

Application Note

Intrinsic Safety Consideration

Introduction

Sensoric's toxic gas sensors are micro fuel cells to be maintenance free and stable over a long period of time.

Sensoric's three electrode toxic gas sensors consist of a sensing electrode, a counter electrode and a reference electrode, which keeps the potential of the sensing electrode constant in co-operation with an electronic circuit.

The central feature of the sensor is the diffusion barrier, which limits the flow of the target gas to the sensing electrode in that way, that all gas can react either by oxidation or reduction at the electrode.

Under this condition there is a linear relationship between the current signal and the partial pressure of the toxic gas, which is combined with the volume concentration of the gas.

The electrocatalysts are especially developed by Sensoric and designed to be specific for the target gas.

The reaction can be a direct charge transfer process or an indirect process, where at first a chemical reaction takes place, before in a second step the electrochemical reaction occurs.

The counter electrode acts to balance out the reaction at the sensing electrode by reducing oxygen in air to water in the case of an oxidation reaction on the sensing electrode, and the inverse process of water oxidation to oxygen, if an oxidation process takes place.

Application Note

Current and Open Circuit Voltages

Due to the mechanical dimensions and the principle working mechanism Sensoric sensors are electrochemical devices which produce very small voltages and currents.

Sensoric sensors are also not able to store large quantities of energy.

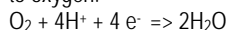
Considering the electrical characteristics of the sensors in normal operation and the possible fault conditions, Sensoric sensors may be considered as a simple apparatus.

Sensoric Sensors are electrochemical sensors which operate as micro fuel cells; which means a current will only be generated if the gas compound is present. Otherwise voltage and current will be nearly zero.

Sensor	Electrode reaction	Open circuit voltage [mV] typical	Open circuit voltage [mV] limit	Short circuit current [μ A] typical ¹⁾	Short circuit current [μ A] limit
AsH ₃ 2E/ PH ₃	6 Ag ⁺ + AsH ₃ + 2H ₂ O => H ₃ AsO ₃ + 6H ⁺ + 6 Ag 6 Ag => 6 Ag ⁺ + e ⁻	<50	<300	<0.8	10
Cl ₂ 3E 10	Cl ₂ + 2e ⁻ => 2Cl ⁻	<50	<200	<0.5	50
Cl ₂ 3E 50	Cl ₂ + 2e ⁻ => 2Cl ⁻	<50	<200	<0.5	50
CO 2E 300	CO + H ₂ O => CO ₂ + 2H ⁺ + 2 e ⁻	<100	<300	<0.09	500
CO 3E 300 / 500S	CO + H ₂ O => CO ₂ + 2H ⁺ + 2 e ⁻	<100	<300	<0.09	
COCl ₂ 3E 1	COCl ₂ + H ₂ O + 2 Ag ⁺ => 2AgCl + 2H ⁺ + CO ₂	<100	<300	<0.8	10
H ₂ 3E 1%	H ₂ => 2 H ⁺ + 2e ⁻	<100	<500	<0.005	500
H ₂ 3E 4%	H ₂ => 2 H ⁺ + 2e ⁻	<100	<500	<0.005	500
H ₂ S 2E 30	2 Ag ⁺ + H ₂ S => Ag ₂ S + 2 H ⁺ + 2e ⁻	<100	<300	<0.1	50
H ₂ S 3E 30	2 Ag ⁺ + H ₂ S => Ag ₂ S + 2 H ⁺ + 2e ⁻	<100	<300	<0.1	50
H ₂ S 2E 50 / 50S	H ₂ S + 4 H ₂ O => H ₂ SO ₄ + 8 H ⁺ + 8e ⁻	<100	<500	<0.5	500
H ₂ S 3E 100 / 100 S	H ₂ S + 4 H ₂ O => H ₂ SO ₄ + 8 H ⁺ + 8e ⁻	<100	<500	<0.5	500
HCl 3E 30	Au ⁺ + 4HCl => AuCl ₄ ⁻ + 4 H ⁺ + Au => Au ⁺ + e ⁻	<100	<500	<0.1	500
HCN 3E 30	Ag => Ag ⁺ + e ⁻ / Ag + HCN => AgCN	<50	<300	<0.04	50
HF 3E 10SE	not specified	<100	<500	<0.5	500
NH ₃ 3E 100	2 NH ₃ + 3 OH ⁻ => N ₂ + 3 H ₂ O + 3e ⁻	<10	<500	<0.1	50
NH ₃ 3E 1000	2 NH ₃ + 3 OH ⁻ => N ₂ + 3 H ₂ O + 3e ⁻	<100	<500	<0.1	50
NH ₃ 3E 100 SE	Not specified	<50	<200	<0.1	50
NH ₃ 3E 1000 SE	Not specified	<50	<200	<0.02	50
NH ₃ 3E 5000 SE	Not specified	<50	<200	<0.01	50
NO 3E 100	NO + 2 H ₂ O => NO ₂ + 2 H ⁺ + 2e ⁻	<100	<500	<0.03	300
NO ₂ 3E 50	NO ₂ + 2 H ⁺ + 2e ⁻ => NO + 2 H ₂ O	<50	<200	<0.1	50
SiH ₄ / GeH ₄ / B ₂ H ₆	SiH ₄ + 3H ₂ O => H ₂ SiO ₃ + 8H ⁺ + 8e ⁻	<50	<300	<0.1	50

¹⁾ regarding to 1 ppm

The Counter electrode acts to balance out the reaction at the sensing electrode either by reducing oxygen in air to water or by reducing water to oxygen.



All Sensoric sensors do not contain any electric components, if not otherwise specified.

