

Toxic Gas Sensor

Electrochemical toxic gas sensors are micro fuel cells, designed to be maintenance-free and stable for long periods. They have a direct response to volume concentration of gas rather than partial pressure.

The simplest form of electro-chemical toxic sensor comprises two electrodes: sensing and counter, separated by a thin layer of electrolyte. This is enclosed in a plastic housing that has a small capillary to allow gas entry to the sensing electrode and includes pins which are electrically attached to both electrodes and allow easy external interface. These pins may be connected to a simple resistor circuit that allows the voltage drop resulting from any current flow to be measured (figure 1). Gas diffusing into the sensor is either oxidized or reduced at the sensing electrode and, coupled with a corresponding (but converse) counter reaction at the other electrode, a current is generated through the external circuit. Since the rate of gas entry into the sensor is controlled by the capillary diffusion barrier, the current generated is proportional to the concentration of gas present outside the sensor and gives a direct measure of the toxic gas present.

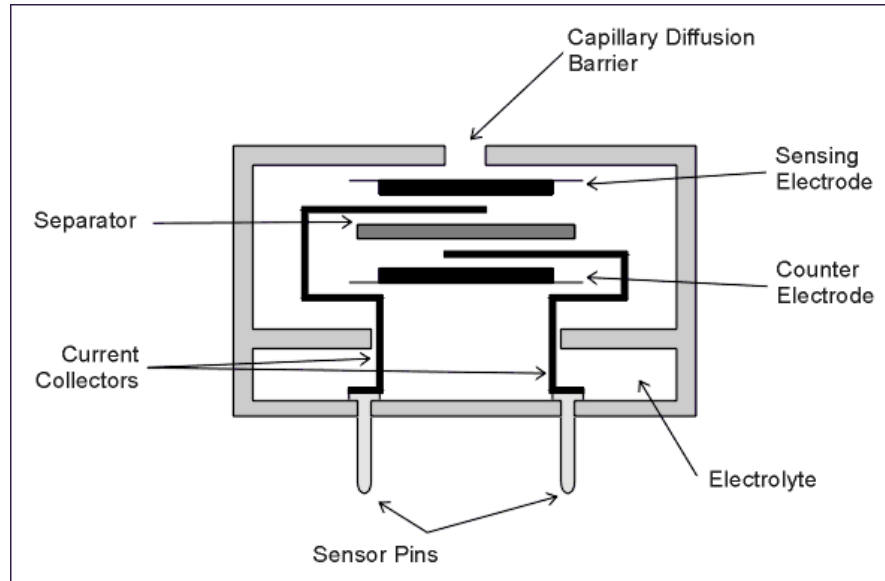
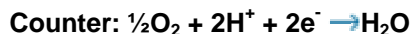
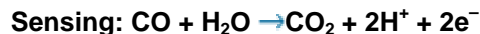


Figure 1 – Toxic Gas Sensor

The central feature of the design is the gaseous diffusion barrier, which limits the flow of gas to the *Sensing* electrode. The electrode is therefore able to react with all the target gas as it reaches its surface, and still has electrochemical activity in reserve. This high activity reserve ensures the sensor can cope with high concentrations within its output range.

The reactions that take place at the electrodes in a carbon monoxide sensor are:



Similar reactions take place for all other toxic gases that are capable of being electrochemically oxidized or reduced.

From the reaction at the counter electrode, it is evident that oxygen is required for the current generation process to take place. This is usually provided in the sample stream by air diffusing to the front of the sensor, or by diffusion through the sides of the sensor (a few thousand ppm is normally sufficient).

However, continuous exposure to an anaerobic sample gas may result in signal drift, despite the oxygen access paths and so we recommend that toxic sensors are never potted with resin or completely immersed in an anaerobic gas mixture.

2-Electrode sensors are the simplest form of toxic gas sensors. However they have limited measuring range due to polarization of the counter electrode. This polarization effect can be eliminated by using a third, reference, electrode with a stable potential in the sensor design. In these sensors the sensing electrode is held at a fixed potential relative to the reference electrode (from which no current is drawn) so both maintain a constant potential. The counter electrode is still free to polarize, but has no effect on the sensing electrode and does not limit the sensor in any way.

3-Electrode sensors are the most widely used design of electrochemical sensors for detecting toxic gases.