1. Operation Principle

The sensing material in TGS gas sensors is metal oxide, most typically SnO2. When a metal oxide crystal such as SnO2 is heated at a certain high temperature in air, oxygen is adsorbed on the crystal surface with a negative charge. Then donor electrons in the crystal surface are transferred to the adsorbed oxygen, resulting in leaving positive charges in a space charge layer. Thus, surface potential is formed to serve as a potential barrier against electron flow (Figure 1).

Inside the sensor, electric current flows through the conjunction parts (grain boundary) of SnO2 micro crystals. At grain boundaries, adsorbed oxygen forms a potential barrier which prevents carriers from moving freely. The electrical resistance of the sensor is attributed to this potential barrier. In the presence of a deoxidizing gas, the surface density of the negatively charged oxygen decreases, so the barrier height in the grain boundary is reduced (Figures 2 and 3). The reduced barrier height decreases sensor resistance.

The relationship between sensor resistance and the concentration of deoxidizing gas can be expressed by the following equation over a certain range of gas concentration:

$$Rs = A[C]^{-\alpha}$$

where: Rs = electrical resistance of the sensor
A = constant
[C] = gas concentration
α = slope of Rs curve

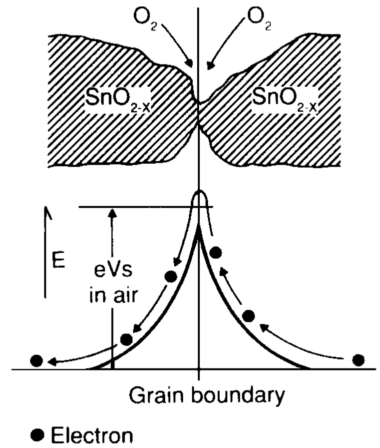

Fig. 1 - Model of inter-grain potential barrier
(in the absence of gases)

$$1/2O_2 + (SnO_{2-x})^* \rightarrow O^-ad(SnO_{2-x})$$
$$CO + O^-ad(SnO_{2-x}) \rightarrow CO_2 + (SnO_{2-x})^*$$

Fig. 2 - Scheme of the reaction between CO and adsorbed oxygen on SnO2

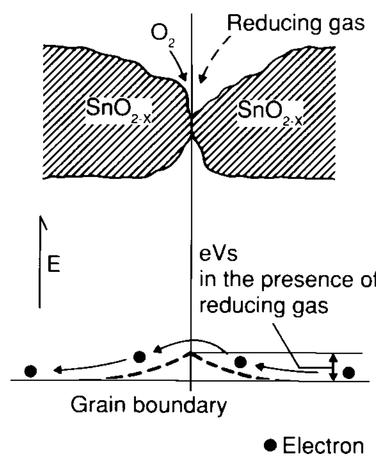

Fig. 3 - Model of inter-grain potential barrier
(in the presence of gases)