



Precision engineered
solutions for
Analytical equipment

TECHNICAL CERAMICS

Engineered materials, components and sub-assemblies for Analytical equipment

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MACOR Advanced Materials provides precision-engineered materials, components and sub-assemblies for Analytical equipment in a variety of industries, including aerospace, medical equipment and general industrial applications.

Our advanced ceramic materials offer superior dimensional stability, strength and stiffness. The resistance of our materials to chemical and physical wear, corrosion and extreme heat makes them ideally suited for use in harsh processing environments.



We make ceramics components for medical instruments, SEM/TEM microscopes and mass spectrometry equipment, including:

- Insulators and lens supports for SEM and FIB columns
- Quadrupole rods and collars
- Valves for blood analysis
- Octupole insulators/supports



Materials offered by MACOR:

- Alumina
- Zirconia Toughened Alumina (ZTA)
- Stabilized Zirconia
- Speciality Carbon & Graphites
- Machinable Glass Ceramic (MACOR®)
- Silica
- CVD Silicon Carbide
- Pyrolytic Boron Nitride
- Diamond Like Coating
- Dielectric Coating
- Glazes
- Precious & Non-Precious Metal Braze Alloys
- Active Braze Alloys (ABA)

With our world-class design expertise and specialist manufacturing capabilities, we work in partnership with our customers to develop bespoke solutions to meet their needs

Mass Spectrometer applications

Morgan's engineering capabilities in ceramics, braze alloys, precious metals, and hermetic sealing allow us to provide assembly solutions to complex mass spectrometer components. Our ceramic orifice plates offer electrical insulating property and hermeticity to allow ionized samples to transition from the atmospheric environment to the vacuum chamber. Our quadrupole products are precision machined to meet the tight tolerances needed by mass spectrometers.

Metallized ceramics

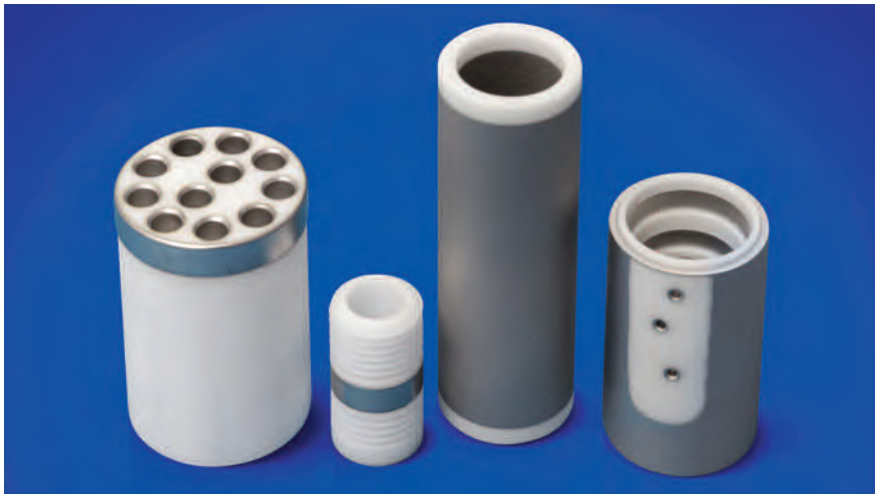
MACOR manufactures a variety of ceramic grades with matching metallizing processes which enable us to provide a solution to your requirements. These metallized ceramic components are ideal for use within high-vacuum, high-voltage and high-pressure applications.

Capabilities:

- Screen Printing
- Pad printing
- Brush coating
- Nickel plating

Benefits:

- Good electrical insulation
- Hermetically sealed
- Metallization traces
- Custom electronic circuit path



Quadrupole components

MACOR has many years of precision machining experience on bare ceramic to meet the tight tolerance requirement on quadrupole rods and spacers.

- Straightness example: 0.00015 – 0.0025mm*
- Roundness example: 0.00050 – 0.0025mm*
- Positional tolerance: 0.1mm
(*Tighter tolerances can be achieved in some circumstances.)

We manufacture our own alumina and braze alloys enabling us to be a vertically integrated supplier for our customers and offer a simplified supply chain



Microscopy applications

MACOR offers many ceramic materials that can be tailored to specific needs of different microscopy instruments such as SEM and TEM. We have a wide variety of alumina grades with purity from 94 – 99.9%. In addition, our specially formulated Charge Dissipative alumina (CD alumina) can be tailored to match the specific resistance needed by the application.

Feedthroughs

Morgan's ceramic feedthroughs are ceramic to metal assemblies used to transmit signals, high voltages, gases or fluids from outside a hermetically seal chamber to the inside.

Benefits:

- Good electrical insulation
- High mechanical strength
- Excellent hermetic joint quality in harsh environments



Types of feedthroughs:

- Feedthrough for low voltages applications (up to 12kV)
- High-voltage feedthroughs (20 to 100kV)
- Water-cooled feedthroughs and RF feedthroughs

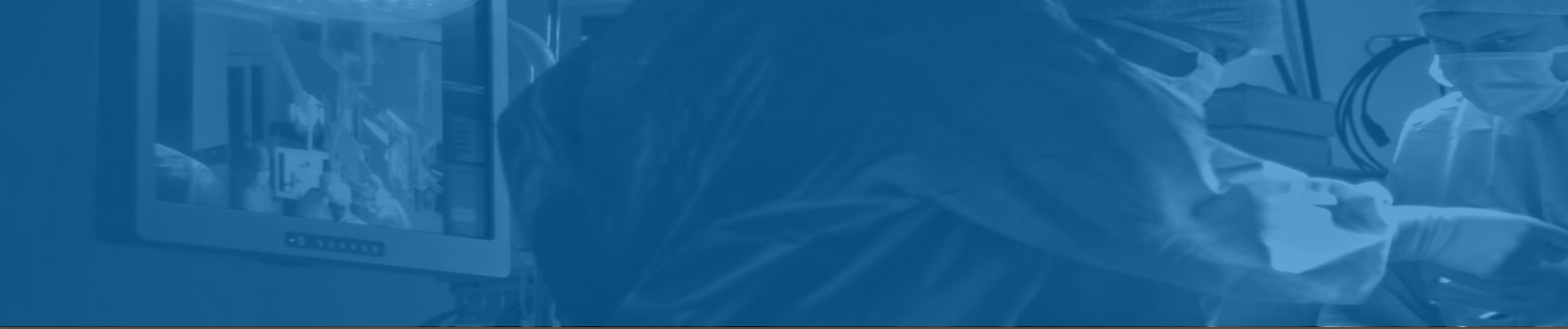
Example of materials used in braze and feedthrough assemblies:

- High purity alumina (94 – 99.9%)
- Zirconia
- ZTA, Si₃N₄, Sapphire, CVD Diamond, CVD SiC
- Glass and glass ceramics
- Conventional brazing materials (moly manganese or active braze alloys (ABA))
- Metals - OFHC copper, stainless steels, mild steels, monel, nickel alloys and titanium
- Glaze option available for protection or to facilitate cleaning

Brazed assemblies

MACOR has the capability to produce custom alumina and metal braze assemblies, using precious and non-precious metals, from sizes below 1mm to 400mm. For SEM applications, Morgan's AL300 offers exceptional high dielectric strength and readily accepts moly-manganese metallizing for high temperature brazing. Along with Morgan's world-class brazing materials, our brazed assemblies are hermetic, able to maintain ultra-high levels of vacuum and joint integrity at elevated temperatures.

We produce high-quality ceramic components and brazed assemblies to tight specifications in quantities from one-offs to volume production



Medical Instrument applications

MACOR has many years of experience in providing precision blood sample valves, shear valve assemblies and distribution valves.

Our products are custom designed and made to meet specific customer requirements for medical diagnostic equipment, clinical systems and analytical laboratory instruments.

Ceramic blood distribution valves

Blood sampling or shear valve assemblies come in a set of two or three precision-made ceramic discs with precisely machined holes for metering blood agents.



Benefits:

- Precision holes for metering
- High purity alumina – chemical (acid) resistance
- High surface finish – Ra 2-13 microinch (μin)
- Flatness < 1 helium light band

Ceramic Pump components

Multi-port ceramic valves are used in pump modules requiring accuracy, reliability, and precision during demanding, long term use in a variety of challenging chemistries. Most of our valve components are made from our specialized high purity 99.5% alumina (CAC995), chosen for its high chemical resistance and smooth finishes ensuring maximum life.

Benefits:

- Excellent accuracy and precision
- Long life span
- Less maintenance required



Materials example

Zirconia

Nilcra® Zirconia is a range of “transformation toughened” ceramics that are inert to most chemicals, have exceptional strength, have high toughness and reliability which together result in outstanding resistance to wear and corrosion.

Morgan's range of Nilcra® Zirconia's are the most mechanically reliable grades of ceramic in the world and include:

- Nilcra® Zirconia **MS** – “Maximum Strength” grade ideal for wear and corrosion solutions and used extensively in materials handling industries.
- Nilcra® Zirconia **3Y-TZP** – A fine grain grade extensively used in the Petrochemical Industry and for applications required to maintain a sharp edge.
- Nilcra® Zirconia **HIP'ed 3Y-TZP** – An ultra high density grade used widely in the manufacture of food and beverage cans.



Charge Dissipative Alumina (CD Alumina)

MACOR supplies charge dissipative alumina and charge dissipative coatings. The resistivity of the CD Alumina can be tailored while still offering high strength, high thermal conductivity, and good dielectric strength.

- Tailorable resistivity, 10^{15} – 10^{12} ohm-cm @ RT
- Can be applied as a coating to improve the breakdown voltage of high power, high vacuum devices

Alumina

Alumina can be produced in a range of purities with additives designed to enhance properties.

A wide variety of ceramic processing methods can be applied including machining or net shape forming to produce a wide variety of sizes and shapes of component.

- Purity range: 94 - 99.9%
- Excellent dielectric properties and wear resistance
- Dense, non-porous and vacuum tight
- Electrically and dimensionally stable across a wide temperature range

Properties	Units	AL300	CAC995	AL995	AL998	AL970CD
Composition (Al ₂ O ₃ Wt%)	%	97.6	99.5	99.5	99.8	>97
Density	g/cm ³	3.76	3.89	3.86	3.94	>3.8
Flexural strength (20°C)	MPa	296	344	310	361	272
Rockwell hardness (R45N)	-	75	85	81	86	75
Dielectric strength	KV/mm	43.3	>22	31.5	>23	27.4
Volume resistivity @ RT	Ohm-cm	> 10 ¹⁴	2.5 x 10 ¹⁴	> 10 ¹⁴	> 10 ¹⁴	10 ⁵ - 10 ¹²
Thermal conductivity @ RT	W/m.K	26.8	26.8	29.3	27	22

MACOR Advanced Materials

MACOR Advanced Materials is a global engineering company offering world-leading competencies in materials science, specialist manufacturing and applications engineering.

We focus on the delivery of products that help our customers solve technically challenging problems, enabling them to address global trends such as energy demand, advances in healthcare and environmental sustainability.

What differentiates us?

- Advanced material science and processing capabilities.
- Extensive applications engineering experience.
- A strong history of innovation and reinvention.
- Consistent and reliable performance.
- A truly global footprint.
- We find and invest in the best people.

New solutions for complex and technologically demanding problems

There are significant trends shaping our modern world. Increasingly, resources are becoming more scarce and harder to access. Our climate and environment is changing, and the pace of innovation and technology change is accelerating.

Each of these directly or indirectly puts more demand on materials, and so advanced materials have never been more important. Morgan's highly experienced scientists and application engineers actively engage with customers, to find new solutions for complex and technologically demanding problems. This goes hand in hand with our commitment to the environment, to health and safety, and to operating to a high-ethical standard.