



Hydrogen purity analysis with HydrogenSense

Problem

Using hydrogen that contains impurities can cause damaged PEM fuel cells after a short time. To counter this, guidelines for appropriate hydrogen purity have been laid out in International Standards ISO 14687:2019 and SAE J2719, which outlines the maximum allowable impurity levels for compounds like H_2O , O_2 , He , N_2 , Ar , CO , CO_2 , TS , THC , $HCHO$, $HCOOH$, NH_3 , HBr , HCl and Cl_2 .

Solution

Unlike others using a number of single analyzers, the real time parallel measurement of limited and unlimited gas components has been achieved by combining two mass spectrometers in one single housing, called the HydrogenSense.

The HydrogenSense is a combination of an Electron Impact (EI-MS) and an Ion-Molecule Reaction (IMR-MS) mass spectrometer in one analyzer unit for the analysis of all the above impurities in hydrogen for PEM fuel cells.

Proven Technology

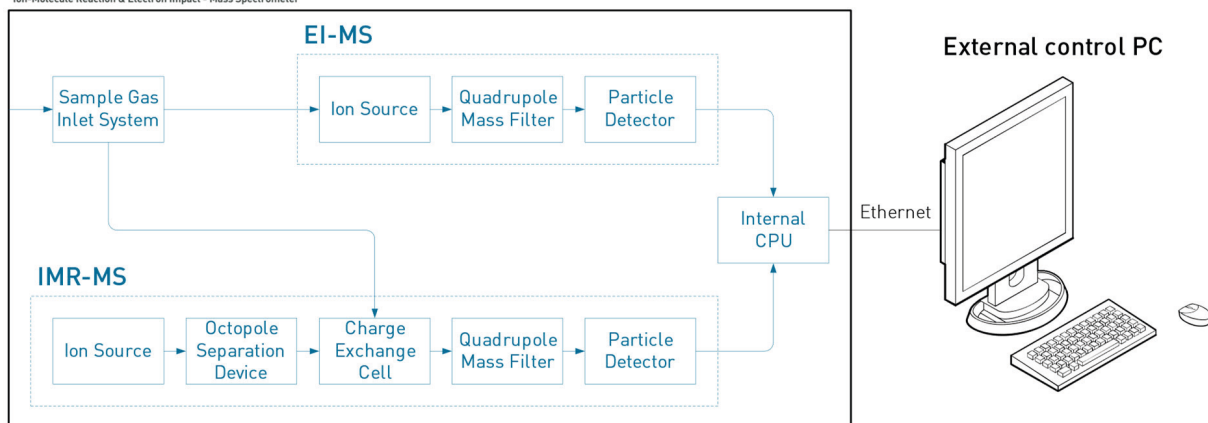
Flexibility and user-friendly handling are achieved by combination of well proven technology and state of the art manufacturing capabilities. The combination of IMR and EI mass spectrometry offers a unique fast response time, a wide dynamic range, selective measurements and lowest detection limits.

Function principle

The HydrogenSense is a combination of the IMR-MS and the EI-MS technology in one single enclosure. By using IMR technique, the measurement becomes fast, selective and almost free of any interference. Unlike others, no fragmentation or overlapping spectra can damage the interpretation of the detected results. The use of primary ions with low energy levels (10 eV to 14 eV) allows to completely ionize the probe gas molecules. The signal/noise ratio is optimized by the integrated octupole separator, focusing the primary ions and filtering out any interference. The quadrupole mass filter (7-519 amu) separates the molecules for further detection at the fast pulse counter.

HydrogenSense

Ion-Molecule Reaction & Electron Impact - Mass Spectrometer



The ionization in the EI-MS takes place at 70 eV and the mass range is from 1 to 100 amu with a resolution of 1 amu. The temperature- and pressure compensated sample gas inlet guarantees correct measurements and avoids any discrimination of the gas.

Features, benefits

- A single analyzer for all purity analysis in compliance with SAE J2719 and ISO14687:2019
- Immediate results for H₂O, O₂, He, N₂, Ar, CO, CO₂, TS, THC, HCHO, HCOOH, NH₃ and halogenated compounds
- Fully automated analysis with generation of CoA and CoC
- Easily integrated to any sampling location: production, refueling, etc.
- ValveBox with integrated temperature-controlled gas inlet switching and automatic gas flow regulation available

Specification, technical data

Technical Data	IMR-MS	Technical Data	EI-MS
Mass range	7 – 519 amu	Mass range	1 – 100 amu
Resolution	< 1 amu	Resolution	< 1 amu
Analysis time	≥ 1 msec/amu	Analysis time	≥ 5 msec/amu
Measuring range*	10 ⁵	Measuring range*	0 – 100 Vol%
Response time*	T ₉₀ < 20 msec	Response time*	T ₉₀ < 20 msec
Lower detection limit*	< 1 ppb	Lower detection limit*	> 0.01 Vol%

Technical Data	IMR-MS & EI-MS	Technical Data	IMR-MS & EI-MS
Gas consumption*	30 – 3.000 ml/min	Gas inlet temperature	50 °C – 190 °C adjustable
Gas inlet pressure	0.75 – 2 bar(a)	Humidity max.	80 % (non-condensing)
Reproducibility	< ± 3 %	Accuracy	< ± 2 %
Concentration drift	< ± 5 % over 24 h	Ambient temperature	20 °C – 35 °C
Dimensions (WxHxD)	600 x 1692 x 700 mm	Weight	215 kg
Power	230 V/50 Hz or 115 V/60 Hz 1000 W		

* depending on the components measured, system setup and the settings