

Innovative Materials for Innovative Automobiles

Inspiration Advanced Ceramics

CeramTec
THE CERAMIC EXPERTS

Advanced Ceramics: Manifold Solutions to Challenging Problems

Due to their unique material properties, advanced ceramics from CeramTec are among the most efficient materials of our time. They are indispensable for enhancing performance, safety, reliability and environmental compatibility in a wide variety of daily applications. Advanced ceramic materials make innovative solutions possible today and lead to groundbreaking advances tomorrow in vehicle and automotive engineering, electronics, energy and environment, equipment and mechanical engineering, and medical technology.

Lightweight

Chemically-resistant

Electrically insulating

Shockproof

Thermally insulating

Thermally conductive

Heat-resistant

Wear-resistant

Low-friction

Cooling

Safe and secure


Reliable





The Material that Drives Automotive Engineering





More efficient progress – with advanced ceramics

International car manufactures face rising challenges: They must reduce emissions and fuel consumption, and further develop alternative drive systems. Environmental protection, lightweight design, hybridization and electrification, networking of vehicle electronics and communications systems, safety engineering, modular vehicle concepts and accelerated development cycles require innovative materials that meet the extreme requirements and provide exceptional properties. Developers, component manufacturers and suppliers are expected to provide high-performance solutions.

CeramTec plays a vital role in automotive progress with innovative advanced ceramics that not only increase the safety, service life, cost-effectiveness, comfort and eco-friendliness of vehicles, but also provide greater efficiency and productivity in the manufacturing process. Technical ceramics offer unmatched functionality and a unique property profile for custom integration of visionary concepts in series production. Take advantage of our comprehensive expertise as a system partner. Develop the future together with CeramTec.

Innovative Advanced Ceramics in Automotive Engineering

Ceramic Tapes CeramTape®
for the Production of Hybrides
in Electronic Control Systems
and Lambda Sensors



Foundry Cores
for Piston and Precision
Casting



Piezoceramic Ring
to detect Signals in the Knock
Sensor



Valve Plates
in the Common Rail Injection
System



Face Seals
in the Coolant Water Pump



Cyrol® Ceramic Rollers
for Camshafts



Lasered Substrates
as Hybrid Circuit in Control
Units (eg. Clutch Transmission)
and for Electrical Isolation
in High-Voltage PTC-Heaters



Integrated Membranes
for Pressure Sensors in Brake
Control Systems and Clutch
Transmission



Preforms
for Material Reinforcement
and Lightweight Construction
in Engine Design



Switching Spark Gap
for Xenon Lights



Base and Insulating Tube
for Halogen- and Xenon
Lighting Technology as well
as Auxiliary Heaters



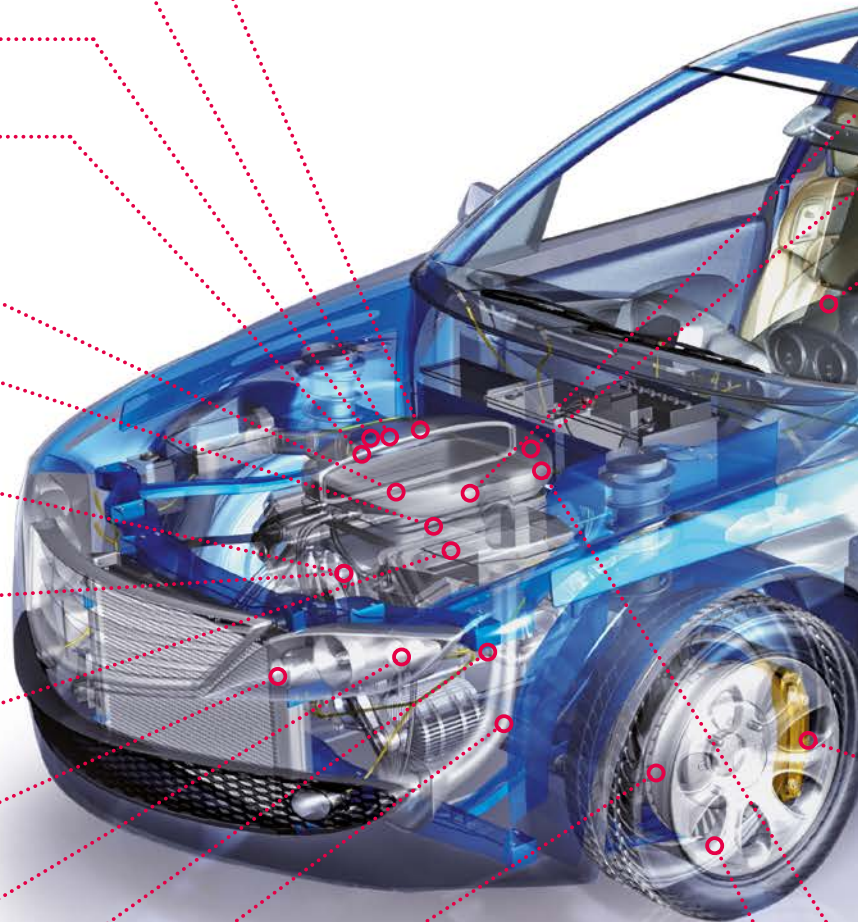
Piezoceramic Elements
for Level Sensors in Oil- and
AdBlue Tanks



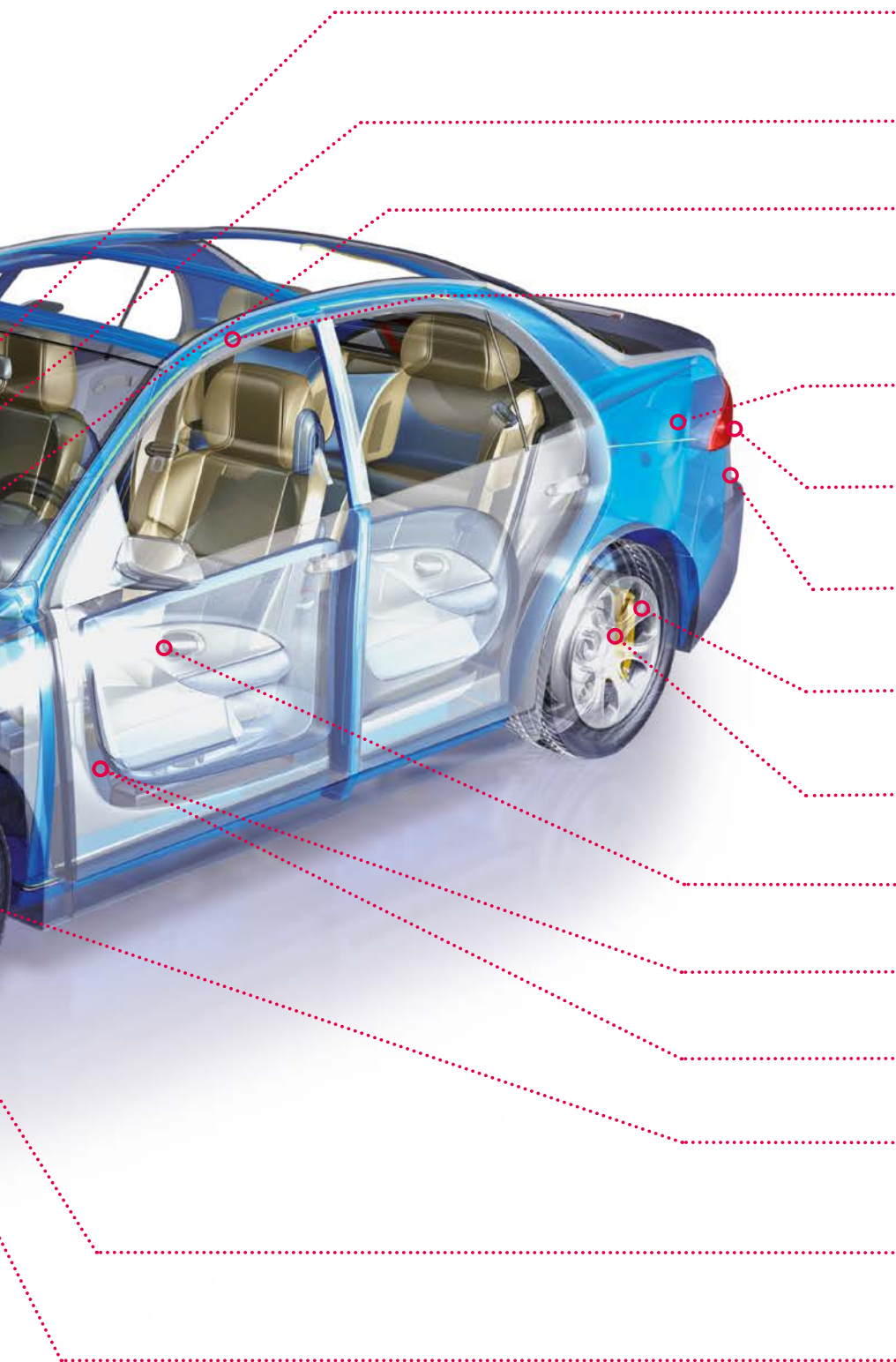
Ceramic Bearings
for Exhaust Gas Hatches and
-Control Valves



**Cyrol® Ceramic Bearing
Rollers**



Products shown are not actual size.



CeramCool®
for Battery Thermal Management, Voltage Converter, Propulsion Control and Brake Energy Recuperation

Resistor Cores
for Resistors in Electronic Circuits

Inductor Cores
for Inductors in Electronic Circuits

Welding Pins and Gas Nozzles
for MAG Welding in Auto Body Production

Side Disc
in the Fuel Pump

CeramCool®
for Xenon-, LED- and Laser Lighting Technology

Air Ultrasonic Transducer
for Interior Monitoring and Parking Assistant

Riser Tubes and Sprue Bushes
to Cast Components for Chassis and Powertrain as well as Rims in Aluminium

Control Disc
in the ABS Modulator

Armor Ceramics
for Vehicle Protection

Insulation Parts
in the Lambda Sensor

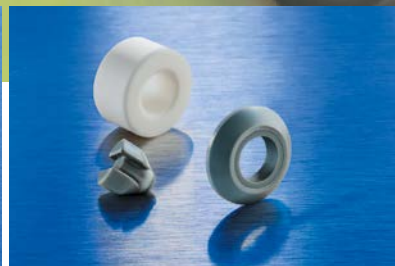
Sealing Components
in the Lambda Sensor

Insulating Rings
in Brake Callipers

Tool Systems and Cutting Materials SPK®
made of Ceramics or PCBN for Machining Cast Iron and Hardened Steel

Porous Pots
for Chroming

For More Durable Components



Long service life under extreme conditions

Components used in engine, drive, exhaust gas systems and powertrains are subject to the greatest stress and various influences by being exposed to extreme pressure and temperature, splash water and shocks – perfect conditions for advanced ceramics, which are very lightweight, extremely heat-resistant, wear-resistant, corrosion-resistant as well as thermally and electrically insulating. Due to their extraordinary reliability, these components operate in core functions where conventional materials fail.

In engines, heat-resistant ceramic parts – such as seal rings, bearings, plates, cam discs, seals, valve components, support shell in crankcases, components for fuel- and water pumps and exhaust control valves – ensure higher efficiency, reliable operation, less friction and wear, and lower exhaust gas and noise emissions.

Advanced ceramics in brake calipers increase vehicle safety. Cyrol® bearing rollers open up new possibilities for lightweight design in roller bearings or camshaft applications.

For Reliable Electronic Functions



Reliably control signals and provide the right light

Vehicle engineering is changing. E-mobility and the complex networking of vehicle systems require integrated electronics solutions. Airbags must function as reliably as electronically controlled hydraulic or mechanical components in vehicles. Even when subjected to severe thermal and electrical stresses or pushed to driving limits, advanced ceramics fulfill their tasks with maximum reliability. Piezo-ceramic sensors have key measurement and control functions in all areas of vehicle engineering. They act as sensors for electronic controls and provide them with information on the vehicle's quiet engine operation, position and changes in direction. Electronic components based on ceramic substrates react to this information and control engine management, automatic transmission and safety systems such as ABS and ASR, and release the airbag when necessary.

More light, greater safety – halogen, xenon or LED light systems with ceramic components significantly improve sight. Advanced ceramics ensure optimized thermal management and withstand extreme loads. Custom-tailored ceramics are also used in fuel cells.

For More Innovative Lightweight Design Solutions



Low weight, high endurance

Ceramic materials are lightweight and extremely durable. They open up new prospects for engineers and designers in lightweight construction, design and protection applications. For example, Metal Matrix Composites (MMC) with ceramic materials are used in lightweight design to reduce weight, fuel consumption and emissions. Ceramic particles are applied at specific places to reinforce light metals in order to withstand high tribological, mechanical and/or thermal loads, e.g. in cylinder sleeves, pistons, brakes or bearings.

For More Efficient Production Processes



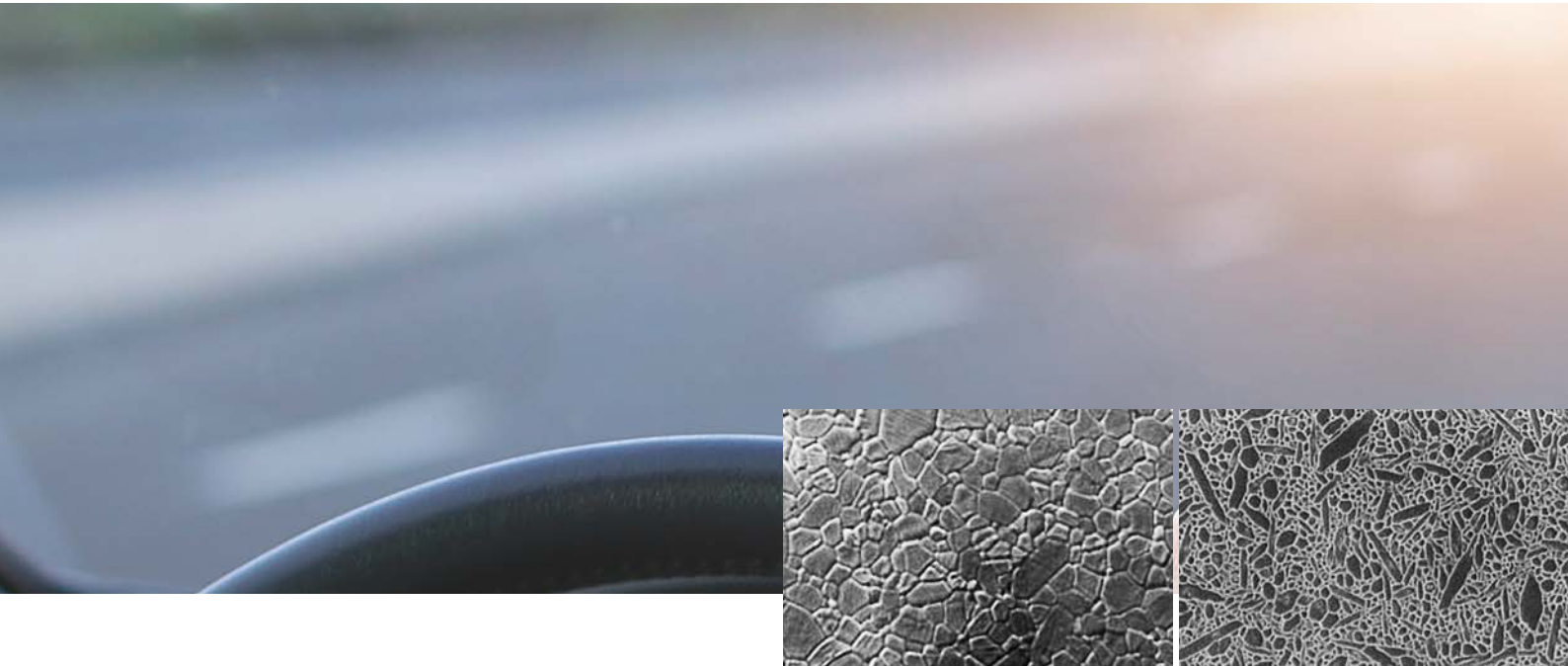
Higher cycle speed, greater efficiency and safety

More speed, precision and better quality: Innovative materials and tool solutions give manufacturers a competitive edge for welding, forming, casting and machining processes in vehicle engineering. The SPK® tool portfolio comprising ceramic and PCBN cutting materials and custom tool systems makes it possible to optimize process reliability, efficiency, production times and cost. For products with maximum precision and perfectly tuned surface qualities. Carmakers and automotive suppliers worldwide use these productivity gains to their advantage – for example in the production of engine, brake, transmission, clutch and drive components.

In welding processes, silicon nitride withstands high loads, minimizes wear and increases service life in gas nozzles and centering pins. In foundry technology, advanced ceramics master challenging conditions such as aggressive melting, maximum temperatures of 1,000 °C and temperature differences of several hundred degrees – as protection and dosing tubes or as cores.

Technical ceramics also stand up to the harsh ambient conditions in the chrome-plating process.

Special Ceramic Materials for the Highest Demands



Alumina

The most important oxide ceramic material in various levels of purity. CeramTec offers low-density, lightweight material types in a variety of property combinations:

- High mechanical strength
- High thermal conductivity
- High corrosion resistance
- Good sliding properties
- Very good electrical insulation

Zirconia

Depending on the crystal structure, pseudo-elastic under mechanical tension: for extremely high component strengths and components subject to high stress, e.g. in abrasive applications and higher temperatures.

- Extraordinary fracture toughness
- High wear and corrosion resistance
- Excellent tribological behavior
- Low thermal conductivity

Silicon nitride

Ideal for manufacturing mechanically stressed components and for engine-specific applications, even at higher temperatures. In addition to their low weight, silicon nitride materials have excellent properties:

- Extremely high strength
- High fracture toughness
- Excellent wear resistance
- High thermal conductivity
- Thermal shock resistance

Silicon carbide

Extremely lightweight, for manufacturing components that reduce inertia forces at high speeds.

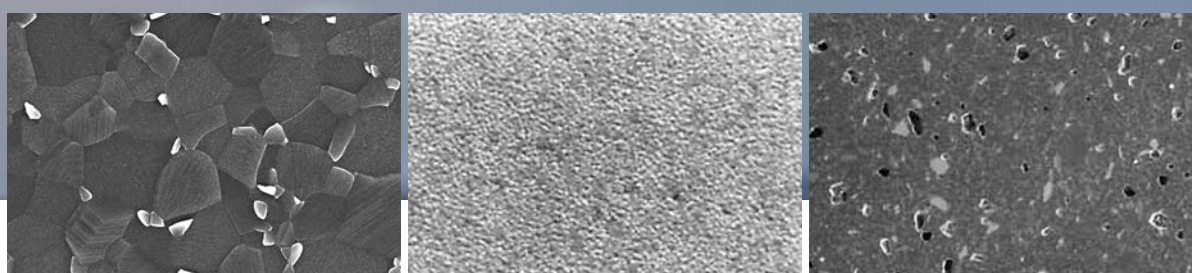
- Very high hardness
- Excellent corrosion resistance even at very high application temperatures
- Thermal shock resistance
- Very high thermal conductivity (higher than steel)
- High wear resistance and very good sliding properties

Aluminum nitride

Suitable as a substrate in semiconductor engineering and power electronics, as an electrical insulation material in micro-electronics, as a resonator material in aluminium metallurgy and in laser technology or as a heat exchanger.

- Very high thermal conductivity
- High electrical insulation capacity
- Good thermal shock resistance
- Good metalization capacity
- Low thermal expansion

The complex interaction of various components and parts in vehicle engineering requires ceramic materials that meet the highest demands with precision and reliability – and feature a property profile custom-tailored to the specific application. CeramTec offers the ideal, custom-tailored advanced ceramics with individual property combinations for every automotive industry requirement thanks to its wide range of materials.



Aluminum titanate

This material does not expand even at high temperatures. Components made of aluminum titanate can withstand even the most abrupt temperature changes of several hundred degrees without damage, e.g. in foundry technology and metallurgical melting.

- Excellent thermal shock resistance
- High thermal insulation
- Low Young's modulus
- Good chemical resistance

Piezo-ceramic

This functional ceramic is at the center of many developments and applications in automotive engineering. Piezo-ceramic components generate an electrical charge when mechanically deformed due to pressure, expansion or acceleration. Conversely, they convert electrical signals into mechanical movement or vibration. They offer flexibility in design.

Metal-ceramic composites

Metal Matrix Composites (MMC): Advanced ceramics reinforce light metal components where they are subject to the most tribological, mechanical or thermal stress. Example of high-volume production: Cylinder sleeves were implemented in the Porsche Boxster and 911. The ceramic material's perfect combination of low weight and high durability opens up new prospects for developers and designer engineers in lightweight design.

Silicate ceramic

Due to its favorable processing conditions, this material enables highly economical solutions in the field of electrical and thermal engineering.

Properties:

- Excellent electrical and thermal insulation properties
- High thermal shock resistance
- Minimal and/or predefined thermal expansion
- Mechanical strength
- Optimal porosity
- Corrosion resistance

Realise New Solutions with the Ceramic Experts





Here to serve you – worldwide

As a system partner with comprehensive ceramics expertise, we are here to serve you worldwide – ready to take on the global challenges faced by suppliers in the automotive industry. We work closely with your development and project teams – collaborating with them on everything from research and development projects to the implementation of intelligent system solutions. Our specific materials, manufacturing and integration expertise and long-term cooperation with international automotive partners are your guarantee for uncompromising quality – certified according to ISO TS 16949 and the latest international standards. Our innovative solutions using advanced ceramic materials create new, unthought of possibilities for design engineers and developers on the road to tomorrow's applications. Get in touch with us. CeramTec advanced ceramics open up new dimensions for tomorrow's mobility.



The measured values mentioned before were determined for test samples and are applicable as standard values. The values were determined on the basis of DIN-/DIN-VDE standards and if these were not available, on the basis of CeramTec standards. The values indicated must not be transferred to arbitrary formats, components or parts featuring different surface qualities. They do not constitute a guarantee for certain properties. We expressly reserve the right to make technical changes.

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