Innovative Materials for Innovative Automobiles
Inspiration Advanced Ceramics
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.
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 Hybrids 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

### Actuator-Technology
- and Piezoceramic Tapes in Injection Systems

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

### Insulating Rings
- in Brake Callipers

### Porous Pots
- for Chroming

### Ceramic Bearings
- for Exhaust Gas Hatches and -Control Valves

### Piezoceramic Elements
- for Level Sensors in Oil- and AdBlue Tanks

### Ceramic Bearings
- for Welding Pins and Gas Nozzles

### Perlucor®
- Transparent Ceramics as Safety- and Design Element

### Actuator Technology
- and Piezoceramic Tapes in Injection Systems

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

### 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
- for Camshafts

### Products shown are not actual size.
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THE CERAMIC EXPERTS

Ceramic Tapes CeramTape® for the Production of Hybrids 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

Cyrol® Ceramic Bearing Rollers

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

Cyrol® Ceramic Rollers for Camshafts

Ceramic Bearings for Exhaust Gas Hatches and -Control Valves

Piezoceramic Elements for Level Sensors in Oil- and AdBlue Tanks

Perlucor® Transparent Ceramics as Safety- and Design Element

Face Seals in the Coolant Water Pump

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

Actuator-Technology and Piezoceramic Tapes in Injection Systems

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

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

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

Products shown are not actual size.

Advanced Ceramics in Automotive Engineering

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

Insulating Rings in Brake Callipers
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.
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. Piezo-ceramic actuators are indispensable in injection systems. 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.
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. Perlucor® is a transparent advanced ceramic that opens up new application and design possibilities. It is used in vehicle interiors as a high-grade material for decorative elements and inlays. Perlucor® laminates provide clear visibility in safety glass panels and lighting elements in high-stress environments (e.g. sand abrasion on panes and headlights). High transparency, hardness, strength, thermal and chemical resistance and weight savings of around 30% compared to conventional safety glass make Perlucor® ideal for ballistic protection. Ceramic-polymer composite armor offers vehicles tremendous weight and volume advantages, which play a crucial role in terms of mobility, payload and maintenance.
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 microelectronics, 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.

### Transparent ceramics
Newly developed transparent material for protection and design applications. High permittivity and thin-film technology (<500 µm for touch screens)
- Very high hardness and strength, 3-4 times higher than glass
- Excellent scratch and wear resistance – only diamond or ruby can scratch it
- Excellent corrosion resistance against acids and lyes
- High transparency, with coating up to 96%
- High surface quality and brilliance

### 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 (e.g. sensors and actuators) 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.
- 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.