



SENSOR & MEASURING TECHNOLOGY

High-Performance Ceramics

www.kyocera-solutions.de

HIGH-PERFORMANCE CERAMICS

Our customers expect precise, repeatable measuring results for sensor and measurement applications. Components made of High-Performance Ceramics provide long-term protection for sensitive sensors, even under the most demanding conditions.

EXTREMELY STABLE

The application area for ceramics in sensor and measuring technology starts when other materials, such as plastic or glass, have reached their limits. Components in High-Performance Ceramics are extremely resistant to heat, corrosion, high voltage and chemical impacts. They are also extremely resistant to deformation and wear, and retain their functionality over a longer period of time.

PRECISE AND RELIABLE

The components in High-Performance Ceramics are characterised by the following properties

- ▶ optical properties
- ▶ microwave properties
- ▶ oxygen conductivity
- ▶ metal coating
- ▶ small dimensions
- ▶ FDA approval
- ▶ magnetic properties
- ▶ dielectric properties



**Together with our
customers we develop
ceramic-to-metal compounds which
permanently protect sensors –
even under extreme demands.**

BEST RATINGS FOR OUR HIGH-PERFORMANCE CERAMICS

With their excellent material properties, components in High-Performance Ceramics have become well established in sensor technology round the world. The variety of materials from KYOCERA Fineceramics Solutions GmbH allows customised solutions for a wide range of demands in practice.

The development of High-Performance Ceramics has allowed us to combine the excellent properties of the individual metals and ceramic into a single component. Our high-performance ceramics have an exceptional resistance to high temperatures, wear and corrosion. Together with their breaking strength and dimensional stability, our High-performance Ceramics are convincing because of their extremely long lifetime.

Our customers expect us to provide customised solutions for their individual requirements. The wide variety of materials in ceramics, metals and coatings allows us to produce optimal customised components.

The physical material properties shown in the table (p. 05) illustrate the potential of KYOCERA's High-Performance Ceramics.

MATERIALS AND THEIR MAIN APPLICATIONS

Material	Aluminium Oxide (Al_2O_3)			
KYOCERA trade name	F99.7	DEGUSSIT AL23	DEGUSSIT AL24	F99.7 hf / DEGUSSIT AL23 hf
Properties	Pure Al_2O_3 , dense, extremely resistant to wear and corrosion, very high electrical insulating	Pure Al_2O_3 , dense, excellent thermal and electrical resistance properties, corrosion resistant, permeable for microwaves	Pure Al_2O_3 , slightly porous, good resistance to thermal shock, extremely good creep strength	Pure Al_2O_3 , dense, extremely resistant to wear and corrosion, very high electrical insulating properties
Typical applications	Matched piston / cylinder units, bearings, shafts and valve components, electrical feedthroughs, brazed ceramic to metal seals for x-ray-technology and ionic accelerators for medical technology, dielectrics for fuel cells, sensor caps	Protection tubes for thermocouples, furnace construction party, laboratory ware e.g. crucibles, boats and plates, reactor lining in the chemical industry, microwave-technology	Tubes, laboratory ware, furnace construction parts	Matched piston / cylinder units, bearings, shafts and valve components, electrical feedthroughs, brazed ceramics to metal seal for x-ray-technology. Dielectrics for fuel cells, sensor caps

Material	Aluminium Oxide fine grain stabilised ($Al_2O_3 + ZrO_2$)	
KYOCERA trade name	FZT	
Properties	Dense, high strength, good resistance to thermal shock, extremely resistant to wear and corrosion, fine grain size	
Typical applications	Vacuum plates for paper-making, flow meter tubes for chemical industry, positioning pins for automotive industry	

Material	Zirconium Oxide partially stabilised with Magnesium Oxide ($ZrO_2 + MgO$)	
KYOCERA trade name	FZM	
Properties	Dense, high strength and highly wear resistant, extremely resistant to corrosion and thermal shock	
Typical applications	High pressure pistons, pressing dies, components for mills, ceramic isolation shells for magnetic drive centrifugal pumps, metal forming tools	

Material	Pure Zirconium Oxide partially stabilised with Yttrium Oxide ($ZrO_2 + Y_2O_3$)	
KYOCERA trade name	DEGUSSIT FZY	
Properties	Dense, high temperature and corrosion resistance, ion conducting for measuring oxygen	
Typical applications	Crucibles, heat-treatment bowls, oxygen measurements	

MATERIALS AND PROCESSES FOR COATING OF CERAMIC

Material	Ag	Au	Pt	Ag-Cu-Ti	MoMn	Ti	TiN	Ni / MoMn	Cu / MoMn	Sn / MoMn
Screen printing	■	■	■	■	■			■		
Manual applications	■	■	■	■	■			■		
PVD	■	■				■				
CVD							■			
Galvanic								■	■	■

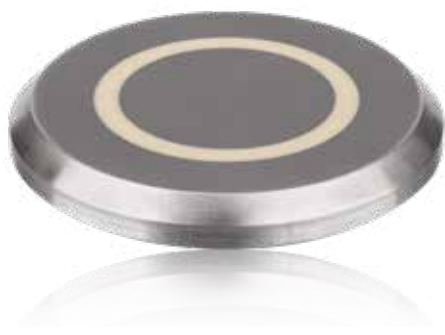
HUMIDITY AND PRESSURE MEASUREMENT

Sensors and measuring cells made of High-Performance Ceramics meet the most stringent requirements because of their high resistance to temperature changes and corrosion even under extreme conditions.

Source: ACO Automation Components Johannes Mergl e.K.



**Individual
solutions for
customised
applications.**



Humidity sensor made of F99.7



Pressure sensor made of F99.7 for the aerospace industry

HUMIDITY SENSORS

Humidity sensors made of aluminium oxide F99.7, DEGUSSIT AL23 hf or zirconium stabilised aluminium oxide FZT are used in a wide range of areas: in crude oil conveyor units to measure water content, in mixers and on cement works conveyors, and also in food processing.

The determination of the capacity in the high frequency field is a physical principle. Due to its optical properties, with the material DEGUSSIT AL23 hf, microwaves can be focussed more precisely than with other materials, such as glass or plastic. In this way, smaller component measurements can be carried out. Other application areas are the analysis of materials and filling level measurements, where the ceramic component is used as a window or antenna. The back of the sensors is given a conductive coating to which the electronics are then connected.

PRESSURE SENSORS

Measurement cells made of aluminium oxide F99.7 for pressure sensors and pressure transducers are used in temperature ranges from -50 to +150 °C and at pressures of up to several 100 bar. The membranes can be produced with a thickness of 0.2 mm and diameters of up to 80 mm. Glass or active soldering is applied as joining technology for the ceramic parts.

Materials for the electrodes are selected in accordance with customer requirements. Measurement cells are used in the chemical, food processing, pharmaceutical and petrochemical industries as well as in aerospace technology.

OXYGEN AND TEMPERATURE MEASUREMENT

With their excellent material properties, components made of High-Performance Ceramics have established themselves globally in sensor and measuring technology. Temperature and oxygen measurements are further examples.

Source: Keramischer OFENBAU GmbH



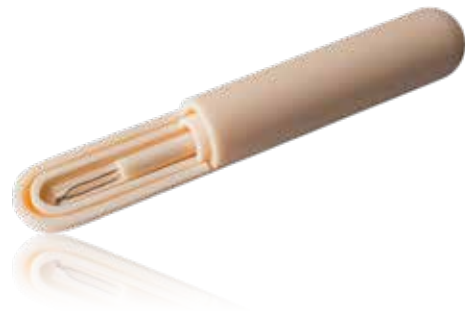
High resistance to deformation and reliability at high temperatures.



Oxygen probes made of DEGUSSIT FZY are characterised by quick response times with constant measuring signals and high ion conductivity.

OXYGEN SENSORS

Oxygen sensors with yttrium oxide-stabilised zirconium oxide DEGUSSIT FZY are suitable for measuring oxygen in gases and atmospheres. The measurement electronics process the EMF supplied by the sensor into a partial oxygen pressure and the derivable value, which can be presented alphanumerically. Zirconium oxide sensors generally work in a temperature range of 400 °C to 1,500 °C. Unheated sensors that are installed directly in the high temperature process and heated sensors installed outside such processes can also be used. Ceramic oxygen sensors are suitable for monitoring annealing processes, monitoring protective gas, surface treatment (e.g. in hardening plants), for redox processes, diffusion processes, biotechnical processes and to control food packaging.



Thermocouples made of DEGUSSIT AL23 can be used at temperatures over 1,800 °C.

THERMOCOUPLE PROTECTIVE TUBES

Tubes and capillary tubes made of aluminium oxide DEGUSSIT AL23/AL24 are the best choice for the highest demands for thermocouple protective tubes. Because of their special structural properties they can also be used at temperatures above 1,800 °C. At the same time, improved stability can be achieved in contrast to the predominant corrosive load in the kiln or melt. In addition there is a high heat conduction and electrical insulation. The excellent processing of the closed end of the tube ensures a uniform, dense structure and, in turn, protection against cracks and leaks.

LEVEL MEASUREMENT

Reliable and flexible measurement of the level in silos or tanks: no matter with sensors made of High-Performance Ceramics.



**Highest
corrosion
resistance even
in aggressive
media.**



Level sensor made of F99.7



Electrode support made of FZM used to measure levels in the chemical industry

LEVEL SENSORS

Level sensors operate more and more frequently with radar or ultrasonic transmitters made of aluminium oxide F99.7 or F99.7 hf. Examples of this are level sensors in silos and tanks. When measuring the level, aluminium oxide ceramics are used as antennas/transmitters of the radio waves, microwaves or ultrasonic waves. The electromagnetic waves emitted are guided along cable or rod probes and reflected on the surface of the product. By means of the connected electronic measurement device precise measurements of the level in the container can be obtained, based on travel time or frequency changes. Adhesives, dust or vapours do not

influence the measurement result. This ensures that liquids, bulk materials and separating layers are simply and reliably measured. Measurements of the level in the storage tanks are carried out using electrode carriers made of magnesium stabilised zirconium oxide FZM. A platinum electrode sintered in magnesium stabilised zirconium oxide FZM or aluminium oxide F99.7 is gas tight. These two compounds are absolutely unbeatable and provide flexible filling level measurements.

FLOW MEASUREMENT

The extraordinary properties of High-Performance Ceramics ensure precise and safe processes in filling systems for liquids and pasty substances.

Source: KRONES AG



**Components
for highest
pressure
requirements.**



Flow meters in FZM for the food processing industry



Float bodies in F99.7 for flow monitoring in the chemical industry

SENSORS FOR FLOW MEASUREMENT

The Cermet electrode is unique and patented, a compound of magnesium oxide stabilised zirconium oxide FZM and platinum. It is used in magnetically inductive flow meters (MID). It is tested in accordance with pressure equipment standards and tenfold nominal pressure safety allowing components made of high-performance ceramics to be used without problem under very difficult conditions and enabling accurate and precise filling.

Float bodies made of aluminium oxide F99.7 extend the application spectrum of measuring devices to flow monitoring. As the material is extremely resistant to corrosion, precise control of the liquid flow can be guaranteed even for aggressive materials.

HIGH-PERFORMANCE CERAMICS

ELECTRICAL ENGINEERING



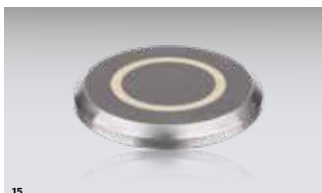
HIGH TEMPERATURE TECHNOLOGY



MECHANICAL ENGINEERING



SENSOR AND MEASURING TECHNOLOGY



01. UHV vacuum chamber
 02. Special insulation tube for physical research institutes
 03. Feedthroughs with ISO-KF flange
 04. High-voltage feedthrough

05. Rectangular tubes
 06. Multi-bore tubes
 07. Crucibles, boats and annealing boxes
 08. Plates with hole

09. Forming tools used in body construction
 10. Dosing unit used in the pharmaceutical and cosmetic industry
 11. Spacer cans for the pump industry
 12. Grinding tools used in metal processing

13. Pressure sensor for aerospace
 14. Flow meters
 15. Humidity sensor
 16. Oxygen sensor

INNOVATIVE SOLUTIONS FOR THE GLOBAL MARKET

INNOVATIONS FOR MORE THAN 150 YEARS

With more than 150 years of experience in ceramic manufacturing, we offer a range of innovative solutions for many industries: system components for high technology applications in electrical and sensor technology, mechanical engineering, analytical technology, medical and semiconductor technology as well as laboratory technology. In the field of ceramic-to-metal assemblies we possess international leading know-how.

SPECTRUM OF INNOVATIVE SOLUTIONS

We see ourselves as a partner in the development of high-performance ceramic solutions, which give our customers added value and ensure their technological advantages. Our team advise comprehensive on the selection of ceramic materials, product design and project execution - from the development stage over the prototype fabrication to the serial.

PARTNER OF A POWERFUL COMMUNITY

Founded in 1863 in Mannheim as brickyard, known as “Deutsche Steinzeug” and later as “Friedrichsfeld GmbH”, the business area Ceramics continued its successful development. Since September 2019, we are part of the KYOCERA Corporation, a world-leading ceramic and technology company.

Kyocera Fineceramics Solutions GmbH
is a specialist company for products
made of non-corroding and
wear-resistant materials.



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