

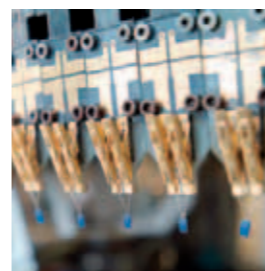
Heraeus



**Heraeus Sensor Technology**  
Dependable sensor technology

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# Heraeus Sensor Technology – the Company

## Products for Subcontractors and System Suppliers

Heraeus Sensor Technology with its headquarters in Kleinostheim near Aschaffenburg in Germany is a division of W.C. Heraeus Hanau. The core capabilities are in development, production and in the international marketing of primarily customised microstructured noble-metal thin-film systems. This includes sensors for temperature and flow measurement as well as sensor platforms which are used for example in the manufacture of gas sensors. The company annually supplies many millions of these components to subcontractors and system suppliers.

With its products Heraeus Sensor Technology offers first class customer benefits and is the market leader in the field of platinum temperature measurement. Ideally equipped, both strategically and technologically, the company is expanding internationally, particularly in developing markets involving environmental technologies and life science applications.

### Focus on customers

The products, production technologies and people at Heraeus Sensor Technology are orientated to the usually extraordinary requirements of our customers.

Initial meetings for orientation are followed by first estimates, realisation tests and the common definition of critical product features. Then development phases and time spans are defined, product qualifications carried out and the technical process parameters for large-scale production optimised. Even after production has started, products and processes are continually optimised together with the customers.



The growth of experience, the permanent generation of knowledge, is one of the expressed company objectives at Heraeus Sensor Technology - not only in the direction of new developments in the form of products, but in particular also with regard to complex production procedures.

Communication takes place without reservation with specialists at all levels of the added value chain. The tasks of the employees at the company include analysing every enquiry for feasibility and testing product ideas. This is the prerequisite for technological leadership.



### Technology without limits

All the manufacturing processes at Heraeus Sensor Technology are specifically developed so far that they run with stability, quickly, cost-effectively and orientated to the customer. A finely structured monitoring system with clearly defined characteristics quantifies the quality of all the procedures. It forms the basis of continuous improvement.

The goal of technological market leadership is also the reason why Heraeus Sensor Technology manufactures exclusively in Germany. This is because, apart from the technical equipment and plant needed, well-trained employees, experienced in their fields and who have a commitment to the company and its customers are essential for high tech production.

### Basic supply

Heraeus Sensor Technology sees itself as a supplier of basic components. The perfect long-term functioning of sensor elements supplied in thin-film technology is a general requirement for high quality end products to be able to function reliably.

Customers of Heraeus Sensor Technology are mainly subcontractors or system suppliers for manufacturers who produce their end products in large quantities: white goods (household appliances), process technology, electronics, automotive industry, heating, ventilation and air conditioning or products for the field of life sciences and medical technology.



# Heraeus Sensor Technology – the Tasks

## Microstructured Noble Metals in Thin Films

### Core expertise

Heraeus Sensor Technology develops, produces and markets throughout the world products whose function is based on structured thin noble-metal films. Amongst its activities the company specialises in the large-scale production of platinum sensors for temperature, the world's most frequently measured process quantity.

### Quality

Heraeus Sensor Technology develops, produces and supplies products with reliable and lasting functional capability - throughout the world in quantities of millions. Special value is placed on the expertise of the engineers in the production process and the scientific knowledge which goes into research and development.

For example, after intensive investigations on various material combinations and the ensuing expansions and changes to the production process, it has been possible to increase the effective application limit for Pt temperature sensors in thin-film technology to 1,000°C. Since then the stability of Pt sensors from cryogenic temperatures at -196°C up to the 1,000°C limit is also available to the process industry.

### Household appliances

With the production processes from Heraeus Sensor Technology products with structured thin platinum films achieve a price level which opens up their numerous advantages also to the field of household appliances. It is the unbeatable combination of a wide temperature measurement range, standardised measurement characteristics and close tolerance which convinces leading oven manufacturers. Here, a million times over, it is not just the exact control of the baking temperature that is involved, but rather also the monitoring of the critical catalytic cleaning using one and the same sensor with an expected product service life of more than twenty years.

### Automotive industry

Heraeus Sensor Technology annually supplies millions of mainly housed sensors to subcontractors in the automotive industry. In upper mid-range and top range vehicles the applications for these components include diesel soot-particle filters or condition sensors for the engine oil with substantial stress due to vibrations and temperature shocks.

### Heating, ventilation and air conditioning

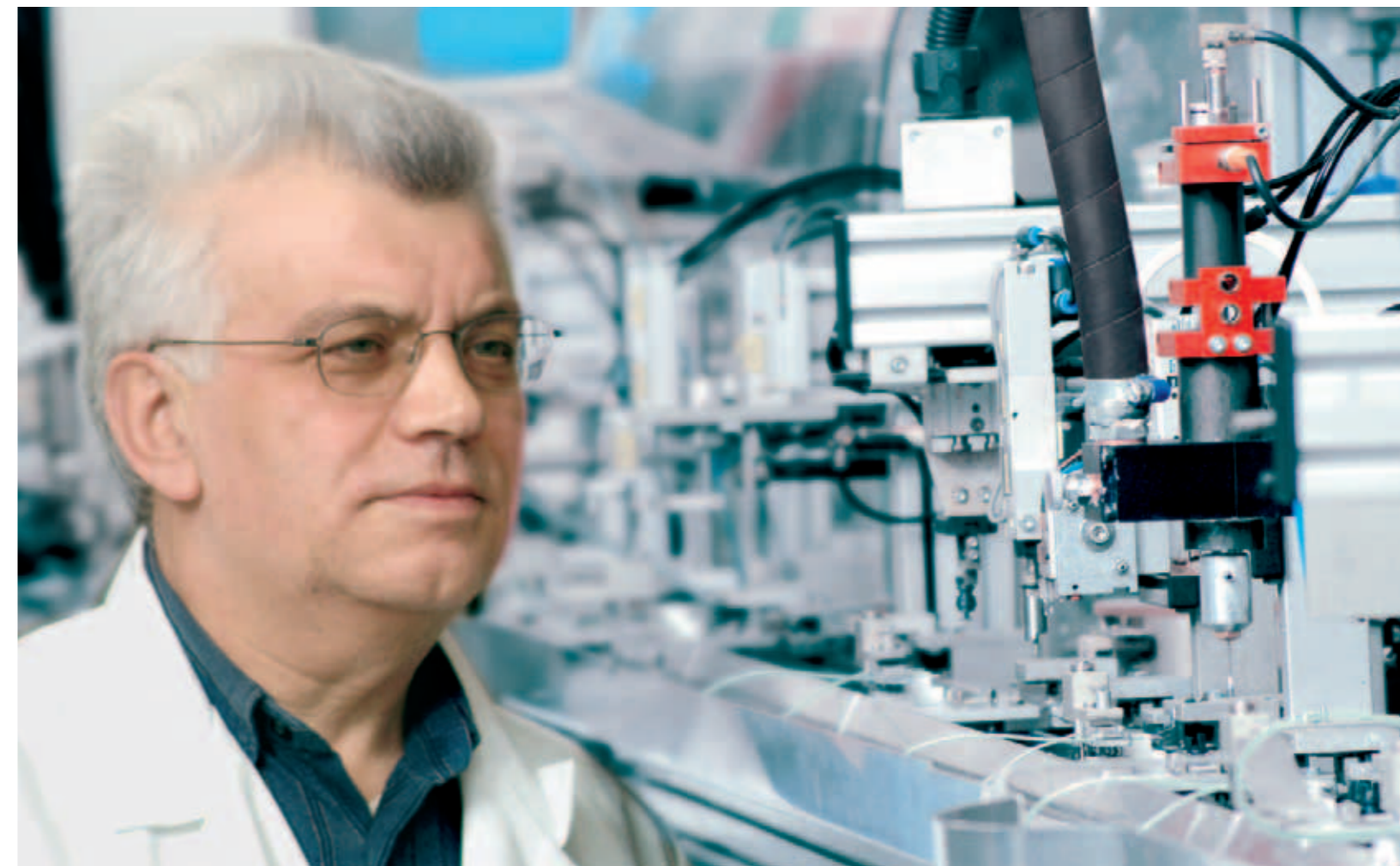
Various gas sensors are based on thin films of platinum. The so-called multi-sensor platform from Heraeus Sensor Technology supplies the manufacturers of gas sensors literally with a foundation for the construction of dedicated gas-sensitive films with which the concentration values of various gases can then be measured.

Also the manufacturers of thermal-energy meters depend on the reliability of Pt temperature probes from the market leader, Heraeus Sensor Technology, for the exact determination of heating costs.

### Life science

Gas-mass flow sensors from Heraeus Sensor Technology are made up of three resistance tracks: The central one provides heating and the others arranged at the side operate as temperature sensors. One of the applications in medical technology is inhalers.

Heraeus Sensor Technology supplies reliable and long lasting sensors in Pt thin-film technology – also for critical applications.



Well-developed automation processes for top quality

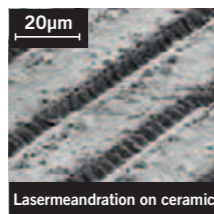


# Heraeus Sensor Technology – the Quality

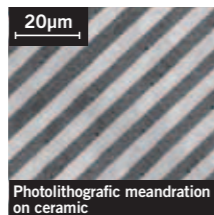
## High Process Quality during Production



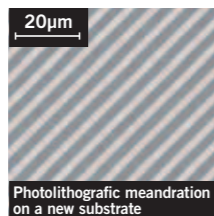
The development of platinum thin-film technology



Laser meandering on ceramic



Photolithographic meandering on ceramic



Photolithographic meandering on a new substrate

Pt sensors from Heraeus Sensor Technology are used throughout the world in the most varied applications. In this respect they contribute to the prevention of energy wastage, to the reduction of environmental pollution, to the safety of processes or also simply to increasing personal well-being. Looking ahead, in order to be able to fulfil increased customer requirements in the long term with a continually increasing production of many millions of Pt sensors, the subject of quality will continue to play a central role in all the business processes at Heraeus Sensor Technology.

Putting the customer in focus, all activities from the initial inquiry, through the emergence of the product, the production and shipment of the products are controlled such that the customers return at the end satisfied with the success that has been achieved together. Intensive and specifically orientated communication between Heraeus Sensor Technology and the customers ensures that possible problem points are clarified in a spirit of partnership and the best possible support is achieved.

### Process quality is a customer benefit

To satisfy customer requirements during large-scale production at the level of millions of pieces per year, each individual process stage must be planned exactly and the possible risks must be known in order to ensure the degree of quality demanded. Heraeus Sensor Technology has aligned its quality management system to the stringent requirements of the Automotive Directive ISO/TS 16949 and within the framework of forward-looking quality planning employs all the methods necessary to be able to promptly assess risks and to safely control processes after establishing their suitability. The use of computerised methods and the integration of all production processes into the existing ERP system are taken for granted here in the monitoring of the process quality and in ensuring traceability of the manufacturing and material data.

Furthermore, Heraeus Sensor Technology has a special commitment to making a positive contribution to the conservation of our environment. One step in this direction is the installation of an environmental management system to ISO 14001 with which possible environmental effects are analysed and assessed right at the beginning in the product definition process so that environmentally compatible development and production of the products are possible.



### Awareness determines the quality

One of the fundamental objectives of the company, Heraeus Sensor Technology, is to differentiate itself from competitors on the market, above all through excellent product quality. The most important basis for this is the well trained and highly motivated workforce. In this regard product-related training starts early in the product generation process so that all the necessary information for achieving the best possible quality is available over all project phases. In addition, an extensive on-going training programme ensures continual personal career development.

Irrespective of their type of employment, all employees are integrated into the Continuous Improvement Process (CIP) so that, through the use of various tools, process and production procedures are again and again examined, individually or in teams, with the objective of obtaining quality and cost optimisation.

### After delivery

Heraeus Sensor Technology accompanies the customer as an expert partner through all product life cycles so that optimum support is ensured also after the products have been shipped.



# Heraeus Sensor Technology – the Solutions

## Automotive Industry

Heraeus Sensor Technology supplies the world's leading companies in the automotive field with measurement probes in platinum thin-film technology developed specifically for the customer. The continually growing use of electronics is today the foundation for more reliability, better safety, improved environmental compatibility and continually increasing ride comfort. A large proportion of the developments in the vehicle field are based on the application of highly specialised sensors.

Heraeus Sensor Technology co-operates with its customers both as a dependable supplier as well as a development partner. In any case many decisions in this company are made along the path from the product idea to a stable, closely tolerated and cost-optimised large-scale production in close consultation with the customers. Here, it is taken as a matter of course that our own wide knowledge base is employed in common development processes for the benefit of the customers.

The majority of applications for Pt thin-film sensors in the vehicle deal with the monitoring of critical temperatures or the control of processes.

### Exhaust treatment

Various items of temperature information are needed in order to produce the optimum exhaust treatment, principally with diesel vehicles. For this application Heraeus Sensor Technology has developed special probes which cover the complete temperature range up to 1,000 °C. Apart from these measurements relating to the exhaust, the high temperature sensors are also used for component protection (protection against overheating).



Heraeus sensors cover a wide spectrum in the automotive field

### Engine oil condition

Depending on the load on an internal combustion engine, the same engine oil may be good for only 5,000 km or 40,000 km of distance travelled. A fundamental measurement quantity for assessing the oil condition is the temperature - and its variation with time. Many millions of Pt sensors from Heraeus Sensor Technology have been operating in this application for years.

### Component protection

Due to their reliability and accuracy, Pt temperature sensors from Heraeus Sensor Technology are used in various applications for the protection of vehicle components. The range extends from severely stressed measuring points, for example on the turbocharger, the monitoring of the oil temperature in automatic transmissions to safety tasks, such as with the burners on auxiliary heating.

With many millions of sensors annually, Heraeus Sensor Technology is contributing to the maintenance of the exhaust limits, to the reduction of consumption figures and to the operational safety of vehicles.

## Heraeus Sensor Technology – the Solutions White Goods

Heraeus Sensor Technology has been supplying Pt temperature sensors in thin-film technology for use in household appliances for years in quantities of millions. With stable production processes the company can provide the subcontractors with the most reliable, accurate and long lasting Pt sensor technology also for this extremely selective market.

With mass markets such as that for household appliances the emphasis is on the requirements profile and the benefits for the end user. Here, there is plenty of scope for objective co-operation. Heraeus Sensor Technology therefore offers the customer direct co-operation in product and cost optimisation.

### Ovens – hotplates – pots and pans

Nowadays, the high repeatability of Pt temperature sensors is used in millions of ovens to monitor both the baking temperature (typically < 220 °C) as well as the pyrolytic self-cleaning (typically > 450 °C).

In very different customised versions and installation positions Pt temperature sensors ensure reliable temperature control with hotplates in glass-ceramics – irrespective of whether it is with gentle steaming, simmering or crispy frying. Through multiple measurement on the same carrier, the SMD style of the sensors from Heraeus Sensor Technology facilitates an integrating wide-area measurement of the hotplate temperature for genuine gourmet cooking.



Highly temperature-stable sensor for hotplate monitoring



## Heraeus Sensor Technology – the Solutions Process Technology



Highly temperature-stable sensor in a pressure-sensitive packaged version

The most important measurement quantity in chemical engineering is temperature. The quality of the end products depends directly on the precise thermal process management. Therefore, more and more manufacturers of process thermometers take advantage of the Pt sensors in thin-film technology from Heraeus Sensor Technology.

The shifting of the application limit for Pt sensors in thin-film technology from 650 °C to 850 °C represents a milestone in process measurement technology. Investigations have shown that the Pt sensors developed by Heraeus Sensor Technology also conform to the requirements of process technology in continuous operation. The versatile film structure safely protects the measurement element against the pressure load in mineral insulated resistance thermometers.

The resistance temperature sensor HD in platinum thin-film technology from Heraeus Sensor Technology is an alternative to thermocouples with their low output signals which are sensitive to interference and with the ageing phenomena that is already noticeable at temperatures above 800 °C.

### Platinum provides stability

The reliability, response characteristics and standardised, easily evaluated output signal make a change of system by the equipment installer a sensible decision. In addition, there is the resistance to shock, impact and typical plant vibrations. Here, the Pt sensors of the HD series from Heraeus Sensor Technology easily shrug off vibrations in the typical process frequency range from 10 Hz to 2000 Hz and accelerations of up to 100g.

The specialists at Heraeus Sensor Technology are agreed that with their stability and dependable signals Pt temperature sensors from their company will in the future make a contribution to reducing maintenance costs and down-times everywhere in chemical engineering, in machine and plant construction and in power stations.



# Heraeus Sensor Technology – the Solutions

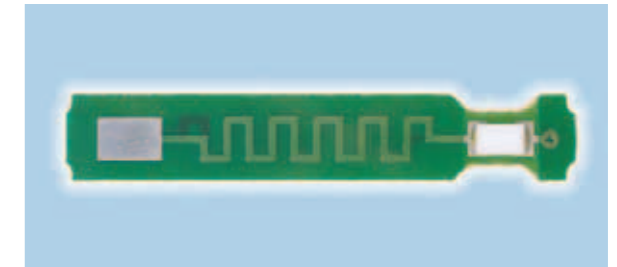
## Heating – Ventilation – Air Conditioning



In times of increasing energy prices the distribution of heating costs is a delicate subject. The basic information is provided by instruments for accurately measuring the temperature on radiators. Pt temperature sensors in thin-film technology from Heraeus Sensor Technology have been used for years in this critical application. In the calorimetric measurement the accurate acquisition of the difference in the quantity of heat is necessary under legal obligations. The pair of sensors used for the billing of heating costs may only differ by 0.1 K from one another. For years state-approved testing stations have been certifying this precision and reliability for the sensors from Heraeus Sensor Technology.

### Heating flame control

Varying gas quality or calorific values necessitate the automated optimisation of the combustion in the boiler. This can be achieved in that the flame temperature is measured directly as the primary quantity in the combustion chamber of the boiler – a typical application for the Pt temperature sensors in thin-film technology from Heraeus Sensor Technology. Their stable long-term characteristics still supply reliable reproducible measurements after thousands of burner cycles.



### Solar heat

In thermal solar collectors a liquid is heated, serving as a transport medium which transports the collected heat to the heat accumulator. But the circulation pump must only come into action when the temperature in the collector has risen above the temperature in the accumulator by a minimum amount. This is traditionally decided by a rugged Pt temperature sensor having long-term stability and a nominal resistance of 1000 ohm. Of course the classical advantages of Pt sensors are the real motive for this deployment: Reliability, standardised characteristic and an easily evaluated measurement signal.

The markets for heating, ventilation and air conditioning technology are on one hand under massive pressure of costs, but on the other hand one hundred percent availability of the system is always expected. Both are good reasons to employ Pt temperature sensors from Heraeus Sensor Technology in these fields of application. The sensors are developed for the respective application together with the customers and are produced in closely managed production processes, optimised for costs.



Applications in the field of heating, ventilation and air conditioning



## Heraeus Sensor Technology – the Solutions Life Science



Users in biotechnology, pharmacy and medical engineering employ Pt temperature sensors in thin-film technology from Heraeus Sensor Technology for the most varied measurement tasks.

One of the main reasons is the biological compatibility of platinum, i.e. there is no chemical or biological interaction between the sensor and the material under investigation. Consequently, the risk of contamination by the measurement probe is excluded.

A further reason is the wide temperature measurement range available with one single sensor, extending from applications in cryotechnology (liquid nitrogen, -196°C) to temperatures well above those prevailing under sterilisation procedures. Pt temperature sensors from Heraeus Sensor Technology are characterised in this range of applications by their optimised long-term properties and they continue to supply reproducible accurate measurements also after many changes in temperature.



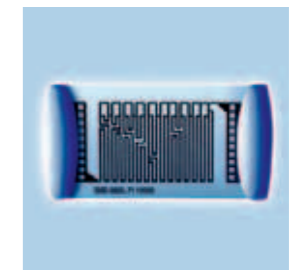
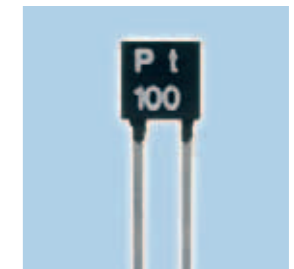
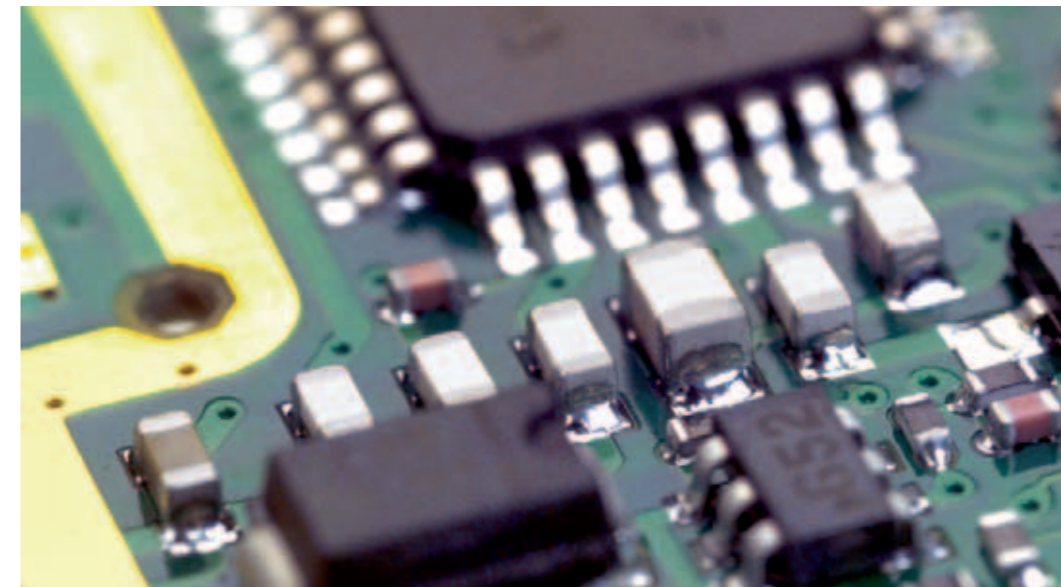
**Medical technology**  
Typical fields of application for Pt temperature sensors can be found in dialysis systems, incubators, centrifuges, gas chromatographs, narcotics evaporators and various analytical and diagnostic systems.

### Multi-sensor platform

Heraeus Sensor Technology provides components with structured thin platinum films customised as a multi-sensor platform. Depending on the further coating of the supplied platinum structures by the customer, the most varied sensors for humidity and gases can be manufactured.

The heater, temperature sensors and, where applicable, the IDK structure can be adapted to the respective application.

## Heraeus Sensor Technology – the Solutions Electronics



Due to their stability, accuracy, standardised characteristic and advantageous signal processing, temperature sensors in Pt thin-film technology from Heraeus Sensor Technology are the first choice when temperature measurements in high quality electronic modules for industrial or laboratory applications are involved. Generally, they are used as reference probes or for the compensation of thermally generated drift effects.

### Platinum as reference

Pt temperature probes from Heraeus Sensor Technology have the central role of ensuring stability and reliability of complete industrial modules at different temperatures. One of the many examples is the large-scale use in precision weighing machines from leading manufacturers.

The positive features of Pt temperature sensors are also exploited in conjunction with measuring amplifiers. Costs for individual balancing are unnecessary due to the standardised characteristic and the minimum spread between samples. Their long-term behaviour eliminates measurement errors due to drift or uncertainty in the specified reference temperature.

Measurement resistors with values up to 10,000 ohm facilitate applications in electronic circuits with low power consumption, e.g. head transmitters in process technology, battery operated measurement systems or data loggers or also independent sensor modules in self-organised radio networks.

### Versions

Heraeus Sensor Technology supplies various versions of Pt temperature sensors in thin-film technology.

The SMD series in the sizes 1206, 0805 and 0603 is available on belts for fully automatic assembly machines. These sensors are primarily used in highly integrated modules. For standard applications they are available in normal transistor cases of the type T092.

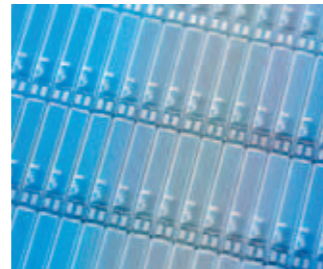
Pt temperature sensors with wire leads are available in various versions. The choice here depends completely on the application.

# Heraeus Sensor Technology – the History



For over 100 years Heraeus has with platinum temperature sensors accompanied the developments in the field of temperature measurement, improving and forming it with many important innovations. As one of the most important physical quantities, temperature affects the function of technical equipment as well as speed and selectivity in numerous industrial processes. Its exact measurement and control has therefore always been of great interest.

The increasing awareness of energy as a valuable resource has further increased this importance. Since 1997 Heraeus Sensor Nite, a subsidiary of the Belgian Heraeus Electro-Nite, has been continuing the tradition of sensor production. In 2003 the company was renamed as Heraeus Sensor Technology GmbH and produces and markets temperature sensors in platinum thin-film technology for the automotive, process technology, household appliance, heating-ventilation-air conditioning, life science and electronic fields.



- 1851** Wilhelm Carl Heraeus takes over the “Einhorn Apotheke zu Hanau” (Hanau Unicorn Pharmacy)
- 1855** Founding of the platinum smelters W.C. Heraeus by Wilhelm Carl Heraeus
- 1906** Invention of the first platinum-resistance thermometer by Richard Küch
- 1930** Production of thermocouples in non-precious metals
- 1952** Platinum temperature sensors in ceramic insulation
- 1972** Founding of the division Temperature Measurement
- 1974** Invention of the platinum resistance thermometer in thin-film technology

- 1986** Development of a quartz thermometer system
- 1989** Founding of Heraeus Sensor within the Electro-Nite International Group
- 1994** Development of the 1000°C platinum resistance thermometer
- 1997** Founding of Heraeus Sensor-Nite, Kleinostheim, Germany
- 2001** Concentration on the manufacture of standard platinum sensors and primarily housed sensors
- 2002** Takeover of the temperature sensor division of ABB Sensycon. Development of the first Pt thin-film sensor in 10 kilo-ohm
- 2005** Sensor-Platform for multifunctional applications
- 2006** Launch of the single-crystal technology
- 2007** Substantial expansion of production capacity



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