INFICON

# APPLICATION NOTE

## Simple and Fast Gas Analysis for University Catalyst Research with Micro GC Fusion®

### OVERVIEW

This application note describes the advantage of using Micro GC Fusion to provide rapid gas composition analysis for catalyst research projects. Simplified operation and accelerated analysis offered by the instrument fast track new catalyst material and process development cycle.

### INTRODUCTION

Gas analysis is needed at universities for catalyst development and alternative energy research. Greater demand for alternative energy sources has led to an increase in research involving sustainable energy conversion systems. These diverse projects are often conducted within a compressed timeline and require compositional analysis of permanent gases and hydrocarbons at parts per million (ppm) to percentage level to monitor and characterize research topics.

Micro GC Fusion configured with 2 modules can be used in analyzing $H_2$, $O_2$, $N_2$, $CH_4$, CO, $CO_2$ and also light hydrocarbons (up to C6+). The first module can analyze permanent gases and the second module can analyze light hydrocarbons. This configuration is suitable for general purpose energy gas analysis such as biogas gas and syngas analysis. It can also be used in catalysis research gas analysis or thermal and catalytic conversion of carbon based material to desired products. Some examples of these alternative energy applications include the conversion of solid waste and biomass to synthetic fuels, liquid fuels to hydrogen, and greenhouse gases to fuels.

Micro GC Fusion offers significant throughput gain with broad application coverage through rapid temperature programming, modular architecture and a highly sensitive detector. With reliable analysis, an easy to use web-based user interface, a compact design enabled by microelectromechanical system (MEMS), and rapid temperature ramping through resistive column heating technology, Micro GC Fusion is the ideal gas analyzer for university catalyst research projects.

### EXPERIMENTAL

A calibration gas standard from AirGas® was used to calibrate the instrument and demonstrate repeatability. Helium was used as the carrier gas for both modules in order to maximize response.

- Module A: Rt®-Molsieve 5A temperature programmable column with a backflush injector and TCD detector
- Module B: Rt®-Q-Bond temperature programmable column with a variable large volume injector and TCD detector

Ten consecutive runs were used to calculate the percent relative standard deviation (%RSD) for peak area and retention time. The concentrations of the components in the calibration gas standard and the %RSD for peak area and retention times are shown in Table 1.

### RESULTS

A chromatogram of Module A is illustrated in Figure 1 with target compounds fully analyzed within 60 seconds. Module B demonstrates target components up to hexane fully analyzed within 160 seconds, which is shown in Figure 2. Micro GC Fusion demonstrates excellent performance with area RSD% under 0.4% and retention time RSD% under 0.1%. If $H_2$ is an analyte of interest, argon can be used as the carrier gas in order to increase $H_2$ response. The Chromatogram in Figure 3 illustrates Module A (Rt®-Molsieve 5A column) with argon as the carrier gas being used to analyze the calibration gas standard which contains 10% $H_2$.

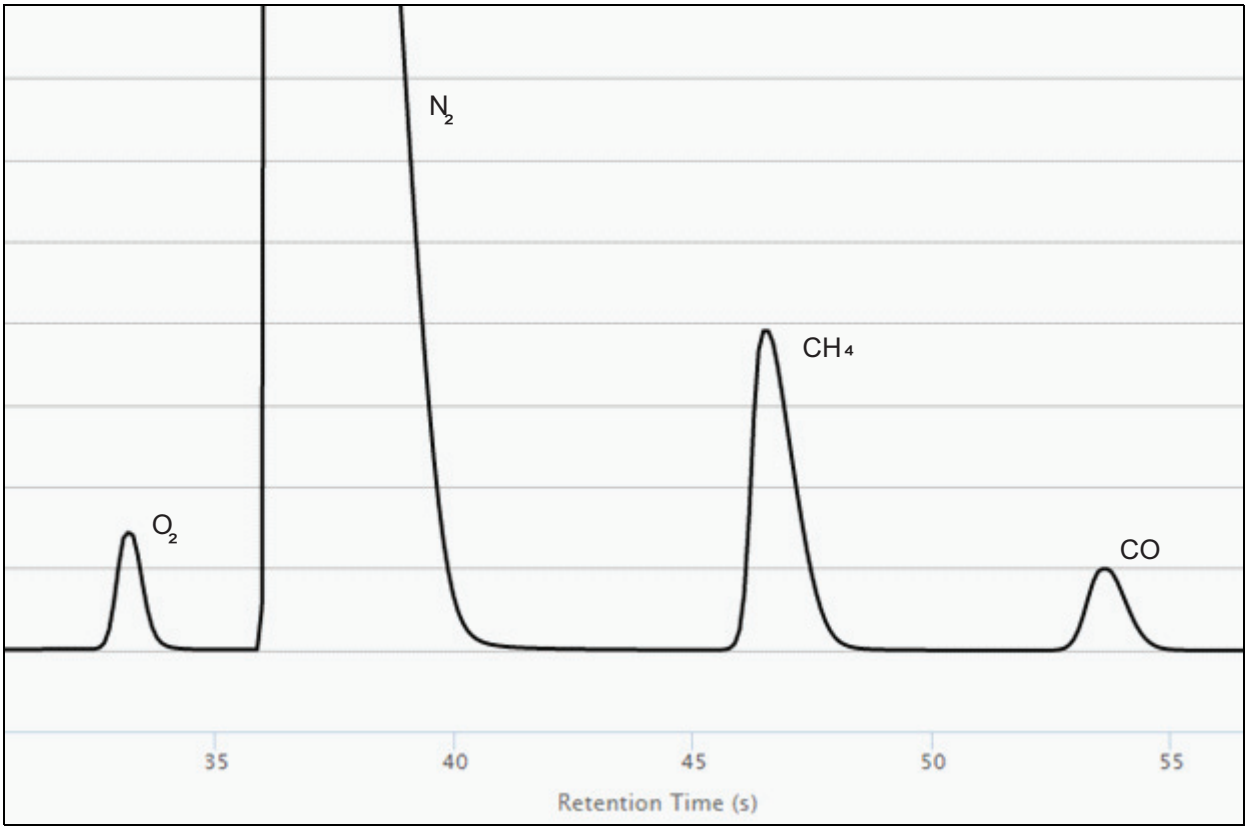
## CONCLUSION

Micro GC Fusion offers exceptional precision and a simple, cost effective means to meet the needs of catalysis gas analysis. The accelerated gas analysis provides the researcher with a larger set of analytical data points, bringing significantly better visibility into processes under study. The simple, reliable and accelerated analysis ensures that research project objectives and deadlines can be effectively met.

**Table 1 Retention time and area repeatability data over 10 runs**

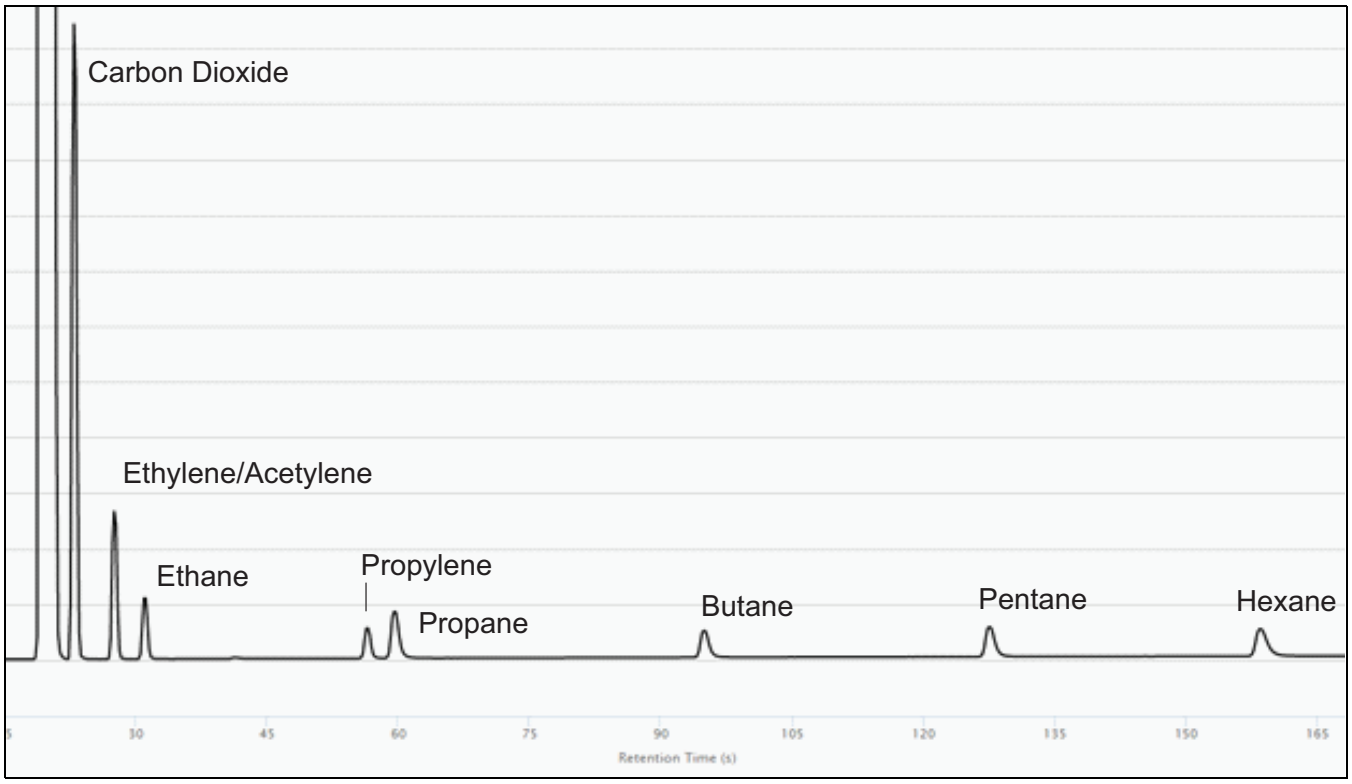
| Module | Compound | Mole % | Retention Time (s) | Retention Time %RSD | Area %RSD |
|---|---|---|---|---|---|
| A | $O_2$ | 1.00 | 33.26 | 0.058 | 0.371 |
| A | $N_2$ | 81.3 | 36.30 | 0.055 | 0.387 |
| A | $CH_4$ | 5.00 | 46.62 | 0.047 | 0.396 |
| A | CO | 1.00 | 53.79 | 0.048 | 0.373 |
| B | $CO_2$ | 1.00 | 23.05 | 0.020 | 0.196 |
| B | ethylene/acetylene | 0.25 | 27.64 | 0.032 | 0.187 |
| B | ethane | 0.10 | 31.12 | 0.042 | 0.201 |
| B | propylene | 0.05 | 56.47 | 0.050 | 0.231 |
| B | propane | 0.10 | 59.58 | 0.048 | 0.231 |
| B | butane | 0.05 | 95.03 | 0.109 | 0.239 |
| B | pentane | 0.05 | 127.58 | 0.108 | 0.355 |
| B | hexane | 0.05 | 158.45 | 0.087 | 0.299 |

**Figure 1 Chromatogram of sampling the calibration gas standard - Module A**



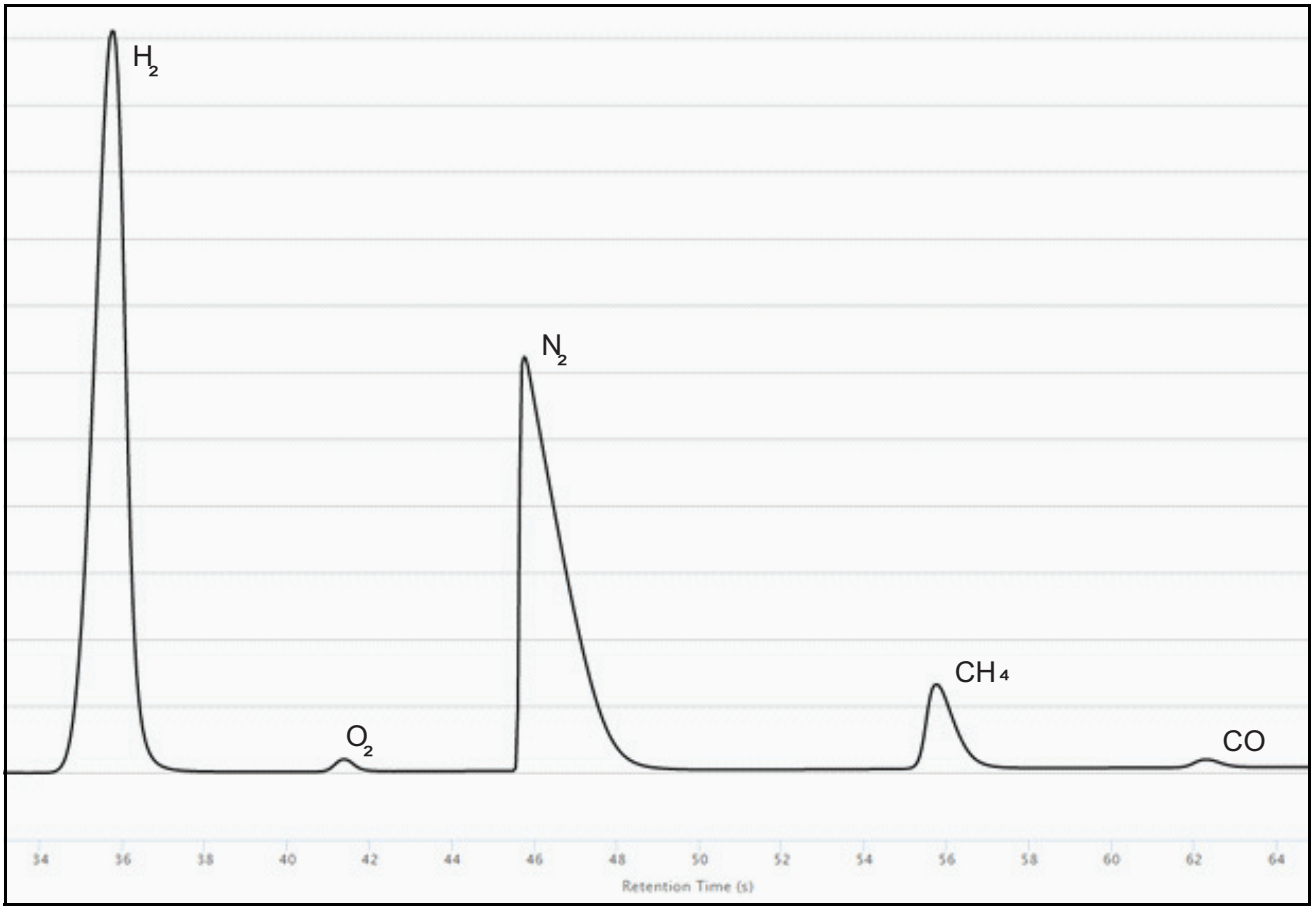

*Column Temperature*: 110°C (hold 30 seconds) → 200°C (hold 20 seconds)*; Ramp Rate:* 1.5°C/s;
*Column Head Pressure*: 23 psi
*Carrier Gas:* Helium

**Figure 2 Chromatogram of sampling the calibration gas standard - Module B**




*Column Temperature*: 60°C (hold 20 seconds) → 200°C (hold 10 seconds)*; Ramp Rate:* 1.0°C/s;
*Column Head Pressure*: 17 psi
*Carrier Gas:* Helium

**Figure 3 Chromatograph of sampling the calibration gas standard using argon carrier gas**




*Column Temperature*: 110°C (hold 30 seconds) → 200°C (hold 20 seconds)*; Ramp Rate:* 1.5°C/s;
*Column Head Pressure*: 23 psi
*Carrier Gas:* Argon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