A GLASS MICROFABRICATED PLANAR GCXGC-PID

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Comprehensive gas chromatography provides a means of achieving analytical resolution that matches and in some cases exceeds that possible with other hyphenated techniques such as GC-MS. Environmental measurements of organic compounds are still underpinned however by GC-MS methods, and it is this technique which has been miniaturised and simplified in apparatus that may be used away from the laboratory and in the field. Inherently however, mass spectrometry is a challenging technique to use in a portable device, not least because of the requirement for high vacuum. Here we report the development of a GCxGC-PID system designed specifically for end use as a low power and portable measurement device, with greater technological simplicity since it relies on the hyphenation of columns to achieve the required analyte isolation rather than a mass spectrometer.

The approach reported here uses a lab on a chip methodology, integrating a thermal desorption device, 8 m and 1 m long 250 micron i.d. capillary columns and a fluidic modulator on to a single microfabricated glass monolith. The channels in the glass chip are isotropically acid etched creating fully circular capillary channels analogous in dimensions with fused silica capillary column combinations typically used in the laboratory. A key advantage of creating GCxGC on a planar monolithic device (rather than by coupling two drawn capillaries) is that the heating and cooling of the independent columns may be achieved using planar thermoelectric devices rather than a turbulent fan oven. This results in power demands up to 100 times lower than normal laboratory GCs for typical heating rates. Using embedded Peltier cooling in the chip extends the operating envelop of the columns from 40-300˚C (typically used in fan ovens) to starting temperatures that are sub-zero and achieved without cryogen. This has a number of advantageous theoretical implications; it opens up analytical accessibility for the most volatile of organic compounds, and reduces film thickness required for initial phase ratio refocusing following thermal desorption, with downstream reduction in band broadening due to stationary phase diffusion.

A selection of results from standalone planar glass GC columns and integrated GCxGC-PID devices will be presented. This will include assessment of the performance of planar glass columns compared to fused silica, the uniformity of column temperatures that can be achieved with a planar heating and cooling approach, the capabilities of the built in fluidic modulator and the utility and applicability of a low cost photoionisation detector as a means of detection in GCxGC.