

Coated Blade Spray Ion Mobility Spectrometry for Medical Applications

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Abstract

Coated Blade Spray (CBS) is a user-friendly microextraction technique that uses polymer-coated blades to selectively enrich analytes, remove unwanted background matrix compounds, and serve as an electrospray emitter. In this study, CBS was coupled with a high-resolution ion mobility spectrometer, performing effectively in both positive and negative ion modes. Using this compact setup, a wide range of substances, including drugs, pesticides, and other pharmaceuticals, can be rapidly detected on-site with highest sensitivity in complex liquid samples.

Keywords: Coated Blade Spray, Ion Mobility Spectrometry, Microextraction, Electrospray Ionization, Medical Technology

Introduction

Coated Blade Spray (CBS) represents an easy to handle and robust microextraction technology introduced by Pawliszyn et al. that employs coated metal blades as both extraction device and emitter for electrospray ionization (ESI) [1]. Thus, the selective enrichment of analytes on a polymer coating, rinsing off complex background, followed by desorption by applying solvent enables direct ionization of analytes by ESI. This approach has now been combined with our previously described ESI-Ion Mobility Spectrometer (ESI-IMS) [2] giving a substantial advancement in the rapid and efficient analysis of complex samples and has already been successfully applied for the detection of drugs and pesticides in drinks and liquids [3].

Experimental section

The IMS used in this study has a drift length of only 75 mm and provides high resolving power of $R_P = 100$. To provide higher throughput, up to 10 blades can be sequentially positioned in front of the IMS by an autosampler. The autosampler also adds a defined volume of the desorption solvent to the coated area before turning on the ESI voltage. Here, Ringer's solution is selected as the sample matrix to substitute for blood, and the short-chain fatty acid isovaleric acid and the painkiller diclofenac are selected as analytes.

Results

The method demonstrates excellent capability for selective pre-concentration and subsequent detection by IMS. In addition to the positive ion mode, the CBS-IMS can also operate in negative ion mode.

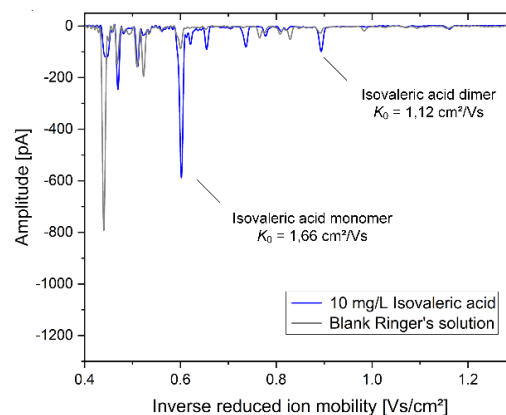


Abb. 1: Example of an ion mobility spectra from 10 mg/L isovaleric acid (blue) in 90:10 (v:v) Ringer's solution:methanol (gray).

Acknowledgments

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References

- [1] M. Tascon, G.A. Gómez-Ríos, N. Reyes-Garcés, J. Poole, E. Boyacı, J. Pawliszyn, *Anal. Chem.* 89, 8421–8428 (2017); doi: 10.1021/acs.analchem.7b01877.
- [2] C. Thoben, T. Werres, I. Henning, P.R. Simon, S. Zimmermann, T.C. Schmidt, T. Teutenberg, *Green Anal. Chem.* 1, 100011 (2022); doi: 10.1016/j.greeac.2022.100011.
- [3] C. Thoben, J.J. Stadtler, P.R. Simon, C.-R. Raddatz, M. Sehlmeier, S. Zimmermann, *Anal. Chem.* 96, 3593–3599 (2024); doi: 10.1021/acs.analchem.3c05586