
DOWN-SCALING OF MEMBRANE BASED EXTRACTIONS TO HANDLE A SINGLE DROPLET OF BIOLOGICAL FLUID

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During the last 10 years, hollow fiber liquid-phase microextraction (LPME) has been developed into an efficient and robust format for miniaturized liquid-liquid extraction [1,2]. In LPME, target analytes are extracted from an aqueous sample, into an organic solvent (supported liquid membrane = SLM) immobilized in the pores in the wall of a porous hollow fiber, and into an aqueous acceptor solution present in the lumen of the hollow fiber. The principal driving for LPME are pH gradients sustained over the SLM. For basic analytes as an example, pH in the sample is adjusted into the alkaline region to promote partition into the SLM, whereas the acceptor solution is acidic for efficient trapping. A large number of applications in the literature have demonstrated that LPME provides acceptable recoveries, high (or very high) enrichment, excellent sample clean-up from biological and environmental samples, and enables almost total elimination of organic solvents for the sample preparation [2].

In a modified version of LPME, termed electro membrane extraction (EME), the pH gradient across the SLM has been replaced by an electrical potential (dc) as the driving force [3]. For basic analytes as an example, pH is low (acidic) in both the sample and the acceptor solution to maintain the analytes protonated, a positive electrode is inserted in the sample, a negative electrode is placed in the acceptor solution, and the target analytes are extracted by electrokinetic migration from the sample, through the SLM, and into the acceptor solution. By application of 10-300 V dc, extraction kinetics in EME were found to be superior to those of LPME [4], suggesting that EME can be used in the future to speed up LPME. Additionally, the driving force in EME is easily adjusted or reversed by simple manipulations of the voltage, and this may open new applications in the future.

In both LPME and EME, sample volumes have typically been in the range 100–4.000 μL . However, with continuously improved detectability of analytical instrumentation (like in liquid chromatography-mass spectrometry), the recall for analyte enrichment has decreased for many applications, sample volumes have been reduced, and attention has been focused on miniaturization of the total analytical process. To address this trend, the current presentation discuss further down-scaling of LPME and EME [5] to a drop-to-drop format, where target analytes are extracted from 10 μL sample (biological fluid), through a SLM sustained in a small piece of a flat porous membrane (not a hollow fiber), and into 10 μL of acceptor solution in direct contact with the SLM on the opposite side. Results both from LPME and EME with this type of system will be demonstrated, where efficient extractions caused by short diffusion distances take place in a totally stagnant system. In addition, implementation onto a lab-on-a-chip will be briefly discussed.

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