



SENSOR AND MEASURING TECHNOLOGY

FRIALIT®-DEGUSSIT® High-Performance Ceramics

www.friatec.de

CUSTOMISED SOLUTIONS FOR SENSOR AND MEASURING TECHNOLOGY

FRIALIT®-DEGUSSIT® **HIGH-PERFORMANCE CERAMICS**

Our customers expect precise, repeatable measuring results for sensor and measurement applications. Components made of FRIALIT-DEGUSSIT 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 FRIALIT-DEGUSSIT 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 FRIALIT-DEGUSSIT 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.**

EXCELLENT **BEST RATINGS FOR OUR HIGH-PERFORMANCE CERAMICS**

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

The development of FRIALIT-DEGUSSIT 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, FRIALIT-DEGUSSIT 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 FRIALIT-DEGUSSIT High-Performance Ceramics.

MATERIALS AND THEIR MAIN APPLICATIONS

Material	Aluminium Oxide (Al ₂ O ₃)			
FRIATEC trade name	FRIALIT F99.7	DEGUSSIT AL23	DEGUSSIT AL24	FRIALIT F99.7 hf / DEGUSSIT AL23 hf
Properties	Pure Al ₂ O ₃ , dense, extremely resistant to wear and corrosion, very high electrical insulating	Pure Al ₂ O ₃ , dense, excellent thermal and electrical resistance properties, corrosion resistant, permeable for microwaves	Pure Al ₂ O ₃ , slightly porous, good resistance to thermal shock, extremely good creep strength	Pure Al ₂ O 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 ₂ O ₃ + ZrO ₂)
FRIATEC trade name	FRIALIT 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)
FRIATEC trade name	FRIALIT 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 ₂ O ₃)
FRIATEC 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								■	■	■

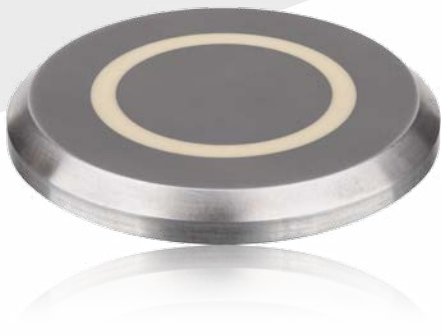
COMPONENTS FOR **HUMIDITY AND PRESSURE MEASUREMENT**

Sensors and measuring cells made of FRIALIT-DEGUSSIT 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 FRIALIT F99.7



Pressure sensor made of FRIALIT F99.7 for the aerospace industry

HUMIDITY SENSORS

Humidity sensors made of aluminium oxide FRIALIT F99.7, DEGUSSIT AL23 hf or zirconium stabilised aluminium oxide FRIALIT 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 FRIALIT 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.

COMPONENTS FOR **OXYGEN AND TEMPERATURE MEASUREMENT**

With their excellent material properties, components made of FRIALIT-DEGUSSIT 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 in both saturated environments and ultra-high vacuum (UHV). 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.

COMPONENTS FOR **LEVEL MEASUREMENT**

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



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



Level sensor made of FRIALIT F99.7



Electrode support made of FRIALIT 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 FRIALIT F99.7 or FRIALIT 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 FRIALIT FZM. A platinum electrode sintered in magnesium stabilised zirconium oxide FRIALIT FZM or aluminium oxide FRIALIT F99.7 is gas tight. These two compounds are absolutely unbeatable and provide flexible filling level measurements.

COMPONENTS FOR **FLOW MEASUREMENT**

The extraordinary properties of FRIALIT-DEGUSSIT 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 FRIALIT FZM for the food processing industry



Float bodies in FRIALIT 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 FRIALIT 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 FRIALIT 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.

FRIALIT®-DEGUSSIT®

HIGH-PERFORMANCE CERAMICS

CERAMIC INNOVATIONS

SINCE 1863

FRIATEC manufactures components made of high-performance ceramics according to customer specifications, as well as a comprehensive standard program.

An experienced team of innovative application engineers and resourceful production specialists alongside painstaking quality controls supports our customers in their choice of ceramic material, design and project execution. More than 150 years of experience in the field of ceramic manufacturing and our individual brand of materials, combined with innovative engineering, form the pillars of our company's successful development.

Our products, made of aluminium oxide, zirconium oxide, silicon carbide and silicon nitride, are used predominantly in the following areas:

ELECTRICAL ENGINEERING

- Single and multiple feedthroughs
- High-pressure feedthroughs for onshore/offshore technology
- Insulation tubes
- Standoffs
- Accelerator components for research and development apparatus
- Sensor components for pressure, temperature, oxygen levels, etc.

HIGH TEMPERATURE TECHNOLOGY

- Tubes and insulating rods for protection and insulation of thermocouples
- Tubes for gas inlet and outlet
- Grooved and heating tubes for construction of electrically heated furnaces
- Diffusion tubes for the semi-conductor industry
- Multibore tubes
- Crucibles, boats, combustion trays and plates

MECHANICAL ENGINEERING

- Pistons for dosing pumps (fitted pistons/cylinder units)
- Plungers for high-pressure pumps
- Spacer cans for the chemical industry
- Glide rings, glide bearings, shaft protection sleeves
- Nozzles
- Shaped parts for wear-and-tear use
- Drawing cones and guide elements for the wire industry

SURFACE FINISHING

- Fine-grinding tools for surface finishing of ultra-hard materials in various shapes and dimensions

FRIATEC

INNOVATIVE SOLUTIONS FOR THE GLOBAL MARKET

INNOVATIONS FOR MORE THAN 150 YEARS

The company was founded in 1863 in Mannheim, Germany, as a brickyard and succeeded in developing its first pathbreaking innovation, chemical stoneware, in 1888. Numerous new developments followed. Among other things, the company started in the mid of the past century processing plastics and combined modern and traditional materials when producing chemical devices and facilities. The following years were characterised by the expansion in the core business and the opening up of more and more new business segments. As Deutsche Steinzeug and later as Friedrichsfeld GmbH, the company, which has been operating under the name FRIATEC AG since 1993, continuously developed to become an internationally active, diversified company.

SPECTRUM OF INNOVATIVE SOLUTIONS

As such, FRIATEC AG today offers a spectrum of innovative solutions for many industries, e.g. jointing technology for pipe systems, special pumps for aggressive, volatile or explosive media, but also ceramic components which are used in laboratory and electrical engineering but also in medical engineering. With its sophisticated solutions, FRIATEC AG is not only among the most well-known and well-established companies in the metropolitan region Rhine-Neckar but is also one of the global market leaders of its industry.

PARTNER OF A POWERFUL COMMUNITY

Since 2003, FRIATEC AG has been a member of the ALIAXIS group of companies with headquarters in Brussels. ALIAXIS is the worldwide largest producer of plastic pipe systems for the construction industry, the industry and utilities.

**FRIATEC AG is a specialist
company for products made
of non-corroding and
wear-resistant materials.**

Aliaxis

UTILITIES & INDUSTRY

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Sensor and
measuring technology