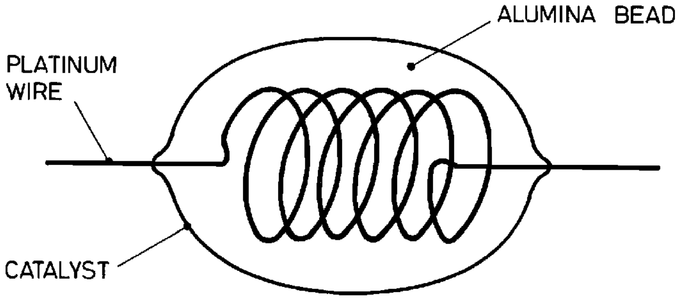
INTRODUCTION

Pellistors are gas sensors that detect combustible gases and vapours in air (or atmospheres containing oxygen), in concentrations approaching the explosive range. In this case, they are operating in a catalytic mode where the target gas is burnt and the heat liberated is measured by the sensor.

They can also be used to detect gases whose thermal conductivities are significantly different to that of air, e.g. helium. This mode is known as the thermal conductivity mode. In this case, the gas can be measured up to 100% volume.



DESCRIPTION

The catalytic sensor consists of a coil of a small diameter platinum wire supported in a refractory bead. A layer of catalyst is deposited on to the bead. A current is passed through the coil heating up the catalytic material to ~500 °C. At this temperature the catalytic material can burn the target gas producing heat. The resulting temperature rise is detected by the coil, in which the resistance rises. This active bead is known as the Detector bead. In order to compensate for environmental factors such as temperature and pressure, the active bead is matched with an inactive reference or Compensator bead. This pair of beads is generally run in a simple Wheatstone bridge circuit. The signal produced is proportional to the gas concentration up to the lower explosive limit, or LEL. The sensor will detect all combustible gases and vapours, although the response to higher hydrocarbons may not be high (see Pellistor Application Note 2).

The thermal conductivity sensor comprises two beads, one of which is exposed to the target gas (the Detector) and the other sealed inside a chamber containing air (the Compensator). Both beads are heated as before and run in the same type of circuit as the catalytic sensor. When the detector bead is exposed to a gas whose thermal conductivity is significantly different to that of air, the rate of heat loss from the bead will change, as will its resistance. This change measured is compared with the compensator bead. The sensor is most often used to detect gases with low molecular weight (e.g. hydrogen or helium), which have much greater thermal conductivities than that of air, consequently giving the highest response.

SAFETY CONSIDERATIONS

These sensors operate at temperatures above 400 °C and as such have the capacity to ignite flammable gas mixtures. To prevent this, if the sensor is to be operated in an environment where combustible gases could be found, then it is necessary to enclose the pellistor beads in a certified flameproof head. This will allow the beads to be exposed to the target gas without the risk of ignition. e2v supplies sensors both as beads and as beads within a certified head. In the former case, the customer must consider whether the beads meet the certification requirements of their own their own flameproof head.

PELLISTOR POISONING

It must be noted that certain chemical compounds can adversely affect the sensor performance of catalytic pellistors. This is seen as either a loss of sensitivity, a drift in the zero, or both. The degree can vary with the length of exposure and the type of chemical but the overall effect can be broken down into the following:

1. **Inhibition** (e.g. with H_2S, CFCs, etc.), where the loss is less pronounced and can be reversible.
2. **Poisoning** (e.g. with organic silicones), where the effect is permanent and significant, e.g. with a total loss of sensitivity.

e2v offers sensor types that have been designed to resist the effects of poisoning, but long-term exposure to poisons will still eventually result in a sensor failure. Further details are available in Pellistor Application Note 6, or contact e2v for more information if required.

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APPLICATIONS

Catalytic Pellistors

As these sensors measure gases in the 0 - 100% LEL range, they are routinely fitted in instruments used in applications where combustible gases could be present. The gas most often measured and encountered in the field is methane. This gas is present in coalmines, in places where organic matter is decomposing such as sewers, and as a major constituent in natural gas. There is also a sizeable market in measuring potential sources of methane in confined spaces associated with telecommunications. The majority of instrumentation is in the form of portable instruments many containing multiple gas sensors.

The main source of non-methane applications is monitoring of hydrocarbons, most commonly in the petrochemical industry both on and offshore and in monitoring for kerosene spillages. These instruments are generally calibrated for butane or pentane. In this case, as well as portable instruments, there is a significant market for fixed gas detection systems.

Applications for other gases also exist, e.g. for hydrogen in battery charging areas and ammonia in refrigeration plants.

Thermal Conductivity (TC) Sensors

The main application for methane calibrated (TC) sensors is in coalmines and natural gas monitoring. Concentrations of methane well over 50% by volume can be found in fissures in coal seams.

The other main application for TC sensors is in the monitoring of 'light' gases such as helium and hydrogen. These gases can be found in various industrial processes (for helium) and for hydrogen in fuel cell and battery charging applications.