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Capsule phase microextraction: A field deployable sample preparation technique with integrated filtration and stirring mechanism for rapid environmental pollution monitoring

Statement of the Problem: Considering the rapid aggression of environmental pollution across the world, the importance of a robust pollution-monitoring plan cannot be overemphasized. Current analytical workflow for environmental pollution monitoring consists of a number of steps including sample collection from the field, addition of preservative, transport to the laboratory, storing at controlled temperature, filtration, extraction of the target analytes using a sample preparation technique, elution of the analytes in organic solvent, solvent evaporation, sample reconstitution in a small volume of organic solvent and finally injecting an aliquot into the chromatographic system. This lengthy list of steps that involved may often cause significant loss of the target analyte(s) and inevitably, result in underreporting the true analyte concentration in the environmental water. A viable solution to minimize the loss of analytes is to develop a field-deployable specimen preparation device that would allow the whole sample preparation directly in the field. Capsule phase microextraction (CPME) is developed to meet the 21st century demands of sample preparation. CPME eliminates sample pretreatment/clean-up step from the sample preparation workflow. It utilizes a porous tubular polypropylene membrane capsule with 0.2 μm pore size and 1.8 mm internal diameter to encapsulate sol-gel organic-inorganic sorbent. This allows easy permeation of aqueous sample containing the target analyte(s) while protecting the sorbent from contamination by matrix interferents. A magnetic metal rod is embedded into the microextraction capsule that allows spinning the device when placed on a magnetic stirrer and diffuses the sample matrix for fast analyte-sorbent interaction and rapid extraction equilibrium. High loading of sol-gel sorbent providing excessive sample capacity for target analyte(s), fast extraction kinetic due to sponge-like porous architecture of the sol-gel sorbent, protection of the sorbent from contamination via encapsulation into a porous tubular membrane capsule have made capsule phase microextraction (CPME) an impressive and robust sample preparation technique. After the extraction, a small volume of organic solvent is used to desorb the accumulated analyte(s). Due to high preconcentration factor achieved in CPME, no solvent evaporation and sample reconstitution is required. The prepared sample can be analyzed in gas chromatograph, liquid chromatograph or capillary electro chromatograph to obtain complimentary information.

Biography

Abuzar Kabir is a research assistant professor in the Department of Chemistry and Biochemistry, Florida International University (FIU), Miami, Florida, USA. His research interest primarily focusses on synthesis and applications of novel sol-gel derived advanced material systems (chromatographic stationary phases, surface coatings of high-efficiency microextraction sorbents, nanoparticles, microporous and mesoporous functionalized sorbents) for analyzing polar, medium polar, nonpolar, ionic analytes, heavy metals and organometallic pollutants from biological/pharmaceutical/clinical/environmental sample matrices. He is an ardent advocate of Green Analytical Chemistry (GAC). His recent inventions, fabric phase sorptive extraction (FPSE), dynamic fabric phase sorptive extraction (DFPSE), Capsule Phase Microextraction (CPME), substrate-free liquid chromatographic stationary phases and extraction sorbents, organic polymeric liquid chromatographic stationary phases and extraction sorbents and universal molecular imprinting technology have drawn tremendous interests among the researchers. He has published more than 50 peer-reviewed journal articles, 9 book chapters and 90 conference proceedings. Dr. Kabir has invented numerous chromatographic stationary phases and sample preparation technologies, resulting in 15 US patents.

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