

Platinum in Thin Films

Meanders for Temperature Sensors and More

Due to their wide-ranging measurement advantages and their reliability, platinum temperature sensors produced in thin-film technology have long since become the standard in mass markets such as the automotive industry, white goods, building and air conditioning engineering and in the process industry. With production processes similar to those found in semiconductor manufacture it has been possible to break through price barriers in recent years. Heraeus Sensor Technology is further advancing this development.

The large-scale production is based on coating processes on substrates of aluminium oxide. Here, the platinum layer is structured in a meander shape using photolithographic processes and then trimmed to within close tolerances of the nominal value by laser technology. A burnt-in glass layer protects the meanders against ambient conditions. The characteristic of all platinum temperature sensors corresponds to IEC 75 and DIN EN 60751. The real art – or the actual expertise – is to have the safe and cost-efficient control of all production stages for many millions of items each year, both for standard products and also for sensor variants optimised to suit customer requirements.

Anyone aspiring to produce millions of platinum temperature sensors with high precision at marketable costs must above all be capable of analysing, automating and permanently controlling each stage of production with continual optimisation. The complete production must be raised from that of conventional sensor manufacture to the level of process engineering. Large-scale production with



▲ Evolution in Platinum Thin-Film Technology

guaranteed product characteristics requires highly motivated, trained personnel, complete process data control and appropriately developed information networks and software tools.

The quality of thin-film production at Heraeus Sensor Technology is characterised by conformance to a long list of standards. For example, DIN EN ISO 9001: 2000 or ISO/TS 16949 for the automotive sector. Then there is also DIN EN ISO 14001. The latter describes a management system with the aid of which possible environmental effects from production are analysed and assessed already in the product initiation phase.

Applications

Reliability, safety, ride comfort and environmental compatibility in the automotive field are increasingly ba-

sed on electronics and sensors in vehicles. In this respect Heraeus Sensor Technology is a development partner for vehicle manufacturers around the world. In this partnership role the company contributes its own wide knowledge base in joint development projects. A typical example here is the particulate filter in diesel-powered cars. In order to function on a continuous basis they must be occasionally regenerated. In this process temperatures up to 900 °C arise, which a temperature sensor must measure safely and accurately so that the particulate filter is not damaged during self-cleaning. In a large number of the cars currently on the road this sensor is based on a Pt temperature sensor element from Heraeus Sensor Technology. And then there is the condition monitoring of the engine oil. Here, one of the crucial stress conditions is caused by peak temperatures which



▲ Sensor-Production in Clean-Room Atmosphere

have to be measured as accurately as possible. Consequently, a few millions of Pt sensors from Heraeus Sensor Technology are now busy at work in the oil sumps of cars. In millions of ovens the high stability of Pt temperature sensors is exploited to monitor the oven cooking tempera-

ture (<220 °C) and pyrolytic self-cleaning (>450 °C). Manufactured using customised production techniques, Pt sensors also provide the temperature control for glass ceramic cooking surfaces. The measurement of thermal energy consumption in buildings involves the accurate acquisi-

tion of a small temperature difference in line with strict legal regulations. At each measuring point for the billing of heating costs at least two sensors are employed, the characteristics of which must not differ by more than 0.1 K. The large-scale use of platinum resistance sensors in electronic circuits is also standard practice these days. Here, the features of accuracy, stability and a standardised characteristic are decisive for selection by the development engineer. Generally, Pt sensors from Heraeus Sensor Technology are used as reference probes or for the compensation of thermally induced drift effects in the electronics. Measurement resistances with values up to 10,000 ohms facilitate integration into equipment and modules with low energy consumption, such as for example head-end transmitters in process engineering and battery-powered measurement systems.

Multi-sensor platforms

Heraeus Sensor Technology's core expertise extends far beyond the lar-

Platinum Temperature Sensors – The Product Portfolio

Each year Heraeus Sensor Technology produces several millions of temperature sensors in platinum thin-film technology. Depending on the field of application four principal groups are available – for cryogenic (-196 °C ... +150 °C), low (up to +400 °C), medium (up to +500 °C) and high (over +1,000 °C) measurement temperatures. Versions with nominal resistance values of 100, 200, 500, 1,000 and 10,000 ohms are available. Depending on the version, the sensors are between 1.7 mm and 9.5 mm long and 1.0 mm to 3.0 mm wide. The height is 1 ±0.1 mm. The standard length of the connec-

ting leads is 10.0 mm. Shorter or longer connecting leads are available on request. For improved labelling of the various sensor ranges, Heraeus Sensor Technology has introduced an unambiguous colour-coding system, which simplifies logistics and avoids errors in production. Heraeus Sensor Technology supplies both SMD versions (1206, 0805 and 603) and also one type in the transistor case (TO92) for the automatic assembly of circuit boards with Pt temperature sensors. Versions with nominal resistance values of 100, 1,000 and 10,000 ohms are available. The main use is temperature acquisi-



tion on circuit boards. For specific applications measurement resistances can be supplied as special versions. Variants are possible with regard to dimensions, nominal resistance, temperature coefficient and measurement tolerance.

ge scale production of Pt temperature sensors.

Structured platinum films form the basis of many sensor modules which are provided with a specific range of functions by customers who later add their own proprietary layers. Metals, semiconductors or metal oxides such as for example gold, silicon, stannic oxide or gallium oxide can be used for the sensitive layers. These so-called multi-sensor platforms are then used to produce, for example, gas sensors with which traces of oxygen, carbon monoxide, nitrogen oxides or methane are detected in concentrations down to the ppm range. There are also applications in biotech-

nology. The electrode structures of thin platinum layers are ideally suited to appropriate further processing, for example, to follow the metabolism of cell structures due to the induced ionic currents.

During joint product development the extensive expertise of Heraeus Sensor Technology is available to the customer in relation to coating, structuring and large-scale production.

Prospects

About 150 employees at Heraeus Sensor Technology currently generate a production volume of several millions of Pt sensors each year. They supply a

basic element for the reliable operation of many products in our high-tech lives and with their enthusiasm for innovation they also continue to consolidate the top position of the company internationally in the field of platinum thin-film elements.

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