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# Gas Sensors For Different Toxic Gases-A Review

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***Abstract: Different types of toxic gases are polluting our atmosphere and producing harmful effects on the flora and fauna of the different regions. They are the by-product of vehicular emissions, presence of vegetative stink and stagnation. A review has been undertaken to know the sources of emissions of these gases and the methods employed to detect and monitor them at ppm levels.***

## 1. Introduction

The monitoring and detection of hazardous gases has become the need of the hour due to vehicular traffic and industrial emissions. So, fast and low cost gas detection and monitoring systems are required for the detection of these gases. So, lot of research investigations are being conducted in this direction of fabrication of fast and cost effective gas sensors. Major toxic gases that pollute the environment include Carbon Monoxide (CO), Variuos oxides of Nitrogen ($NO_x$), Sulphur dioxide ($SO_2$), Ammonia ($NH_3$) and Hydrogen sulphide ($H_2S$) **[1-6].** Ammonia is a gas without colour with a bad smell. The main sources of ammonia are the agricultural processes and combustions in chemical plants. If the concentration of ammonia in air exceeds 300 ppm, then it poses danger to the health of the human beings **[7].** Many different types of gas sensors are used for the detection of toxic gases. Out of these, electrochemical gas sensors are very popular as other types of sensors suffer from one or more than one problems. These sensors are highly specific for the gases and are capable of giving sensor signal in parts per million (ppm) or in parts per billion (ppb) levels **[8-9].**

## 2. DETECTION OF $NH_3$ GAS

The concentration of $NH_3$ is increasing in the ambient very fast because of the actions performed by the human beings. The ammonia emission throughout the world ranges from 10-80 Teragram, where 1 Tera gram (Tg) = $10^{12}$g **[10].** Higher concentrations of this gas can lead to various complications and even death. So, a fast, reliable and selective gas sensor capable of ammonia detection is urgently needed. Amongst the various materials, tin oxide doped with poly-pyrrole has come up as a most promising material for ammonia detection **[11].** The detection limit for this sensor is approximately 300ppb and the sensitivity was in the range of 6.2% for a few ppm of ammonia gas. The enhanced sensing characteristics was attributed to the fact that $SnO_2$ and poly-pyrrole forms a pn junction on its surface.

The $Sr/SnO_2$ composite is another well studied composite for $NH_3$ gas detection. In many ways this composite shows a better response towards $NH_3$ than un- doped $SnO_2$. The fast response of $Sr/SnO_2$ sensor is due to more oxygen adsorption by the tube like structures. Similarly, the $Co_3O_4$ nanorods showed fast response and recovery times towards ammonia gas **[12-15].** Similarly, many other research investigators $Co_3O_4$,mixed potential type sensors, NASICON(Sodium super ionic conductor) and $Co_3O_4$/polyethyleneimine-carbon nanotubes nanocomposites. These materials showed good response towards ammonia gas**.** The sensing characteristics of the sensor elements towards $NH_3$ gas is improved by catalytic layers. An electrochemical sensor consisting of a thin film of ionic liquid as an electrolyte and a sensor

is capable of detecting ammonia with concentration as low as 1ppm in air**[16-20].** Because of high aspect ratio, unique physical and chemical properties, Carbon nano tubes are also considered as candidates for the fabrication of sensors that work at room temperature. Conducting polymers can also be used for ammonia sensor at room temperature. For example, PANI/MWCNTS was used as an efficient ammonia gas sensor by various research investigators. In a nutshell, nano materials can be used as ammonia gas sensors because of their unique properties like high surface area and good reactivity **[21, 22].**

### 3. Detection of $NO_x$ gases

Oxides of Nitrogen are collectively called $NO_x$ gases. The major gases are NO and $NO_2$ ,which come in this category. These gases produce bad effects on the atmosphere. These gases degrade the ozone layer by reacting with it and is responsible for increasing the temperature of the globe. These gases also effect the respiration of the human beings **[23-, 24].** There is an urgent need to detect and monitor these gases , therefore the demand of gas sensing systems for these gases is rising. The electrochemical sensors are showing promise in the field of detection and monitoring of these gases. The primary requirement is that the gas sensors should be operating in the range of 550-900$^oC$ as these are mainly installed in monitoring the exhaust gases of the vehicles. Various methods have been employed by the research investigators for increasing the sensitivity of the gas sensors **[25-27].**

### 4. Detection of $H_2S$ gas

Hydrogen sulphide is a very toxic gas. It becomes fatal if inhaled more than the permissible limit and for longer duration of time. Various methods were employed for the fabrication of hydrogen sulphide gas sensors. These methods include solvent evaporation method, hydrothermal method etc. The nano-materials were used extensively for the detection of hydrogen sulphide by various research workers.

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