

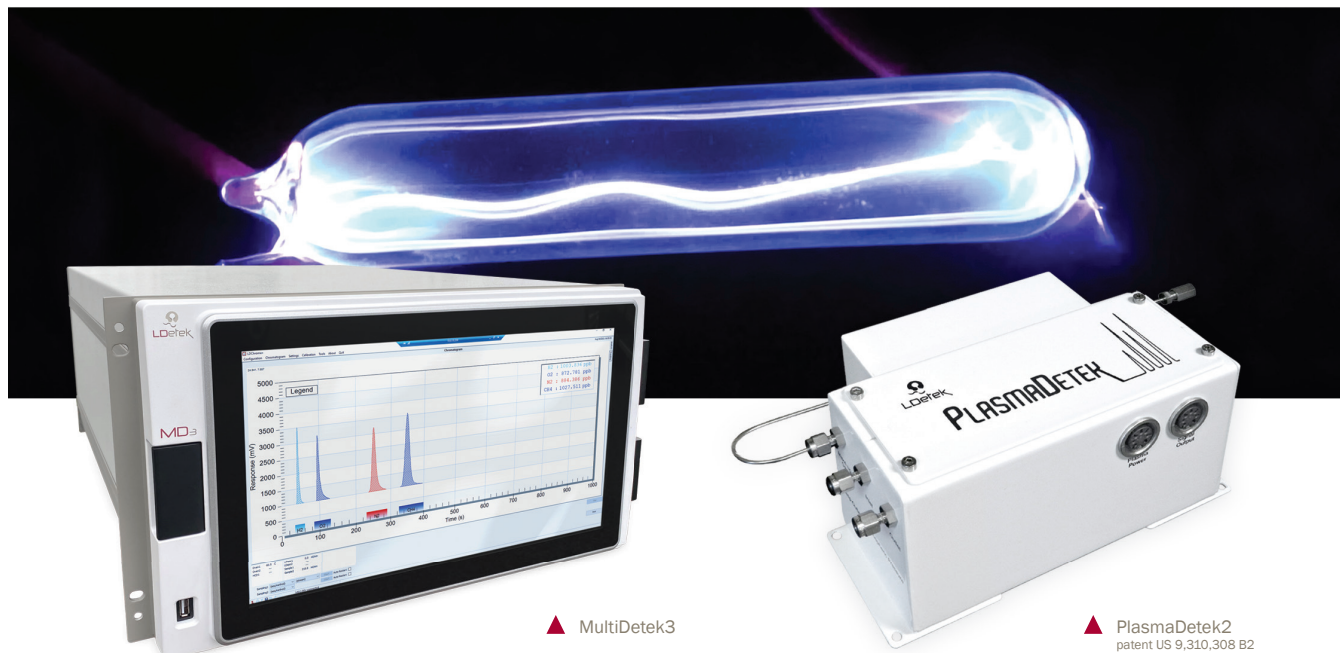
APPLICATION NOTE

LD23-03

PST
PROCESS SENSING
TECHNOLOGIES



Analysis of trace impurities in UHP Krypton



The krypton is one of the most valuable gas as it is produced from fractional distillation of liquefied air. Considering only 1ppm Krypton is presents in ambient air, it becomes a costly process to produce pure krypton.

In the forecast period of 2022-2027, the global krypton gas market is expected to grow at a CAGR of 6%. As per the analysis by Expert Market Research, the market is expected to be driven by the rising demand of oxygen, since the need for ventilators has rapidly increased in the wake of the COVID-19 pandemic.

The drastic impact of the pandemic has taken the world by storm and governments and hospitals are anticipating the situation to only get worse in the coming months. These institutions are stocking up the necessary inventory to prevent shortage, which is boosting the krypton gas market significantly. The increase in research and development activities (R&D) in the production of krypton gas has given rise to various technologies of production, thereby bolstering the market growth.

Krypton is used with argon in fluorescent lights to improve their brightness and with nitrogen in incandescent lights to extend their lifetime. It is also used in flashbulbs to produce a very bright light for a very short period of time, for use in high-speed photography.

LDETEK SOLUTION

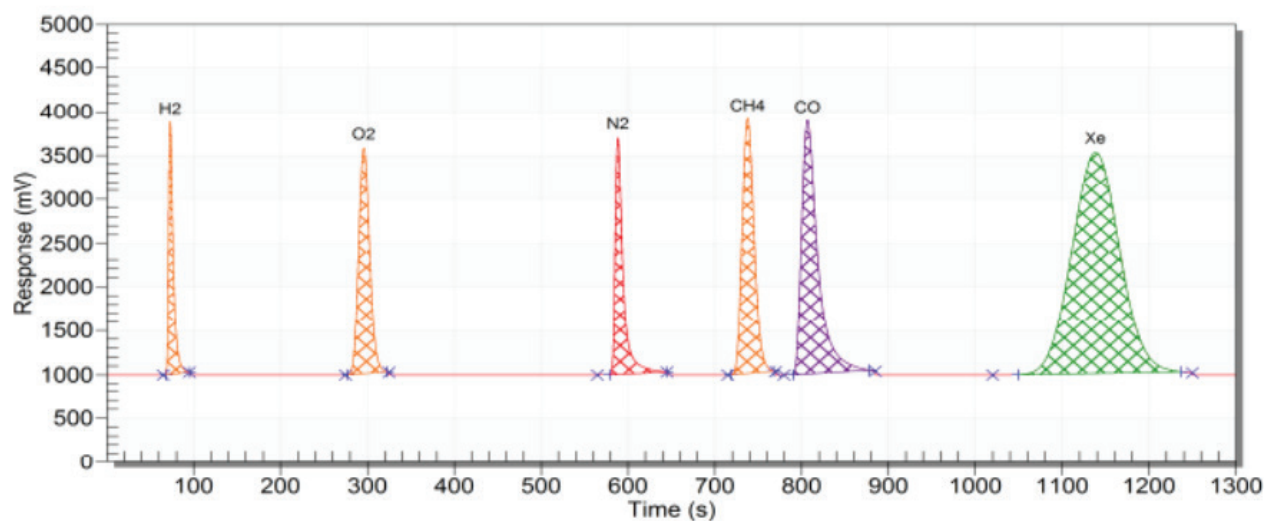
The purity Krypton can be qualified with the use of the MultiDetek3 gas chromatograph configured with PED. Due to the small presence of about 1ppm krypton in air used as raw material to produce UHP krypton, it is usually required to measure multiple impurities for the validation of krypton purity. The MultiDetek3 here has been configured with PED module with helium carrier gas to measure ppb/ppm trace impurities of H₂-O₂-N₂-CH₄-CO-XE-CF₄-C₂F₆ in pure krypton.

The unit has been configured with measuring range of 0-10ppm and Idl of 5-10ppb for impurities H₂-O₂-N₂-CH₄-CO-Xe. The other impurities CF₄ and C₂F₆ use a range of 0-500ppm with an Idl of 25ppb.

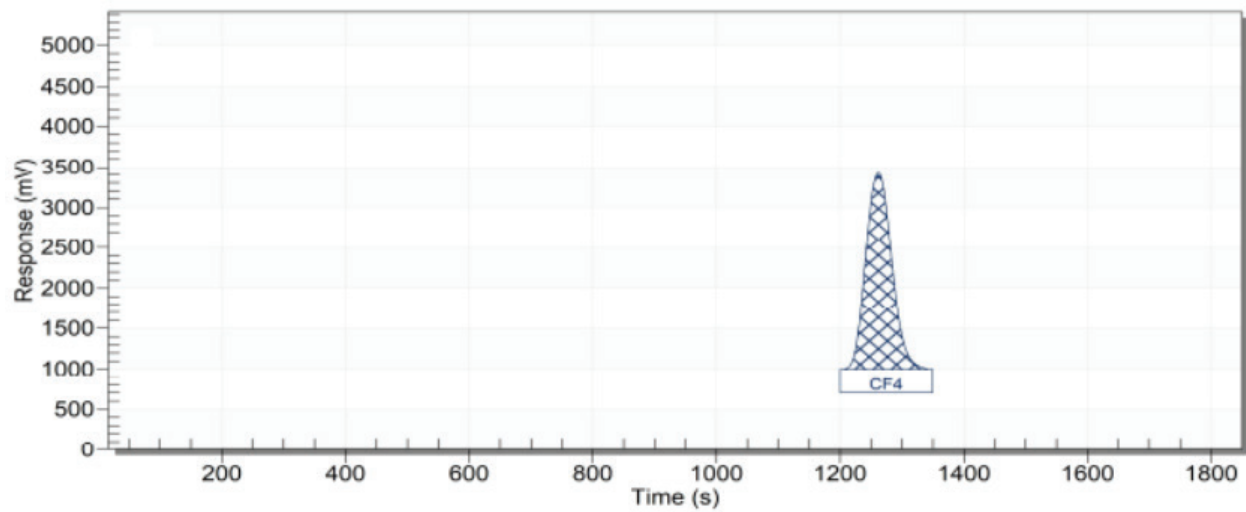
Other configurations and ranges/Idls are possible. The parameters mostly depends of the site production requirements and process.

RESULTS

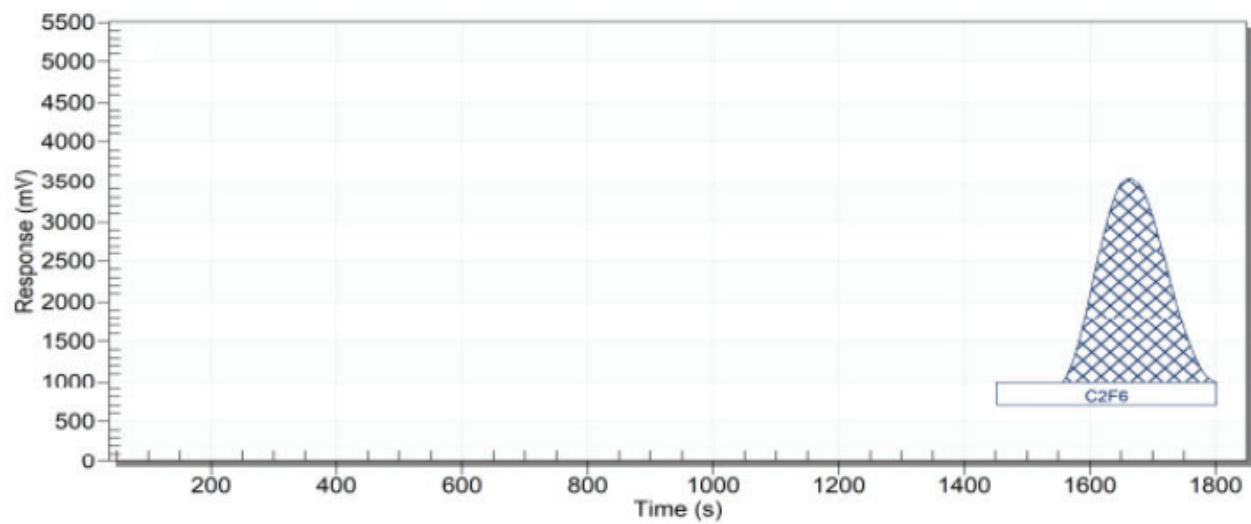
Chromatograms (Span calibration) of trace impurities H₂-O₂-N₂-CH₄-CO-Xe-CF₄-C₂F₆ in balance gas Krypton



Peak	Unit	Calibration Value	_Area Counts
H2	ppm	9.50	18135
O2	ppm	8.50	36798
N2	ppm	9.10	28493
CH4	ppm	9.80	47016
CO	ppm	9.50	62590
Xe	ppm	10.00	161004



Peak	Unit	Calibration Value	_Area Counts
CF4	ppm	397.00	20608



Peak	Unit	Calibration Value	_Area Counts
C2F6	ppm	100.00	73418

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

COMPONENTS	CONCENTRATION (ppb)	PEAK HEIGHT	NOISE	LDL (3X NOISE)
H2	9.5	2988mV	0.53mV	5ppb
O2	8.5	2678mV	0.46mV	4ppb
N2	9.1	2852mV	0.71mV	7ppb
CH4	9.8	3026mV	0.69mV	7ppb
CO	9.5	2918mV	0.68mV	6ppb
Xe	10.0	2578mV	0.36mV	7ppb
CF4	397	2452mV	0.05mV	24ppb
C2F6	100	2526mV	0.17mV	20ppb

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

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

Linearity: Based on the GC standards. A linear curve having its R2 at a value between 0.998 and 1.00.

Accuracy: Based on the GC standards. <= 1% of error or IdI whichever is higher

CONCLUSION

The MultiDetek3 configured with PED can offers a good analytical solution for trace ppb/ppm impurities for quality and validation of UHP Krypton. The gas chromatograph is configured with standard industrial communication protocols and remote-control interface. The platform is modular to adapt any of additional requirement in terms of purity Kr production. The MultiDetek3 is a very robust gas analyzer configured for industrial market to run 24/7.



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