Strategies for the direct coupling of solid phase microextraction (SPME) to mass spectrometry: applications in the clinical lab

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Short abstract

In this work we introduce two novel strategies for the direct coupling of SPME devices to MS for trace analysis of target compounds: coated blade spray (CBS) and solid phase microextraction-transmission mode (SPME-TM). Contrary to the general believes that sample prep is slow, analyte-enrichment and sample-clean-up is performed in 1 minute, and the total analysis time does not exceed 3 minutes in both approaches. Detection limits at the low ppt levels are feasible in complex matrices of clinical relevance. Given the structural configuration of the apparatus, sample prep can be used to perform extractions independently of the sample complexity or its dimensions.

Topic: New advances

Long abstract

Ambient ionization mass spectrometry methods are advantageous for point-of-care (POC) and therapeutic drug monitoring (TDM) due to their speed, simplicity, linear dynamic range, and ability to monitor multiple analytes simultaneously. In spite of the fast and convenient sample analysis of biofluids and tissue provided by ambient ionization methods, most of them are mainly limited in selectivity, sensitivity and/or quantitation capabilities due to the lack of an appropriate sample preparation. Thus, the performance of modern mass ambient spectrometry instruments in the clinical environment can be enhanced by using fast, simple and efficient sample preparation¹. SPME is a green sample preparation technique that combines extraction and pre-concentration of analytes in one step thus simplifying the analytical process². Succinctly, SPME does not require any sample collection because extraction takes place in situ by inserting a biocompatible device directly into tissue, blood or other biological matrix for a short period of time². Alternatively, the
same device can be used for ex vivo analysis using a small amount of the studied sample. This work presents numerous strategies recently developed for the direct coupling of SPME to MS. In order to have a broader range of applications, different SPME geometries such coated fibers, blades and meshes, as well as ionization approaches such DART and ESI, were studied. These novel SPME devices called SPME-transmission mode (SPME-TM), coated blade spray (CBS), and SPME-nanoESI, can be easily coupled to MS for targeted analysis at trace levels (ppt to ppm levels). Given the structural configuration of the devices, these can be used to perform extractions independently of the sample complexity or its dimensions. Contrary to the general believe, analyte-enrichment and sample-clean-up with the different configurations of SPME is performed in less than 1 minute, and the total analysis time does not exceed 180 seconds.

**Keywords:** SPME, ambient ionization, complex matrices, trace analysis, mass spectrometry