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Advancing Microsampling in Clinical and Pharmacokinetic Research Through Solid Phase Microextraction

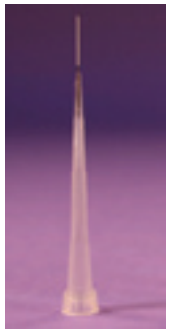
BioSPME Background

There is a growing emphasis in clinical assays and pharmaceutical development to minimize the physiological impact of the sample collection on the test subject. The use of microsampling allows the collection of sufficient sample for analysis while minimizing the stress and impact on the test subject. Microsampling has incorporated techniques such as dried blood spot, microcapillary and absorptive media to facilitate microsample collection. Many of these allow for extended sample retention and enable remote sampling with convenient sample transportation.

BioSPME is an equilibrium extraction technique in which the analyte partitions between the sample matrix and the BioSPME coating. The BioSPME fibers consist of functionalized particles that are embedded in a biocompatible proprietary binder. The particles can range from functionalized silica particles to carbon and polymeric particles. The polymer binder used to embed the particles onto the fiber core does not impede extraction of small molecules. The polymer binder does impede the extraction of biological matrix. The BioSPME technique allows for isolation of target analytes while minimizing co-extraction of sample matrix allowing for more sensitive bioanalysis over other microsampling techniques.

BioSPME LC Probes

BioSPME LC Tips

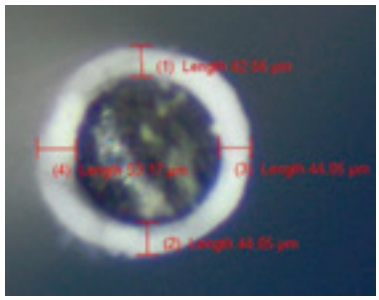


The BioSPME probe allows for direct *in vivo* sampling from animals, eliminating the need for terminal blood draws. The unique feature of the BioSPME technique enables direct analysis of biological samples without the need for protein precipitation, centrifugation, or digestion. The BioSPME techniques extract the free or unbound portion of an analyte, thus making it a viable method for performing drug protein binding assays. The amount of analyte extracted by BioSPME is directly proportional to the unbound concentration of the drug present in a given system.

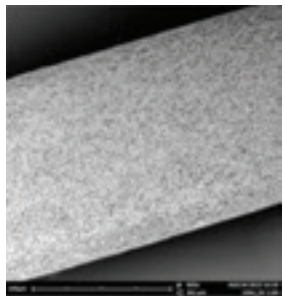
BioSPME fibers are first conditioned in aqueous/organic before insertion into sample. Fiber exposure to the sample ranges from 1 to 60 minutes depending on the study. Afterward, analytes are desorbed from the fibers using a small volume of solvent (50 µL).

Biocompatible Solid Phase Microextraction or "BioSPME" is an innovative technology that promises a significant advancement for microsampling in pharmacokinetic and clinical assays. The applications detailed are a culmination of several different collaborative projects.

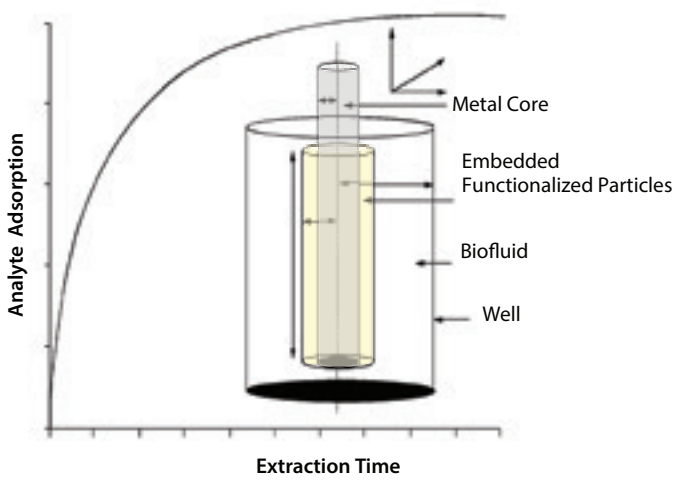
Cross Section of Coated Fiber



SEM Image of Coated Fiber



Analyte Uptake onto BioSPME Fiber



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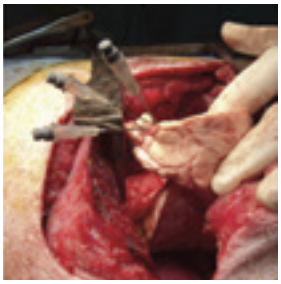
Popular Applications

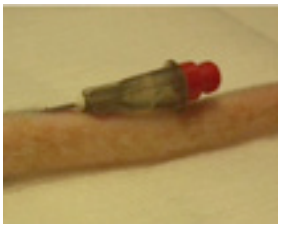
Direct Lung Perfuseate Analysis



Collaborators at Toronto General Hospital in Canada have utilized BioSPME sampling technology for direct measurement of lung perfusate during transplant surgery in porcine models. This technique was shown to be less invasive than biopsy sampling, while enabling the isolation of unstable metabolites that could not be detected using tissue extraction techniques.

Trends in Analytical Chemistry, 71, 2015, 249-264.
Analytica Chimica Acta, 803, 75-81 (2013).

Direct *In Vivo* Sampling – Zero Blood Draw

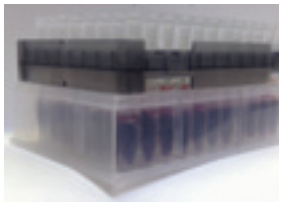


BioSPME probes have been utilized for pharmacokinetics (PK) animal studies with zero blood drawn. The BioSPME technology allows for direct insertion of fiber into a rodent tail, eliminating terminal blood draws. PK studies monitoring metabolism of carbamazepine have been successfully accomplished with this technique.

Anal. Chem. 2015, 87, 754–759.

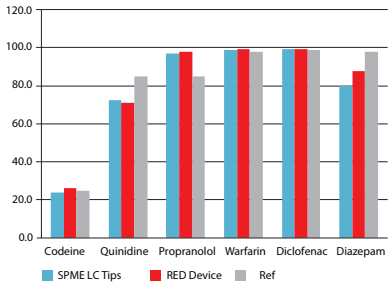
Determination of Drug Protein Binding Levels

BioSPME Tip on Tray Holder



Clinical Well Plate

Protein Binding Levels



BioSPME has been utilized to determine drug protein binding affinities used for drug development. Here, BioSPME LC tips are inserted directly into drawn blood samples from a drug binding study. BioSPME allows for the differentiation between free circulating compounds versus protein bound analytes. In this case, BioSPME is capable of performing the determination in a fraction of the time, 30 minutes as compared to 6 hours for membrane dialysis techniques.

Clinical Drugs of Abuse Screening

Drugs of abuse screening is performed by exposing BioSPME fibers to urine samples. Fibers are then analyzed directly by DESI MS analysis, eliminating the chromatographic separation for both qualitative and quantitative analysis. This technique was found to be more sensitive and specific over ELISA assay methods, allowing for assays to be completed in less than 1 minute per sample.

Anal. Chem. 2010, 82, 7502–7508.

Conclusion

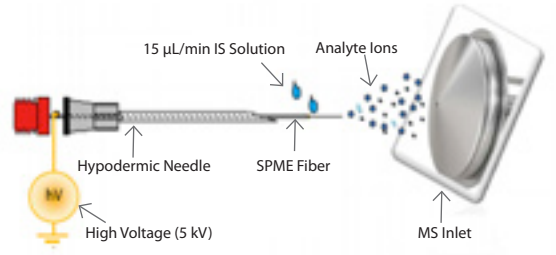
The utility of BioSPME continues to expand to include applications in high throughput sampling and direct MS analysis techniques. The direct MS analysis approach allows for quantitation from the BioSPME fiber while eliminating the need for chromatographic separation.

Future expansion on the BioSPME technology will include:

- Creation of high precision fibers by utilizing sub 1 µm particles
- Development of BioSPME fibers for rapid extraction (<1 minute)
- Expanding selectivity through the utilization of polymeric particles

Summary

BioSPME offers an innovative approach for biological microsampling, while enabling the direct measurement of free fraction analyte to be determined. The BioSPME platform enhances traditional LC/MS applications while driving the future for direct MS analysis.



Anal. Chem. 2010, 87, 754–759.

Ordering Information

Description	Cat. No.
SPME-LC Fiber Needle Probe, C18 coating, pack of 5 probes	57281-U
SPME-LC Pipette Tips, 96-tip array, C18 coating, pack of 96 tips	57234-U
SPME-LC Pipette Tips, 96-tip array, PDMS/DVB coating, pack of 96 tips	57248-U

For more product information, visit
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