

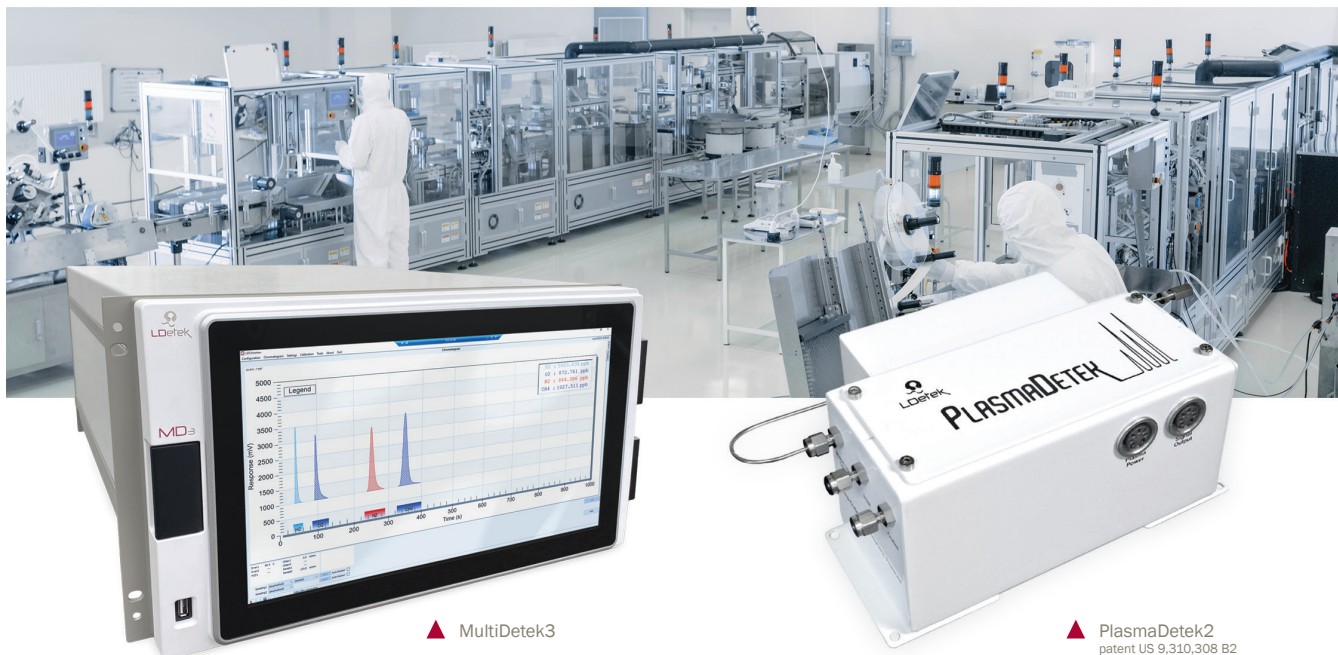
APPLICATION NOTE

LD22-03

PST
PROCESS SENSING
TECHNOLOGIES



Analysis of sub ppb trace impurities in UHP Oxygen



▲ MultiDetek3

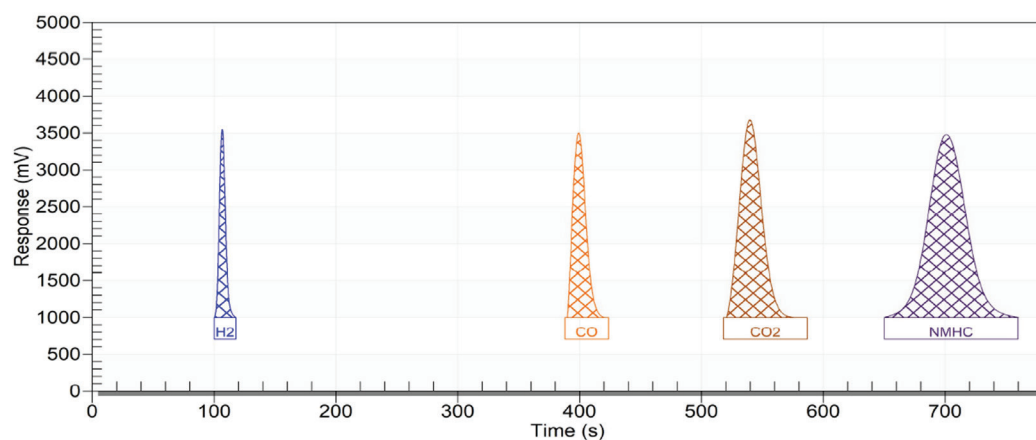
▲ PlasmaDetek2
patent US 9,310,308 B2

Measuring low ppb trace impurities in controlled environment has always been required by the semiconductor manufacturing process and laboratory. Over years, the tendency is to keep improving the purity level of the manufacturing process to increase the range of uses of the electronic components produced. The detection of sub ppb impurities down to 0.1ppb is possible with the MultiDetek3 series using the micro plasma emission patented technology. Offering the modern semiconductor installations, the capacity to improve the quality and production.

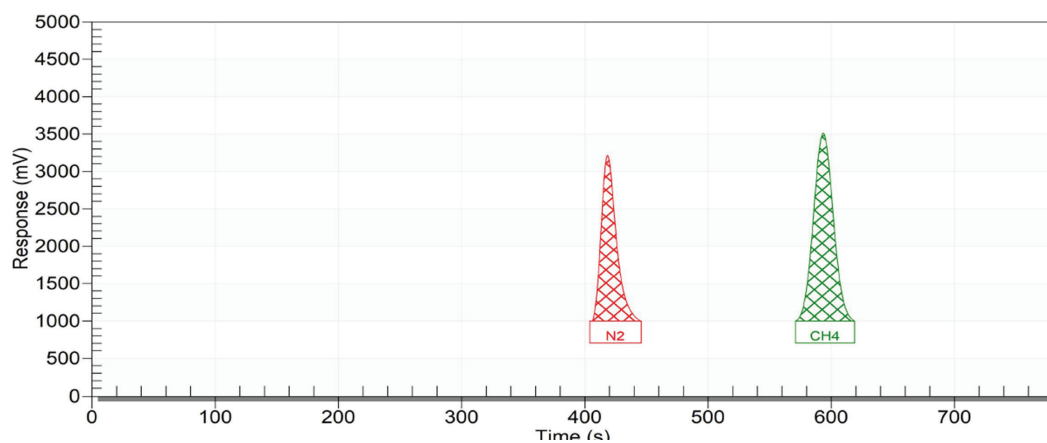
LDETEK SOLUTION

The Multidetek3 industrial gas chromatograph has been configured with the plasma emission detector using Helium as carrier gas. The unit is constructed using multiple channels to allow the simultaneous analysis of sub ppb impurities H₂-CO-CO₂-NMHC-N₂-CH₄ in balance pure Oxygen. The analysis is performed in less than 13 minutes for all impurities. In case faster analysis time is required, the MultiDetek3 has the capacity to have a dual sample inlet that allow to perform parallel chromatography. In this mode, some critical impurities can be focused to be analysed very fast while the less critical impurities keep using the standard analysis time. This analysis technique with dual sample inlet, having fully independent data management/parameters offer more possibilities.

RESULTS



Peak	Unit	Calibration Value	_Area Counts
H ₂	ppb	508.30	2715
CO	ppb	508.30	15349
CO ₂	ppb	536.60	20795
NMHC	ppb	496.00	63598



Peak	Unit	Calibration Value	_Area Counts
N ₂	ppb	444.70	4537
CH ₄	ppb	500.00	15585

Limit of detection (based on 3 times the noise level from a blank)

COMPONENTS	CONCENTRATION (ppb)	PEAK HEIGHT	NOISE	LDL (3X NOISE)
H2	508	2500mV	0.2mV	0.1ppb
CO	508	2500mV	0.2mV	0.1ppb
CO2	537	2700mV	0.2mV	0.1ppb
C3H8	496	2500mV	0.2mV	0.1ppb
N2	445	2200mV	0.2mV	0.1ppb
CH4	500	2500mV	0.2mV	0.1ppb

Note: other LDL could be obtained with different injection volume and chromatographic condition.

Stability: Based on the GC standards. Within few hours runs, being lower than 10% of 3*CV%

Peak	Average	Standard Deviation	Coef. Variation (%)	3 * CV (%)	Status
CH4	328.10233200 ppb	7.82245259	2.38	7.15	Accepted
CO	364.25439300 ppb	1.08730412	0.30	0.90	Accepted
CO2	386.59766500 ppb	2.36884334	0.61	1.84	Accepted
H2	367.41526700 ppb	1.00636241	0.27	0.82	Accepted
N2	299.84060700 ppb	3.71447400	1.24	3.72	Accepted
NMHC	358.88264700 ppb	0.40429446	0.11	0.34	Accepted

Repeatability: Based on the GC standards. Using 6 of 10 consecutive runs, being lower than 5% of 3*CV%

Peak	Average	Standard Deviation	Coef. Variation (%)	3 * CV (%)	Status
CH4	326.43002500 ppb	1.90480140	0.58	1.75	Accepted
CO	365.00640000 ppb	0.51991522	0.14	0.43	Accepted
CO2	385.48400667 ppb	2.04753965	0.53	1.59	Accepted
H2	366.82781667 ppb	0.47376130	0.13	0.39	Accepted
N2	297.41186667 ppb	1.53133150	0.51	1.54	Accepted
NMHC	358.65457167 ppb	0.16465685	0.05	0.14	Accepted

Results for 6 of 10 consecutive analyses

Start Date	H2	CO	N2	CO2	CH4	NMHC
2022-08-16 16:38	366.103 ppb	364.882 ppb	294.446 ppb	387.676 ppb	323.580 ppb	358.442 ppb
2022-08-16 16:25	366.455 ppb	364.947 ppb	297.718 ppb	388.289 ppb	326.671 ppb	358.504 ppb
2022-08-16 16:12	366.926 ppb	365.649 ppb	298.616 ppb	383.961 ppb	328.650 ppb	358.651 ppb
2022-08-16 15:58	366.923 ppb	365.600 ppb	298.494 ppb	383.229 ppb	328.380 ppb	358.668 ppb
2022-08-16 15:45	367.157 ppb	364.557 ppb	297.330 ppb	385.139 ppb	325.565 ppb	358.782 ppb
2022-08-16 15:32	367.403 ppb	364.402 ppb	297.867 ppb	384.609 ppb	325.736 ppb	358.881 ppb

CONCLUSION

The MultiDetek3 process industrial gas chromatograph configured with PED can achieve a lowest detection limit of 0.1ppb for impurities in pure Oxygen. The GC offers an integrated temperature-controlled system which allows to achieve better sensitivity and stability. The gas chromatograph comes with all standard communication protocols and data management system required by the industries. Using the dual sample inlet mode, quicker analysis can be performed when quick critical measurement is important.