



Low level H₂ / O₂ analyser for renewable energy research

- ppb analysis of H₂ and O₂
- no interference from water
- fast: < 1 min analysis time
- small 19" footprint
- reliable diaphragm valves

AN 233WA0118A

GAS offers custom configured GC analysers for many application fields since 40 years. GAS analysers are designed to meet many standardised methods from GPA, ASTM, UOP, ISO, EN and others. The efficient configurations are based on proven GC technology, resulting in robust instruments with an optimal return on investment.

Large-scale deployment of hydrogen vehicles can decrease emission of greenhouse gases and ozone precursors. Hydrogen can be produced using renewable sources like photoelectrochemical (PEC) water splitting: specialised semiconductors use light energy to directly dissociate water molecules into hydrogen and oxygen. CompactGC^{4.0} equipped with PDD offers a fast and sensitive research tool.

Fast

Figure 1 shows the diagram of the analyser. Hydrogen and oxygen are separated by a Molsieve column, preceded by a pre-column to prevent heavier components from entering the analysis column. For instance water, which is present at high levels, is effectively backflushed in this way. A fast run-to-run time (below 1 minute) is achieved by using a narrow bore capillary separation column. The sample is injected by valve V1, while V2 acts as input selector for both sample streams.

Sensitive

The Pulsed Discharge Detector (PDD) is known for its high sensitivity for permanent gases. Combined with a narrow bore fast separation column, the limits of detection for H₂ and O₂ are respectively below 100 and below 50 ppb.

Purge option, robust

The analyser is equipped with diaphragm valves with internal purge option for zero leak rate and subsequently a very low detector background level. This is important for stability, sensitivity and good dynamic range. Diaphragm valves offer very long lifetime, and consequently low operational costs. These valves combined with an inert sample path and a well tuned back flush option provide robust and unattended measurement.

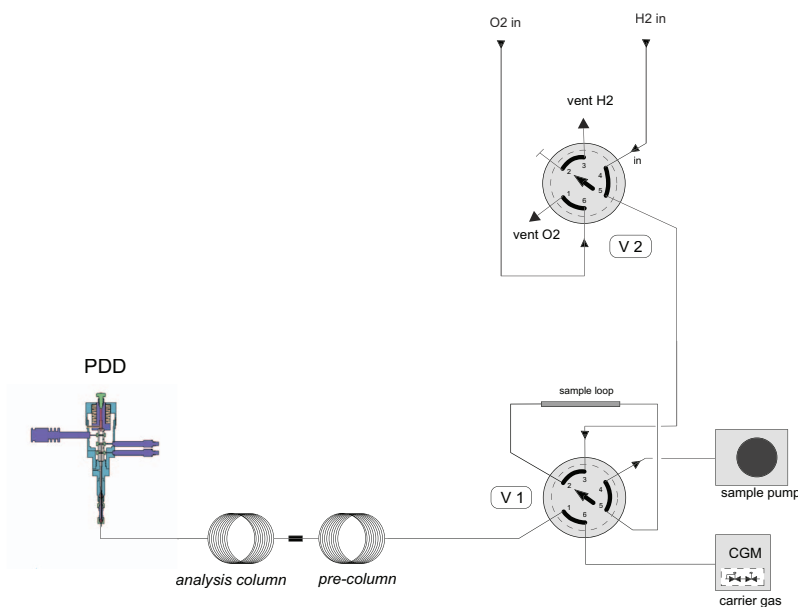


Figure 1. Diagram H₂ - O₂ analyser



Figure 2. Diaphragm valve with internal purge option for zero leak rate

Results

Figure 3 shows the typical chromatogram of a 5 ppm standard in helium. In this example other permanent gases like N₂ and CH₄ are analysed as well besides H₂ and O₂. Figure 4 shows repeatability below 1% RSD.

Chromatography Data Systems

Powerful, easy to use data systems offer a high level of automation and reporting. The H₂-O₂ analyser is available with Chromeleon or OpenLab chromatography data systems. Extensive automated reporting is offered in this way.

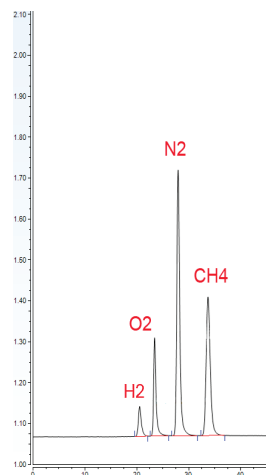


Figure 3. 5 ppm permanent gases in He.

Inj. No.	Injection Name Selected Peak:	Type	Area					
			pA*min PDD		Area			
			Hydrogen	Oxygen	Nitrogen	Methane	Carbon mo	Carbon d
23	Repro	Unknown	0.00088	0.00220	0.00793	0.00597	0.00264	0.00477
24	Repro	Unknown	0.00089	0.00224	0.00793	0.00593	0.00265	0.00477
25	Repro	Unknown	0.00088	0.00220	0.00794	0.00595	0.00268	0.00477
26	Repro	Unknown	0.00088	0.00220	0.00787	0.00591	0.00266	0.00475
27	Repro	Unknown	0.00089	0.00220	0.00786	0.00591	0.00267	0.00472
28	Repro	Unknown	0.00089	0.00220	0.00786	0.00590	0.00269	0.00472
29	Repro	Unknown	0.00089	0.00221	0.00788	0.00590	0.00261	0.00473
30	Repro	Unknown	0.00088	0.00220	0.00785	0.00592	0.00265	0.00474
31	Repro	Unknown	0.00088	0.00223	0.00785	0.00590	0.00264	0.00478
32	Repro	Unknown	0.00088	0.00218	0.00784	0.00589	0.00265	0.00474
Maximum			0.0009	0.0022	0.0079	0.0060	0.0027	0.0048
Average			0.0009	0.0022	0.0079	0.0059	0.0027	0.0048
Minimum			0.0009	0.0022	0.0078	0.0059	0.0026	0.0047
Standard Deviation			0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Relative Standard Deviation			0.54%	0.71%	0.49%	0.41%	0.86%	0.41%

Figure 4. Excellent repeatability at 5 ppm level.

Options:

- Second channel for CO₂ and C₂

Besides H₂ and O₂, other permanent gases like N₂, CH₄ and CO can be analysed using the same configuration. When CO₂, C₂/C₃-hydrocarbons and other components are required as well, the analyser is extended with an additional valve and separation column, with figure 5 as a result. The runtime can be reduced by adding a second PDD, for parallel analysis of both channels.

- Other additional analysis channels

PDD is typically designed for ppb/ppm level measurement. When higher concentration levels need to be analysed, the instrument can be configured with extra channels using TCD or FID. In this way low ppb to 100% levels are covered. With CompactGC^{4.0}, up to 4 analysis channels are available, providing measurement of a wide range of components

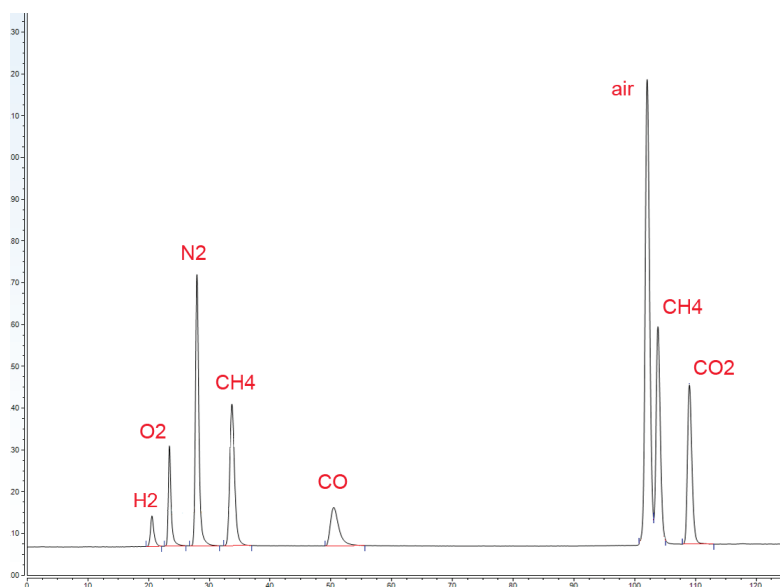


Figure 5. Analysis at 5 ppm using 2 analysis channels with single PDD.

Specifications:

Standardised method:	ASTM D2504
Configuration:	1 channel instrument with PDD
GC instrument:	CompactGC ^{4.0}
Optional:	<ul style="list-style-type: none">- input selector valve for various streams- input selector valve for calibration gases- sample stop flow valve- additional channel for CO₂ and C₂/C₃- hydrocarbons- additional channels using TCD and/or FID
Sample tubing:	Sulfinert® tubing for inert sample path
Application:	Custom configured analyser for the analysis of hydrogen and oxygen from PEC water splitting cells. The instrument is factory tuned for the specific application intended
Sample requirements:	See our pre-installation guide for additional requirements
Analysis time:	< 1 minute
Minimum detectability:	100 ppb for H ₂ ; 50 ppb for O ₂ , when fast narrow bore columns are used. 60-30 ppb in case of packed or wide-bore columns
Dynamic Range:	2-3 decades
Repeatability:	Better than 1% RSD at 5 ppm



Figure 6. Trace permanent gas analyser based on 19" CompactGC^{4.0}

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