

# Ceramic & Glass



***GoodFellow***

Your global supplier for materials

# Intro to Ceramics

For more than 70 years, Goodfellow, the leading global supplier of Metals, Alloys, Ceramics, Glasses, Polymers, Compounds and Composites, has been ahead of the market in product innovation.

Ceramics represent a range of diverse materials which includes traditional products such as those used in pottery or as a refractory material, as well as advanced engineering materials such as Alumina and Silicon Nitride which are used in electronic devices, aerospace components and cutting tools.

Goodfellow recently provided advanced ceramics for a permanent exhibition at The National Museum of Scotland in Edinburgh. The properties of ceramics have many applications across industry, science and technology, and ceramics have been a key component in global trade for thousands of years. The materials provided by Goodfellow have helped to showcase the decorative and practical uses of ceramics, highlighting current uses of high-performance ceramics.

More information about our ceramics case studies can be found on [Goodfellow.com](https://www.goodfellow.com)



## Fun Facts



By the late 1990s, enough fibre optic cable had been installed to go to and return from the moon  
**160 times**



Some ceramics are so strong that a 1-inch diameter cable could lift  
**50 cars**

# A Review of the Leading and Innovative Ceramic and Glass Materials

Ceramics exhibit very strong ionic and/or covalent bonds which are stronger than the bonds found in metals. These confer the properties commonly associated with ceramics, namely hardness, high compressive strength, low thermal and electrical conductivities, and chemical inertness.

In general, the microstructure of ceramics can be entirely crystalline or a combination of crystalline and glassy. When the microstructure is entirely glassy, non-crystalline and amorphous, the material is defined as glass.

Many components are either made or contain ceramic and glass materials. Examples include:



Fibre optics which have uses in many areas including communication networks, sensors and imaging devices.  
(Sapphire, Silica)



Heat-resistant tiles on the outer surface of the Space Shuttle (Silica coated with Reaction Cured Glass (RCG) which contains Tetrasilicide and Borosilicate glass)



The touch screens of electronic components (Indium Tin Oxide (ITO), Aluminosilicate glass, Piezoelectric ceramics like Titanates or Zirconates)



Hybrid materials containing Alumina or Zirconia are used for dentistry and arthroplasty



Batteries and fuel cells (Alumina, Stabilised Zirconia, Perovskites)

Our collection of ceramics in more than 30 forms is available off the shelf, with most subject to free delivery within 48 hours and with no minimum order quantities.

# Machinable Ceramic Materials

## Shapal® Hi-M Soft

Shapal® Hi-M Soft is a composite ceramic material of AlN and BN. It has a crystal structure which makes it hard, yet it can be machined using carbide-tipped tools. With a thermal conductivity of approximately 5x that of Alumina, along with excellent mechanical properties, Shapal® Hi-M Soft is an excellent material for engineering applications, as close-tolerance components can be easily fabricated. Goodfellow supplies rods and sheets of Shapal® Hi-M Soft from stock and can also supply machined components.

### Applications

- THz optical and spacecraft design components
- Semiconductor parts
- Electronic parts where electrical insulation and heat dissipation are required
- Heat sinks
- Crucibles for vacuum deposition
- Vacuum components

Excellent Machinability



High Thermal Conductivity



Mechanical Strength

[Click here for the Technical Data Sheet](#)

## MACOR®

MACOR® Machinable Glass Ceramic is a versatile engineering material that is machinable using conventional metalworking or carbide tools. With a maximum use temperature of 1000°C and excellent electrical properties, MACOR® is an ideal material for prototypes and small-to-medium volume production requirements.

Goodfellow supplies rods, bars and sheets from stock. We are also able to supply components produced to specific customer requirements.

### Manufacturing Applications of MACOR® Machinable Glass Ceramic

- Precision coil formers (**electronic/semiconductor industry**)
- Spacers, cavities and reflectors (**laser industry**)
- Thermal breaks, coil supports and vacuum feed-throughs (**aerospace industry**)
- Fixtures and reference blocks in power generation (**nuclear industry**)

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MACOR® is a registered trademark of Corning Incorporated







# Boron Nitride Nanotubes

70% Purity and 90% Purity



## Applications

- Electrically insulating thermal materials
- Piezoelectric sensors
- High-temperature catalyst
- Fire retardant cables
- Aerospace & nuclear engineering
- Polymer nanocomposites
- Ceramic composites
- Biomedical

Boron Nitride Nanotubes are a next-generation nanomaterial which will lead the 4<sup>th</sup> Industrial Revolution.

Boron Nitride Nanotubes (BNNTs) represent another form of Boron Nitride.

Structurally they are nano-cylinders with sub-micrometre diameters and micrometre lengths. They are composed of hexagonal Boron Nitride, constructed by combining Boron and Nitrogen.

The key features of BNNTs are light weight, mechanical strength, thermal and chemical stability, high electrical resistivity and neutron absorption capacity.

[Click here for the Technical Data Sheet](#)



## Optical Glasses

Goodfellow supplies a variety of windows and optical components.

### Sizes

Depending on the material, standard sizes start from 0.025mm thick and lengths of 2mm.

### Materials

BK7 Glass, B270, Corning Eagle 2000 XG, Quartz, Fused Silica, Sapphire, Zerodur, Potassium Aluminosilicate and Filter Glasses.

### Infrared Materials

Germanium, IR Grade Quartz, Calcium Fluoride, Sapphire.

### Components

Beamsplitters, FS mirrors, prisms, light guides, viewports, precision spheres, aspheric lenses, crucibles and domes.

### Coatings

Anti-Reflection (AR) coatings, optical coatings, metallic coatings and electrically conductive coatings.

[Click here for the Technical Information](#)



# Perovskites

## Introducing our new range of Ceramic Perovskites

Researchers are currently focusing on the development of Perovskites, materials which are demonstrating great potential for optoelectronic applications.

Perovskites are a group of materials having a unique versatile crystal structure. This crystal structure consists of a variation in the chemical formula  $ABX_3$ , with many Perovskites occurring as oxides ( $ABO_3$ ), where A and B are typically metal cations. Due to their lattice, these materials are characterised by special properties like superconductivity, magnetoresistance, piezoelectricity and dielectric and pyroelectric behaviours.

Therefore, these materials are being considered as excellent candidates for multilayer capacitors like fuel cells, solar

cells, sensors and electric batteries, or even next-generation display screens, LEDs, memory devices (RAM) and high-temperature superconductors.

Goodfellow has a range of Perovskites including  $BaTiO_3$ ,  $CaTiO_3$ ,  $PbTiO_3$ , in different forms such as powders or sputtering targets.

Materials we stock in powder and solid forms:

Barium Titanate  
Bismuth Aluminate  
Bismuth Titanium Oxide  
Calcium Titanate  
Copper Tungsten Oxide  
Lithium Titanate  
Lead Titanium Oxide  
Lanthanum Titanate  
Samarium Ferrite

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# Quartz Melting Trays

Opaque Fused Quartz is a popular choice of melting tray material due to its excellent thermal and chemical stabilities and superior thermal shock resistance. It is ideal for situations where rapid temperature changes may occur during processing.

Some material manufacturing processes can lead to inconsistencies in the melting vessels that risk a much-reduced lifetime or even failure during the melting process. To overcome these shortcomings, Goodfellow supplies high-purity (>99.995%) moulded Opaque Fused Quartz melting trays which provide excellent characteristics for demanding melting applications.

## Applications

- High-temperature processing vessels
- Calcining and melting vessels
- Solder pots

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# FORMS



## Bar

A straight length of rectangular, square or oval section material.



## Bead

A small piece of material with a hole through it. Beads can be spherical, tubular or "fish-spine" interlocking forms.



## Bolt

A threaded pin that can be screwed into a nut or a tapped hole to fasten items together. Bolts are available with different head styles and also in metric and inch-threaded sizes.



## Chopped Fibre

Fibres cut into short lengths called cut, staple or chopped fiber.



## Crucible

A vessel in which other materials may be heated or melted, usually at high temperatures.



## Fabric

Woven fabrics are made by the regular interlacing of two arrays of yarns at right angles to each other, these being referred to as the warp and weft (see also Non-woven fabric).



## Fibre

Yarns or tows consisting of several approximately parallel individual filaments, each filament usually being smaller in diameter than a monofilament. Yarns contain a defined number of filaments, typically three to several hundred; tows contain thousands of filaments whose number is only defined approximately. Both are primarily specified by their linear density measured in "tex", the weight in grams of a 1km length of material.



## Film

A non-metallic sheet material with a thickness < 0.5mm.



## Flake

Flat, irregularly shaped pieces of material. A maximum flake size is indicated but individual flakes may vary greatly in size.



## Foam

A low density, permeable structure of cells and continuous ligaments offering a high surface area to volume ratio, and also a high strength to weight ratio.



## Foil

Thin sheets of pure metal and metal alloys. Due to their fragile nature, some foils are coated on one side with an acrylic or polyester support. Where foils are supported they are indicated in the detailed item description.



## Granule

Pellets of an approximately regular shape. Granules may vary in size and, therefore, the dimensions stated are nominal. In addition, the shape of a granule may vary from item to item.



## Honeycomb

A cellular structure similar in appearance to natural honeycomb.



## Ink

A liquid or paste used for writing, printing or drawing. In many instances it is a colloidal sol system of fine pigment particles dispersed in a solvent. The ink will impart colour and its properties by being adsorbed/absorbed onto the substrate, often via ionic bonding.



## Insulated Wire

A single or multiple flexible strand of metal or alloy with an insulating sheath.



## Laminate

Layers of material which have been bonded together by the use of heat, pressure and, possibly, adhesive.



## Lump

A solid piece of material with no defined shape.



## Mesh

Mesh is available as either a woven wire or electroformed product; in all cases, the quoted aperture sizes are nominal. Wire mesh: a material which is woven from metal wires to provide a thin grid with a regular series of holes. Electroformed mesh: a product made by electroplating the mesh geometry through a mask onto a substrate which is subsequently etched away.



## Metallised Film

Film which is coated with a metal. The thickness of the metal is measured and described in terms of the material's specific electrical resistance in ohms per square.



## Microfoil

An extremely thin sheet of metal or alloy mounted on a permanent support. This support **cannot** be removed without destroying the Microfoil.



## Microleaf

An extremely thin sheet of metal mounted on a removable support. Microleaf is not available for metals which are too brittle to be free standing.



## Monofilament

A single strand of a non-metallic material.



## Non-Woven Fabric

Non-woven fabrics are made by methods other than weaving or knitting, the yarns and fibres being held together, often quite loosely, by means other than geometric interlacing. Due to the open and porous nature of this material, all other dimensions are nominal.



## Nut

Generally a flat piece of material with a threaded hole which can be screwed onto a bolt to fasten items together. Nuts typically have a hexagonal external shape. Nuts are available in metric and inch threaded sizes.



## Powder

Small particles with an approximately defined size range. Those materials described as alloy precursors are not true alloys - they are made by sintering a blend of powders of the component metals to achieve alloying by diffusion. The resultant cake is ground and sieved to the required particle size range. Unless otherwise stated, the particle sizes shown are for guidance only. We do not guarantee either any particular size distribution between the quoted minimum and maximum sizes, or a specific particle shape.



## Rod

A straight length of circular section material.



## Sheet

Flat material with a thickness >0.5mm.



## Single Crystal

A material grown as a monocrystal, generally to a specific orientation, dimension and surface finish. It may contain a dopant. Single crystals are usually made to order.



## Sphere

A regular solid or hollow three-dimensional form in which every cross-section is a circle. Spheres are available with standard or precision tolerances, and can be supplied with different surface finishes depending on the material.



## Sputtering Target

A high purity material used as a source for sputtering, a cold vaporization process in which atoms are physically removed from the target surface by ion bombardment.



## Tube

A hollow length of material normally circular in section. Most tubes are straight except those made of flexible polymer.



## Washer

A thin, flat piece of material with a hole in the middle, used in conjunction with bolts and nuts to distribute the load of a threaded fastener.



## Wire

A single or multiple flexible strand of pure metal or alloy.

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