



## Gas Sensors : A Need of Hour

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### ABSTRACT

*We are suffering from the destructive natural events viz. Earthquakes, Tsunamis, Cyclones, High tides as well as from the harmful diseases viz. High fever, Typhoid, Malaria, Chikungunya, Bird flu, Dengue, etc., which have been increased tremendously. No doubt, these are the products of environmental pollution and ultimately, of the global warming. Industries, vehicles, few natural events and man-made events are the major source of polluting gas. These gases beyond the certain limit cause undesirable and disastrous effects on human and environment. Along with trace level (ppb and sub ppb level) gaseous species detection and gas concentration detection, in the environment, gas sensors are useful for disease diagnosis, food inspection, to detect food freshness, etc.*

### KEYWORDS :

#### 1. Introduction

21<sup>st</sup> century is the age of IT and automation which requires quick, easy and safety control and measurement technology of physical quantities [1]. It need more sophisticated and delicate digital instrumentations. To increase the efficiency and capability of the instruments in measurement and detection technology, to reduce the cost, shape, size, weight, etc., it is necessary to introduce the sensor units at the input ports of domestic, industrial and scientific instruments in development .

Man is running, as fast as Tolstoy's man, continuously at day and night, providing contribution in development and hence is not giving proper attention to the damage that is being done by him to the environment [2]. The net visible results is the destruction and degradation of the quality of the environment, which causes tremendous pollution. Environmental pollution has posed serious problems viz. physical, chemical, biological, social, economical etc.

Environmental pollution is defined as "the condition that exists when the atmosphere contains the concentration of pollutants those produce objectionable effects". The environmental may be defined as "the imperceptible relationship and interaction between the nature and the human mind". If there is no mind, then there is no environment. Man, with a rapidly growing and advancing technology, grabbing and robbing the beautiful nature speedily and thoughtlessly. During the competition of qualitative and quantitative production and development, many toxic and hazardous gases are released by the industries in the environment. Man is one of the great deformer of land for many reasons such as mining, cutting, boring, building, construction and deposition, nuclear explosions, bomb attacks, etc. add to imbalance the gravity resulting in land slide [3].

Environmental pollution is a today's global issue. Pollution has raised its ugly head high in the global environment. The pollutants so badly affect all the components of the environment such as air, water, soil, noise, etc. that the environment has become polluted. Pollution is the price of industrialization and urbanization, and a by-product of development. Carbon monoxide(CO), carbon dioxide(CO<sub>2</sub>), hydrogen sulphide(H<sub>2</sub>S), sulphur dioxide(SO<sub>2</sub>), sulphur trioxide(SO<sub>3</sub>), nitric oxide(NO<sub>3</sub>), nitrogen dioxide, chlorine, ethanol, ammonia, etc. are toxic and polluting gases; the leakages of which can reach to dangerous level up to 100 ppm. It can cause the serious health hazards in all sense. Exposure of a few such gases up to 150 ppm and above can cause death. Unwanted gases released by the industries and vehicles, smoke and particulate matters are the major pollutants in air [4]. The gases which beyond the certain limit cause undesirable and disastrous effects on human and environment are called as air pollutants. The gases produced by industries in large extent are stored in the tanks. The leakage of storage tanks caused the cruellest events all over the world.

The exposure of toxic and hazardous gases can cause heart and respiratory track diseases, lung cancer, reduction in haemoglobin, impairment of nervous system, mental retardation, disorders of di-

gestive systems, disorders of reproductive system, blindness, forgetfulness, headaches, hypertension, etc. The application of gas sensing technology range from environmental analysis and food processing to the pharmaceuticals industry and medicine [5].

#### 1.1 Air Pollutants

Air pollutants are classified as:

##### 1.1.1 Inorganic Gases :

This class includes the oxides of carbon, Sulfur, nitrogen and other gases viz. H<sub>2</sub>S, NH<sub>3</sub>, Cl<sub>2</sub>, HF, etc.

##### 1.1.2 Organic gases :

This class includes the hydrocarbons viz. CH<sub>4</sub>, C<sub>2</sub>H<sub>6</sub>, C<sub>3</sub>H<sub>2</sub>, C<sub>2</sub>H<sub>4</sub>, C<sub>8</sub>H<sub>18</sub>, C<sub>6</sub>H<sub>6</sub>, formaldehyde, vapours of acetone, alcohols, organic acids etc. Vapours of petrol, diesel, LPG and LNG are the gases containing volatile organic compounds.

##### 1.2 Particulate matters :

This class includes dust, smoke, ash, carbon, lead, sprays, insecticides, pesticides, oils, greases, paints, etc.

On the basis of direct or indirect release of gases, there are mainly two types of pollutants; they are primary and secondary pollutants.

##### 1.2.1 Primary pollutants :

The pollutants which are directly released from sources are known to be primary pollutants e.g. H<sub>2</sub>S, NH<sub>3</sub>, CO<sub>2</sub>, SO<sub>2</sub>, NO, vapours of petro-, diesel, kerosene, LPG, LNG, dust particles etc.

##### 1.2.2 Secondary pollutants :

The pollutants which are formed in atmosphere by chemical interactions among primary pollutants e.g. NO<sub>2</sub>, SO<sub>3</sub>, O<sub>3</sub>, Ketones, H<sub>2</sub>SO<sub>4</sub> etc. Like human activities, few natural activities are also responsible for emitting particulate matters and polluting gases.

#### 1.3 Health Problems Due To Different Gases

Different gases cause various health hazards. On the basis of nature and kind of Gases, few health hazards are discussed below:

##### 1.3.1 Hydrogen Sulfide (H<sub>2</sub>S)

The biogenic decomposition of sulphur containing organic matter occurs both on the land and in the sea. The major sulphur compounds generated in biogenic decomposition is hydrogen sulphide (H<sub>2</sub>S). H<sub>2</sub>S is one of the major pollutants, hazardous and toxic in nature, which is also released from industries and laboratories.

##### 1.3.2 Ammonia (NH<sub>3</sub>)

Ammonia is utilized extensively in many chemical industries, fertilizer plants, refrigeration systems, etc. A leak in the system can result in health hazards. Ammonia is harmful and toxic in nature. The exposure of ammonia causes chronic lung disease, irritation and even burning the respiratory track etc.

### 1.3.3 Chlorine (Cl<sub>2</sub>)

Chlorine is a yellowish-green gas having pungent smell, which is explosively utilized in industrial applications such as to bleach paper pulp, to disinfect sewage and drinking water, etc. As it has wide range of applications, its toxicity can affect the health of humans in contact. Chlorine has excellent bleaching ability, but once it is discharged in aquatic systems, it interacts with other industrial effluents to produce a host of chlorinated organics such as dioxin.

### 1.3.4 Ethanol (C<sub>2</sub>H<sub>5</sub>OH)

Pure ethanol is called as an absolute alcohol. Ethanol is used for beverages, scientific and industrial purposes. Ethanol is a hypnotic (sleep producer) gas. It depresses activity in the upper brain even though it gives the illusion of being a stimulant. Ethanol is also toxic like methanol. Abuse of ethanol is a major drug problem in most countries.

The atmospheric concentration of CO<sub>2</sub> at present is about 356 ppm. The greenhouse contribution of CO<sub>2</sub> is 50%. If the present emission trend of CO<sub>2</sub> continues, a global warming of 3.5 to 4.5°C is likely to occur. It has been estimated that, the sea level may rise 0.5 to 1.5 m in the next 50 to 100 years. An increase in average in average global temperature is likely to increase the incidence of infectious diseases, viz. malaria, chikungunya, schistosomiasis, sleeping sickness, dengue, yellow fever etc. The outbreak of cholera in Latin America (1991), the outbreak of pneumonic plague in india (1994) and the Hantavirus epidemic in South America (1994) can be directly linked to global warming.

### 1.3.5 Carbon monoxide (CO) :

Haemoglobin (Hb) has about 210 times more affinity for CO than for oxygen. Hence, less oxygen is taken up by haemoglobin, if CO is inhaled during breathing. When CO is inhaled during breathing, it combines with haemoglobin (Hb) in the blood stream to form more stable complex known as carboxy-hemoglobin CO-Hb.



The constituents components of LPG, Liquefied Natural Gas (LNG) and Liquefied Petroleum Gas (LPG) are highly inflammable gases. They are explosively utilized in industrial and domestic fields as fuels.

### 1.3.6 Hydrogen (H<sub>2</sub>)

Energy is the driving force of all activities in the universe. Nothing moves, changes, grows or decays without consumption of energy. It flows downhill from high-potential to "low-potential and high-temperature source to cosmic cold of the outer space. For most organisms, the energy required is derived from food. Unlike other organisms, human not only require food energy but also energy to drive machines, to produce heat, to generate electricity, transport, etc.

### Conclusion

It is, therefore, necessary to turn our attention towards the development of fuel economy based on hydrogen. Hydrogen is not the primary source of energy. It is an energy carrier. On combustion, it produces only water. Hence, the advantage of hydrogen is its virtually pollution-free combustion. It is therefore, destined to become the fuel of the future. Cracking of hydrocarbons, cracking, electrolysis and thermo chemical decomposition of water produce the hydrogen. Hydrogen as an energy carrier has widespread applications. It is explosively utilized in industrial fields as fuels. It is a colourless and odourless gas. Its leakage cannot be noticed easily. This gas is potentially hazardous because of explosion possibility.

To reduce the risks of global warming, we should control the emission of polluting gases. To reduce the environmental pollution and risks, we can not stop the production through industries and transportation, but many simple things are in our hand, by which we can reduce the pollution viz. periodically tuning the engines, servicing of machines properly and regularly, by using pure form of fuels, by stopping unnecessary working of machines, etc.

Many gas sensors are already, fabricated by Figaro Engg. Inc., Eco Sensors Inc., Sierra monitors, IST, etc. However, they couldn't meet the challenges up to the depth demand by society, e.g. Sensor for sensing ammonia gas, which could detect the ammonia. However, the Threshold Limit Value (TLV) for ammonia leaks by any means in the environment above 25 ppm it affects the living beings in that environment. And at this concentration of the ammonia, the available sensor detects ammonia.

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