Pewatron Application Note PAN-03: Zirconia oxygen gas sensor – cross sensitivity to other gases and materials

The FCX zirconia oxygen sensor works excellent and reliable in a number of applications, including CO_2 incubators, nitrogen and oxygen concentrators, oxygen transmitters and in fruit & vegetable storage applications. Zirconium oxide (with proper dopant elements; zirconia) when heated > 350 °C is penetrable for oxygen ions. The FCX oxygen series has the working point at 450°C. A voltage applied to the oxygen-sensing element, pumps the oxygen out of a closed inner chamber. At a constant gas pressure, the quantity of oxygen pumped out is equal to the quantity of oxygen molecules diffusing in through a small capillary hole. It is independent of the voltage applied between the electrodes within a certain range. The measurement current is proportional to the quantity of oxygen molecules pumped away. Because of the high temperature and the voltage driving force for oxygen diffusion, there is number of gases and materials, which can result in a false oxygen concentration measurement or can destroy the oxygen sensing element. In this application note, we will discuss most of these gases and material that have an adverse effect on the oxygen-sensing principle of the zirconia sensor.

Combustible Gases

Small amounts of combustible gases does not burn at the hot sensor surfaces, but they can decompose because of a high applied voltage across the sensor element. Below the decomposition voltage, the sensor will measure the residual oxygen pressure.

Gases investigated:

- H_2 (Hydrogen) up to 3%
- CO (Carbon Monoxide) up to 3%
- CH_4 (Methane) up to 4%
- CO_2 (Carbon dioxide) up to 80%

Heavy Metals Vapors

Pt (Platinum), Zn (Zinc), Cd (Cadmium), Pb (Lead), Bi (Bismuth) will have a negative effect on the catalytic properties of the oxygen sensing electrodes. Exposures to such metal vapors must be avoided.

Halogen and Sulphur Compounds

Small amounts (< 100ppm) of Halogens and/or Sulphur compounds have a negative effect on the lifetime and performance of the oxygen sensor. These types of gases cause sensor degradation.

Gases investigated:

- Halogens, F_2 (Fluorine), Cl_2 (Chlorine)
- HCL (Hydrogen Chloride), HF (Hydrogen Fluoride)
- SO_2 (Sulphur Dioxide), H_2S (Hydrogen Sulphide)
- Freons, CFCs (Chlorofluorocarbon)

Nitrous gases

Exposure to nitrous gases in ppm levels change the catalytic effect of the Pt-electrodes and result in false signals. This can be the case for NO_x and NH_x gases.

Gases investigated:

- NO_2 (Nitrogen Dioxide)
- NO_x (Nitrogen oxides)
- NH_3 (Ammonia)

Others

Gases evaporating from silicone compounds or rubbers are to be avoided. Ppm levels of SiO_2 and Si reacts with the Platinum electrodes or blocks the pores and active parts of the electrodes.

VOC or other organic gases in high concentrations and with a low decomposition temperature can have a negative influence on the lifetime and performance of the oxygen sensor

For humidity and water condensation issues concerning the sensor performance, please refer to Pewatron application note PAN-04

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