# Characterization of a Mini Membrane Inlet Mass Spectrometer Operating at High Pressure (~ 1•10-3 torr) Using Different Types of Microporous Membranes

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<u>Introduction:</u> Membrane inlet mass spectrometry (MIMS) is normally performed using a mass spectrometer that requires a vacuum below 1•10-5 torr for proper function. This choice prevents the use of most microporous membranes because of their high permeability and it increases the weight of the system due to the pumping facilities required. To overcome these problems we have assembled a small MIMS system (total weight ≈ 15 kg everything included) based upon a miniature Multipole from Ferran Scientific, which is capable of operating at pressures above 1•10-3 mbar. The system is equipped with a simple interchangeable membrane interface that makes it possible to operate with membrane areas that varies up to a factor of 80. We have explored the possibility of using the mini-MIMS with three microporous membranes and a standard non-porous silicone membrane for the analysis of contaminants in air, water and organic solvents (ethanol and toluene tested).

<u>Results:</u> Cellulose: The hydrophilic cellulose membrane was compatible with all four solvents. However, water and ethanol had to be analyzed using the 0.8 mm2 membrane, whereas toluene and air could be analyzed using the 60 mm2 membrane without exceeding the upper pressure limit in the vacuum chamber. The cellulose membrane gave promising results with respect to the fast and direct detection of organic contaminants (<0.1 %) in organic solvents. Organic contaminants in water at relevant levels (≈ 1 ppm) were not detectable.

Polyethersulphone: This membrane had almost the same characteristics as the cellulose membrane except that it deteriorated slowly when exposed to toluene. This membrane is therefore not recommended for the direct analysis of organic solvents.

Microporous polypropylene: This membrane behaves in the opposite way as the cellulose and polyethersulphone membrane. It is highly permeable to air and hydrophobic organic compounds, whereas water as a solvent reduces permeability. Unfortunately, solvent water blocks the pores of this membrane so much that organic contaminants at relevant levels (≈ 1 ppm) were not detectable and toluene as a solvent passes the membrane too well and the upper pressure limit of the system is exceeded even with the 0.8 mm2 membrane.

Polydimethyl siloxane: This standard (non-porous) membrane for MIMS systems has the same characteristics with the mini-MIMS as with most other MIMS systems. That is: Organic contaminants in water and air are detectable below 1 ppm levels (ethanol, methyl-t-butylether, benzaldehyde, toluene and 1,1-dichloroethylene tested), whereas the membrane cannot be recommended for direct analysis of organic solvents.

<u>Conclusion:</u> The mini-MIMS system has demonstrated an interesting potential as a flexible on-site instrument for the analysis of contaminants in air, water and organic solvents. The standard silicone membrane is still the optimal choice with respect to the analysis of air and aqueous samples, whereas the highly hydrophilic cellulose membrane was the optimal choice for the detection of organic contaminants in organic solvents. In fact the mini-MIMS system with a cellulose membrane is the first reported MIMS system with opposite selectivity as the standard MIMS system using silicone membranes.