B197 Microextraction Capsules (MEC): A New Direction in Green Analytical and Forensic Sample Preparation

Abuzar Kabir, PhD, Florida International University, 11200 SW 8th Street, AHC4-215, Miami, FL 33199*

After attending this presentation, attendees will better understand the fabrication, working principle, and advantages of MEC in preparing different analytical, environmental, toxicological, pharmaceutical, food, and forensic samples for chromatographic separation and identification.

This presentation will impact the forensic science community by educating attendees interested in analyzing trace organic analytes in various sample matrices and also has the potential to offer a paradigm shift approach in sample preparation by complete elimination of time-consuming, error-prone, and labor-intensive sample pretreatment steps (e.g., filtration, protein precipitation, centrifugation, etc.) from the sample preparation exercises.

Following the sustained demand for establishing the principle of Green Analytical Chemistry (GAC) in all aspects of analytical processes, the current trend in sample preparation inevitably favors miniaturization of the extraction device to minimize sample volume requirement, to reduce or eliminate organic solvent consumption and to minimize the amount of waste generated in the sample preparation process. Due to the high consumption of toxic and hazardous organic solvents and other shortcomings in major sample preparation techniques, including Liquid-Liquid Extraction (LLE) and Solid Phase Extraction (SPE), a number of miniaturized and green sample preparation techniques such as Solid Phase Microextraction (SPME), Stir Bar Sorptive Extraction (SBSE), Thin Film Microextraction (TFME), Microextraction by Packed Sorbent (MEPS), Fabric Phase Sorptive Extraction (FPSE) have emerged during last few decades.[1-5] Among others, these techniques are environment friendly, do not require a high volume of samples, and are fast and efficient.

Despite all the advances in sample preparation technologies, most of the new generation sample preparation techniques cannot handle real-life analytical, environmental, toxicological, pharmaceutical, food, and forensic samples which often contain high volumes of particulates, debris, biomasses, and other matrix interferents and unavoidably require a sample pretreatment process (e.g., filtration, centrifugation, protein precipitation, etc.). Oftentimes, this sample pretreatment/cleaning step leads to significant analyte loss.

MECs are designed to completely eliminate the sample pretreatment/clean-up step from the sample preparation protocol.[6] MEC utilizes a porous tubular polypropylene membrane with 0.2µm pore size and a 5.5mm internal diameter to encapsulate sol-gel hybrid organic/inorganic sorbent in the form of monolithic bed or spherical particles. The porous membrane allows easy permeation of an aqueous sample containing the target analyte(s) while protecting the sorbent from being contaminated. A magnetic metal rod implanted into the MEC allows spinning of the device when placed on a magnetic stirrer and diffuses the sample matrix for fast analyte-sorbent interaction. Thus, high loading of sol-gel sorbent provides high sample capacity for target analyte(s), fast extraction kinetics due to the sponge-like porous architecture of sol-gel sorbents, and protection of the sorbent from contamination via encapsulation into a porous tubular membrane making MEC a formidable and robust sample preparation technique. After the extraction, a small volume of organic solvent can be used to back-extract the accumulated analyte(s). Due to the high preconcentration factor achieved in the sample preparation using MEC, no solvent evaporation or sample reconstitution is required. The prepared sample can be analyzed using gas chromatography, liquid chromatography, or capillary electrochromatography to obtain complementary information if a suitable solvent compatible with these chromatographic techniques is chosen.

Analytical data obtained from a number of real-life applications of MEC will also be presented showcasing its advantages, extraction characteristics, performance superiority, and analytical figures of merit.

*Presenting Author

Reference(s):

1. Pawliszyn J., Liu S. Sample introduction for capillary gas chromatography with laser desorption and optical fibers. *Analytical Chemistry*. 1987. 59(10): p. 1475-1478.
2. Baltussen E. et al. Stir bar sorptive extraction (SBSE), a novel extraction technique for aqueous samples: Theory and principles. *Journal of Microcolumn Separations*. 1999. 11(10): p. 737-747.
3. Bruheim I., Liu X.C., Pawliszyn J. Thin-film microextraction. *Analytical Chemistry*. 2003. 75(4): p. 1002-1010.
4. Abdel-Rehim M. New trends in sample preparation: on-line microextraction in packed syringe for liquid and gas chromatography applications - I. Determination of local anaesthetics in human plasma samples using gas chromatography-mass spectrometry. *Journal of Chromatography B-Analytical Technologies in the Biomedical and Life Sciences*. 2004. 801(2): p. 317-321.
5. Kabir A., Furton K.G. Fabric Phase Sorptive Extractors (FPSE). Patent Pending. USPTO Serial Number 61/786,910. March 17, 2014.
6. Kabir A., Furton K.G. Microextraction Capsules and Methods of Making. Submitted for provisional patent application to USPTO Serial Number 14/806,100. July 22, 2015.

Microextraction Capsules (MEC), Sample Preparation, Green Analytical Chemistry