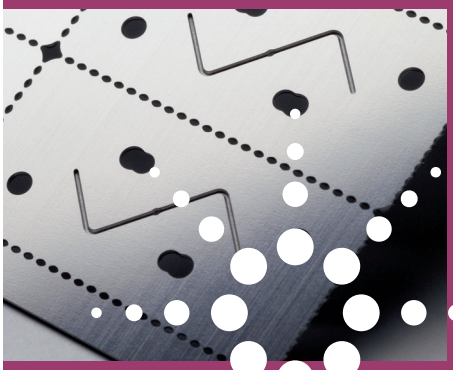


Agilent Capillary Flow Technology

simpler, more reliable GC x GC

Comprehensive gas chromatography, also called "GC x GC," offers powerful capabilities for analyzing complex mixtures such as petrochemicals, fragrances and environmental samples.

In GC x GC, peak generation can be significantly greater than conventional GC. Compared to a single column separation, GC x GC can improve peak resolution and peak capacity to provide highly detailed sample characterization.

No cryogen needed

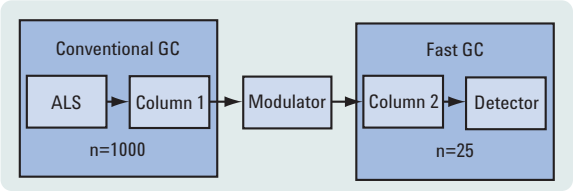
Because most systems require complicated cryo-focusing, GC x GC has generally been left to the chromatography experts in research labs. But with the reliable, easy-to-use Capillary Flow device installed in Agilent's 7890A gas chromatograph, this valuable technique is now ready for more routine lab settings. The new approach requires no costly and troublesome cryogen, making the benefits of this valuable analysis tool more accessible—and more affordable, too.

Our measure is your success.

Basic Principles: How does GC x GC work?

GC x GC methodology uses two capillary columns in series. Usually, these columns have different polarities. Between the two columns, a flow modulator collects very narrow analyte bands from the first column in a fixed-volume channel and successively feeds them into the second column for further analysis. Because any separation that occurs on the first column is preserved during transfer to the second column, this two-column method significantly increases peak capacity and resolving power.

A typical column pair consists of a conventional low-polarity column coupled to a very short (3–5 m) polar column. The second column is sized to provide separation of all injected analytes during a typical 1.5-second modulation cycle.

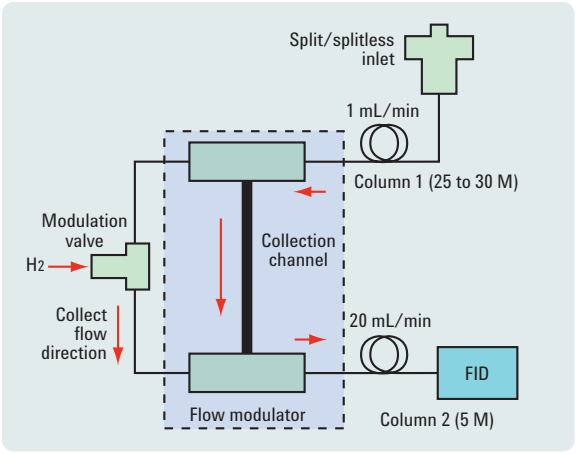


Basic configuration, using a single GC oven. *GC x GC utilizes a primary conventional separation column, a flow modulator, a second column that provides very fast separation and a fast detector. The technique can provide a significant increase in separation power compared to conventional GC methods.*

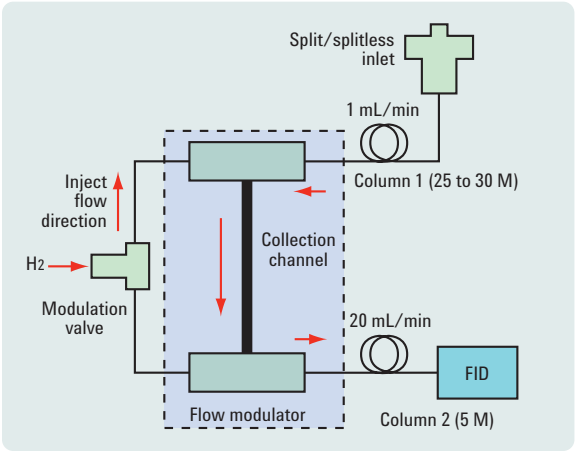
The key to routine GC x GC: Agilent's Capillary Flow modulator

For successful results, the flow modulator must transfer effluent from the first column to the second with great precision and repeatability under optimized carrier flow rates and temperatures.

Unlike complicated thermal modulation methods that depend on rapid, delicately balanced heating and cooling, Agilent's GC x GC solution operates on a very simple principle of differential flow modulation. It uses a robust, proprietary Capillary Flow device interfaced to an auxiliary pneumatic control module (PCM) via a three-way micro-solenoid valve. Driven by extremely precise, highly reproducible timing from the 7890A GC, flow differentials within the modulator focus analytes as they exit the first column.



Load Cycle. *Flow rates and flow directions during the load or "collect" portion of the modulation cycle.*



Transfer Cycle. *Flow rates and flow directions during the transfer or "inject" portion of the modulation cycle.*

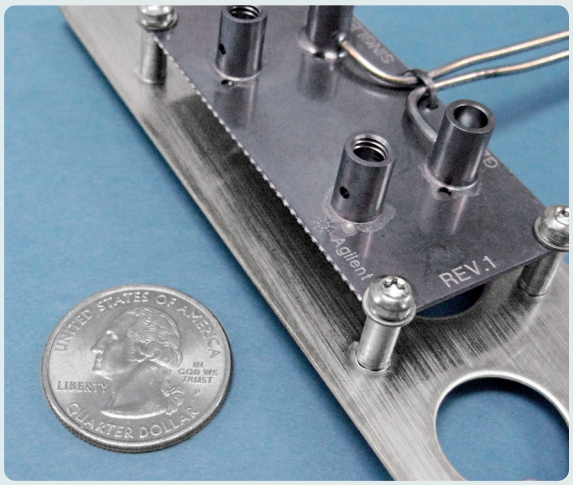
GC x GC at work: Analyzing complex hydrocarbons

The figures below show unmodulated and modulated peaks of a pure analyte, n-butylbenzene, with approximately four modulations across the peak. Because of the focusing effect of the flow modulator and the speed of transfer to the second column, each modulated peak is very narrow, approximately 65 to 75 ms at half height. Since all mass is conserved, the peak height increases relative to the unmodulated peak.

For a more in-depth look at the technology behind Agilent 2D GC, visit www.agilent.com/chem/GCxGC

Agilent Capillary Flow Technology

Agilent's innovative Capillary Flow Technology enables reliable, leak-free, in-oven connections. Available in a number of useful configurations, the inert, low-mass, low-dead-volume devices not only make it easy to make secure connections, they give you the ability to precisely divert your gas flow where and when you want. This opens the door to another highly useful two-dimensional technique, Deans Switching (heart cutting). Capillary Flow Technology makes multidimensional chromatography, from simple heart cutting to comprehensive GC x GC, routine for any GC lab.



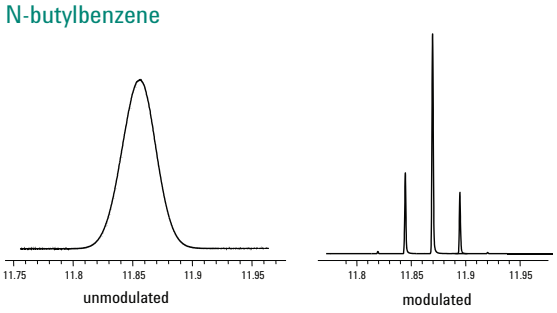
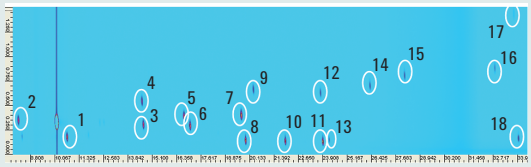


Figure 1. *Unmodulated and modulated n-butylbenzene peaks from a hydrocarbon test sample.*



1. Octane
2. Fluorobenzene
3. Propylbenzene
4. Bromo-2-fluorobenzene
5. Indane
6. Butylbenzene
7. Tetralin
8. Dodecane
9. Naphthalene
10. Tridecane
11. Tetradecane
12. Fluorobiphenyl
13. 1, 3, 5-Tributylbenzene
14. Acenaphthalene
15. Fluorene
16. Terphenyl
17. 2-Methylanthracene
18. Elcosan

Figure 2. *2D GC display verifies the separation results from the hydrocarbon test sample.*

Visualizing GC x GC data: Turning data into information

The ability to visualize hydrocarbon class separations is a major attraction of GC x GC. Using a non-polar column followed by a polar column produces hydrocarbon type retention in the following order: 1) alkanes, 2) cyclic alkanes, 3) olefins, 4) single-ring aromatics and 5) multiring aromatics. The figure below shows a 2D image of kerosene with chemical classes clearly discernible for all of these petrochemical materials, especially the aromatics.

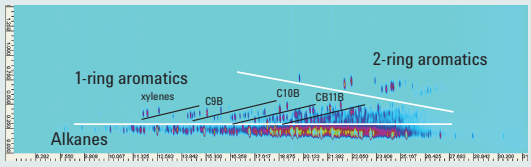


Figure 3. *To visualize data in two dimensions, the modulated chromatograms are assembled as shown above. The one-ring and two-ring aromatics are clearly visible in this 2D measurement of kerosene.**

**GC x GC data display is via commercially available software (purchased separately).*

To learn more about Agilent's innovative GC solutions, visit www.agilent.com/chem/GCxGC

Agilent 7890A Gas Chromatograph takes your lab to the next level of GC performance.

Incorporating important new separation capabilities and productivity features—including Capillary Flow Technology—the 7890A GC is the ideal platform for GC x GC analysis.

Agilent Performance and Reliability

5th-generation electronic pneumatics control (EPC) and digital electronics set a new benchmark for retention time locking (RTL) precision and retention time repeatability, and help make the 7890A Agilent's most dependable GC ever.

Higher Productivity

Faster oven cool-down, robust backflush capability and advanced automation features let you get more done in less time, at the lowest possible cost per sample.

Expanded Chromatographic Capabilities

Highly flexible EPC design enables even more sophisticated hydrocarbon analyses. A fast FID (up to 500 Hz) provides data acquisition speeds useful in comprehensive gas chromatography.

Easier Operation

Practical, time-saving design features speed up and simplify routine maintenance.

For more information

Learn more:
www.agilent.com/chem/GCxGC

Buy online:
www.agilent.com/chem/store

Find an Agilent customer center in your country:
www.agilent.com/chem/contactus

U.S. and Canada
1-800-227-9770
agilent_inquiries@agilent.com

Europe
info_agilent@agilent.com

Asia Pacific
adinquiry_aplsca@agilent.com

Printed in USA December 19, 2007
5989-7631EN

Agilent Technologies