

CARBIDE CERAMICS

The most important carbide ceramic is **Silicon Carbide (SiC)**.

Silicon Carbide materials are produced by in either porous or dense form and by using different technological methods:

- ▣ [Open Porous Silicon Carbides](#)
- ▣ [Dense Silicon Carbides](#)
- ▣ [Properties of some silicon carbide ceramics](#)

Open Porous Silicon Carbides

▣ **Silicate Bonded Silicon Carbide**

Oxide binder (aluminosilicate) in amounts of 5-15% is added to relatively coarse Silicon Carbide powder.

Manufacturing technique of Silicate Bonded Silicon Carbide is cost effective; however the presence of oxides decreases high temperature strength and corrosion resistance of the material.

▣ **Recrystallized Silicon Carbide (RSC)**

Recrystallized Silicon Carbide ceramics are produced from pure silicon carbide powders.

Since no binders are added, the manufacturing process requires high [sintering](#) temperature 4170-4530 °F (2300-2500 °C).

Absence of binders allows using the materials at temperatures up to 3000 °F (1650 °C).

Recrystallized Silicon Carbide materials have 10-15% of open porosity favoring their high [thermal shock resistance](#).

Due to their porosity [mechanical strength](#) and [corrosion](#) resistance of the materials are lower than those of dense silicon carbide ceramics.

▣ **Nitride Bonded Silicon Carbide (NSC)**

Nitride Bonded Silicon Carbide ceramics are produced from a mixture of silicon carbide and silicon powders, which is sintered first in [Nitrogen](#) atmosphere and then in oxidizing atmosphere.

The resulting material has small pores with open porosity up to 5%.

Nitride Bonded Silicon Carbide materials possess better corrosion resistance and higher mechanical strength than Recrystallized Silicon Carbides, but their [maximum service temperature](#) is lower – up to 2730 °F (1500 °C).

Nitride Bonded Silicon Carbides are hardly wetted by molten non-ferrous metals.

Dense Silicon Carbides

☐ **Liquid Phase Sintered Silicon Carbide (LPSC)**

Liquid Phase Sintered Silicon Carbide ceramics are produced from a mixture of silicon carbide and oxides powders, which is sintered at a temperature above 3630 °F (2000 °C) and under high pressure up to 4400 psi (30 MPa).

Fine [Grain structure](#) and absence of pores provide high mechanical strength and [fracture toughness](#) of the material.

☐ **Reaction Bonded Silicon Infiltrated Silicon Carbide (SSC)**

Reaction Bonded Silicon Infiltrated Silicon Carbide ceramics are produced from a mixture of silicon carbide and [carbon](#) powders, through which molten silicon is infiltrated. Silicon, reacting with carbon, forms bonding between the silicon carbide grains.

The material possesses high mechanical strength, corrosion, wear and thermal shock resistance at temperatures below 2515 °F (1380 °C).

☐ **Hot Pressed Silicon Carbide (HPSC)**

Hot Pressed and hot isostatically pressed Silicon Carbide ceramics are produced under pressure up to 2000 atm. and they possess high mechanical strength.

☐ **Sintered Silicon Carbide (SSIC)**

Sintered Silicon Carbide ceramics are produced by conventional sintering technique under natural pressure of inert gas atmosphere and at temperatures 3630-4000 °F (2000-2200 °C).

The material possesses high corrosion resistance and high [hardness](#) and mechanical strength up to 2900 °F (1600 °C).

The following characteristics are typical for the most of Silicon Carbide Ceramics:

- ☐ Low density;
- ☐ High mechanical strength and hardness;
- ☐ Good high temperature strength;
- ☐ Good oxidation and corrosion resistance even at high temperatures;
- ☐ Excellent thermal shock resistance;
- ☐ Good wear resistance;
- ☐ Low [coefficient of thermal expansion](#);
- ☐ High [thermal conductivity](#);
- ☐ [Semi-conducting properties](#).

Silicon Carbide ceramics are used for manufacturing melting crucibles, kiln furniture, heat exchangers, burner nozzles, sealing rings for pumps and other parts working at high temperature and in aggressive media, milling balls, wear plates, heating elements.