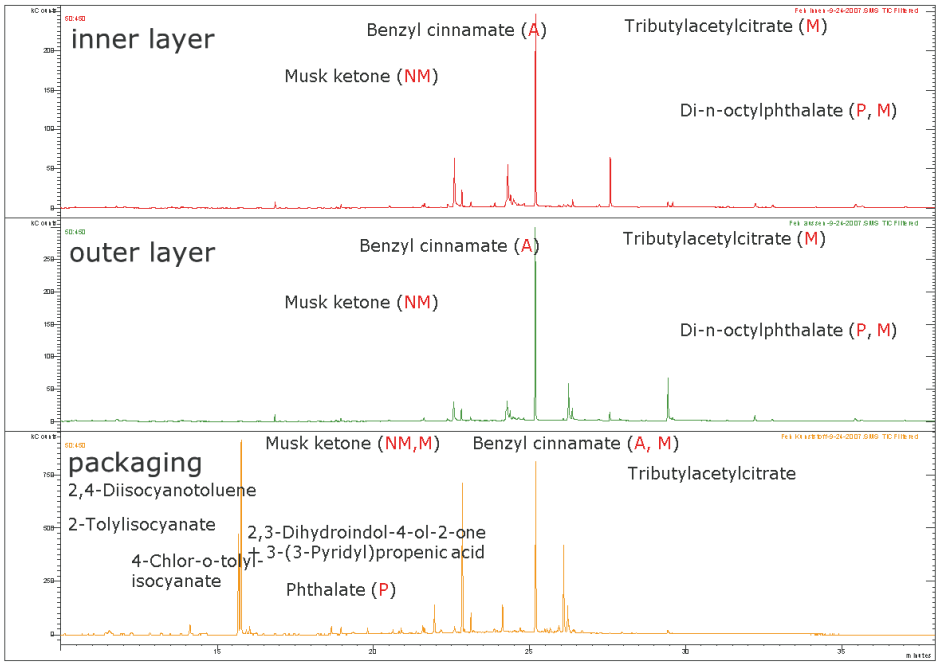

Figure 2: Matrix of perfumed handkerchief 02 shows the inclusion of banned synthetic and nitromusk compounds that have been linked with carcinogenic effects.

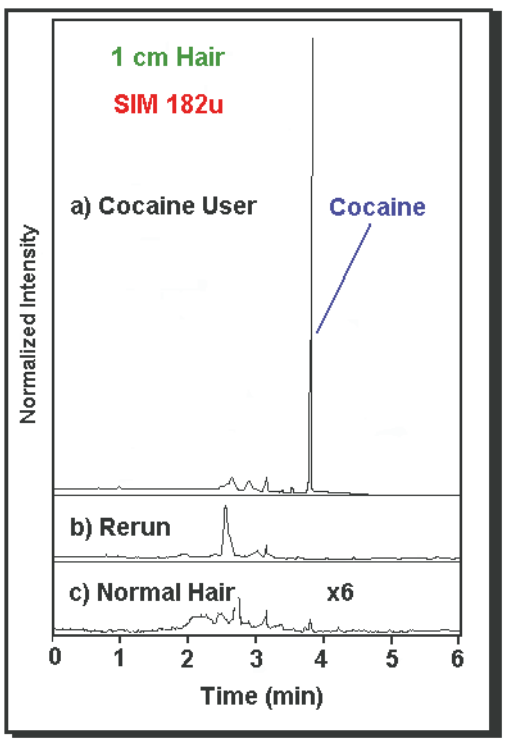

Figure 3: Forensic analysis of hair for drugs. All the cocaine was extracted on the first run.[2]

Forensic screening: hair and urine

The third application area studied was the analysis of pesticide residues from heavy matrix. Pesticides are widely used in agriculture and are mostly strictly monitored, as they can be harmful to the environment and consumers. However, the use of pesticides in emerging economies is not as rigorously controlled, meaning imports are subject to analysis before being accepted.

Dill extracts were analyzed with the ChromatoProbe and EVOQ GC-TQ. During sample introduction for GC-MS/MS with ChromatoProbe, the MS detector cooperates continuously. Disposable vials were used to eliminate the risk of leaks and loss of performance associated. Figure 5 shows the ChromatoProbe disposable microvials as a container for heavy samples. The vial on the left shows the extract before injection and on the right the extract afterwards. The analytes of interest were vaporized, while the high boilers remained in the disposable vial. Removing the vials still containing the high boilers between runs keeps the injector clean. As a result GC-MS/MS operation was simplified with increased uptime.

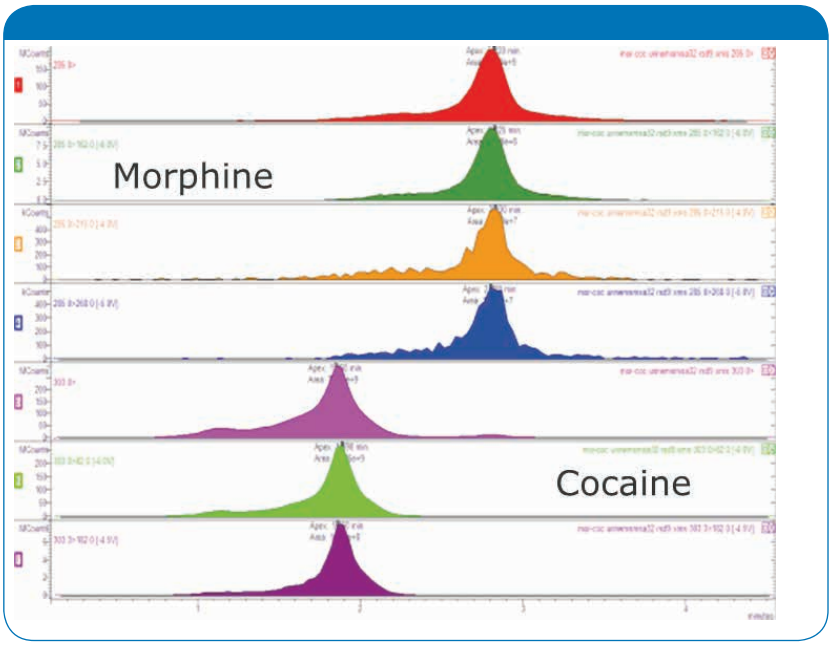

Figure 4: Fast determination of morphine and cocaine in urine by thermal desorption.

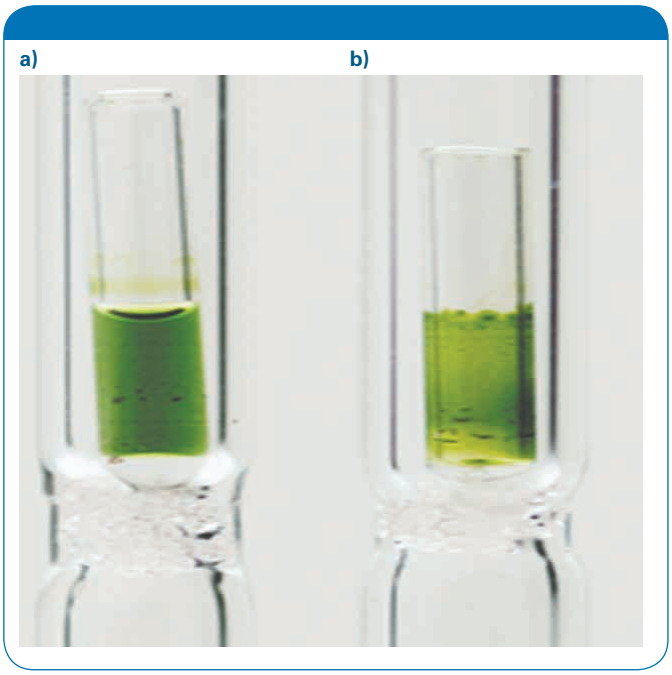

Figure 5: (a) Extract before injection and (b) the extract after injection.

Conclusion

Bruker's ChromatoProbe with the versatile PTV injector offers a wide range of application areas. The device can analyze solid, liquid and slurry samples with the EVOQ GC-TQ, while increasing uptime as an alternative easy-to-use alternative to solid probe. The ChromatoProbe's temperature programming in both the injector and GC column improved the identification of mixtures. By combining the ChromatoProbe and EVOQ GC-TQ superior measurements were easily and quickly achieved with little sample preparation and no sample clean-up. This makes the ChromatoProbe ideal for any laboratories conducting high-throughput QC analysis.

References

[1] European Commission, Regulatory framework, EU Regulation 1223/2009. http://ec.europa.eu/consumers/consumers_safety/cosmetics/legislation/index_en.htm

[2] J Am Soc Mass Spectrom, 1998, 1311, Wainhaus, Tzanani, Dagan, Miller and Amirav

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