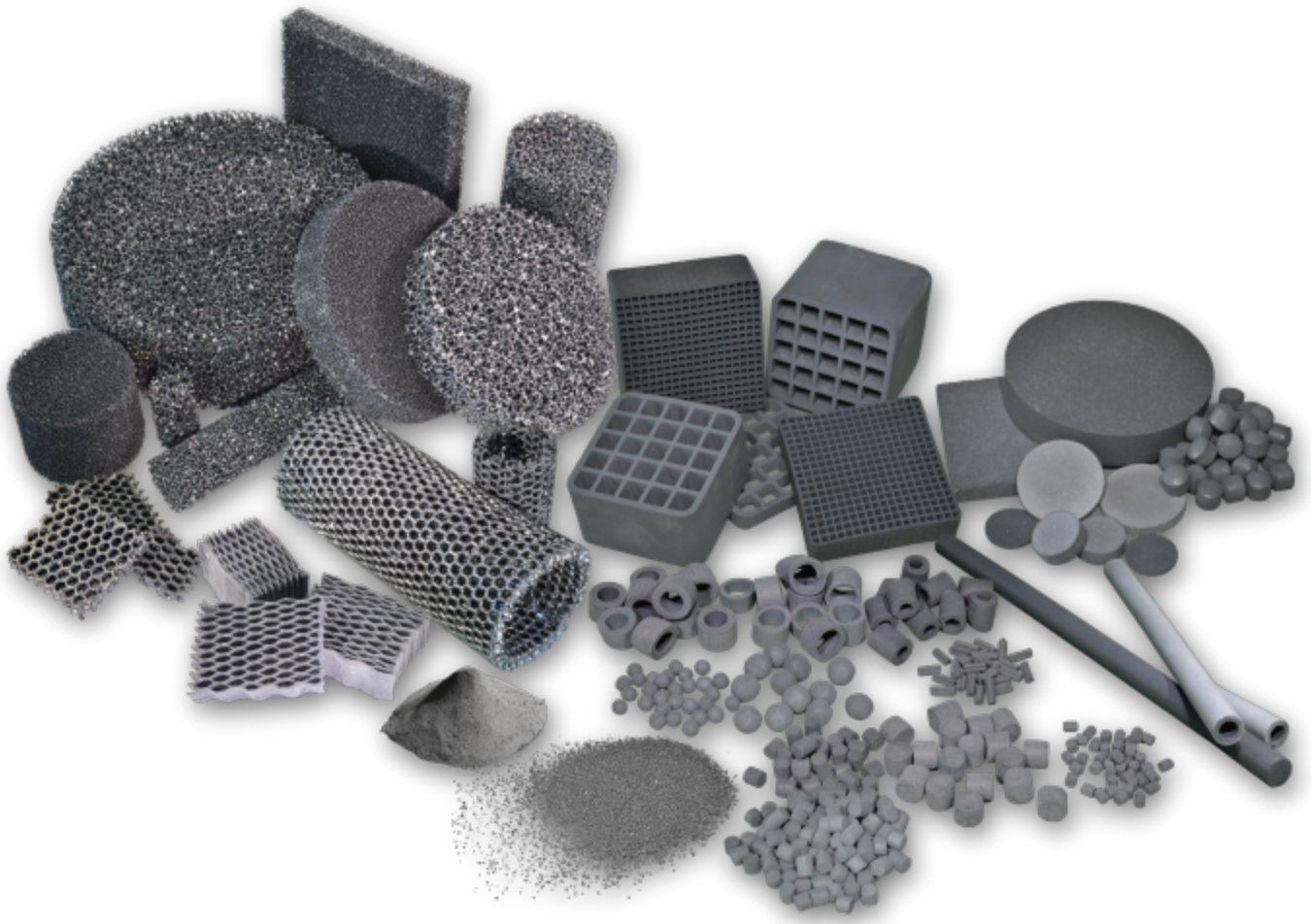
# SICAT

BETA SiC CATALYST SUPPORTS



Porous silicon carbide materials combining high surface area, high purity, controlled porosity and outstanding mechanical strength

# TAILORING SILICON CARBIDE BASED MATERIALS

Customized shape

Customized surface area

Customized purity

Customized porosity

Customized surface chemistry

**High surface area SiC with:**
- outstanding mechanical strength
- chemical resistance
- high thermal conductivity
- strong thermal stability

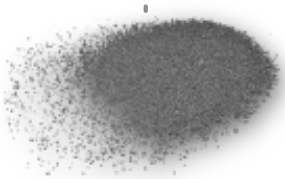
JOINT DEVELOPMENT

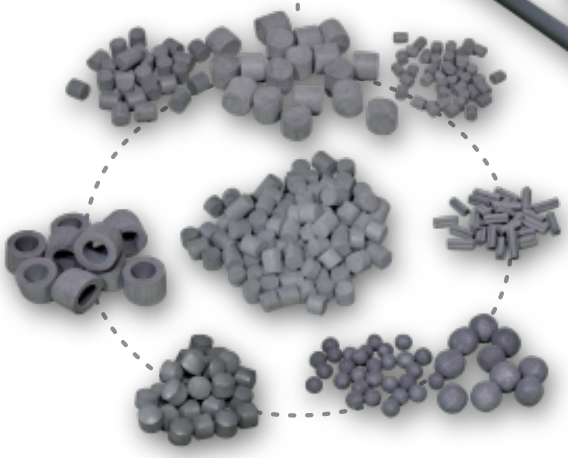
# CUSTOMIZED SHAPE

Our porous beta silicon carbide can be easily shaped in a wide range of sizes.

What are your needs? Let's talk!

| $10^{-6}$ m | $10^{-4}$ m | $10^{-3}$ m | $10^{-2}$ m | $10^{-1}$ m |
|---|---|---|---|---|
| Powders | Grains, Microspheres | Extrudates, Trilobes, Rings, Spheres, Tablets | Pressed pieces, Tubes, Rods | Foams, 3D Structures Honeycombs |





| Shape | Diameter (mm) | Length (mm) |
|---|---|---|
| Extrudates | 1 - 5 | 2 - 10 |
| Trilobes | 0.8 - 1.6 | 2 - 10 |
| Rings | OD 5 - 13 / ID 3 - 8 | 5 - 15 |
| Spheres | 2 - 8 | - |
| | **Cell size (PPI)** | **Size (mm)** |
| Foams | 8 - 30 | 20 - 300 |

# β-SiC KEY PROPERTIES

Our porous beta silicon carbide materials are unique thanks to SICAT's proprietary self bonding SiC manufacturing process.

## Outstanding mechanical strength

| Shape | Crushing strength* | Bed Density |
|---|---|---|
| Pellets: Ø 3 mm (Pore Volume: 0.5 cc/g) | > 40 N/mm | 800 g/l |
| Rings: Ø 8/5 mm (Pore Volume: 0.5 cc/g) | > 10 N/mm | 500 g/l |
| Spheres: Ø 5.5 mm (Pore Volume: 0.5 cc/g) | 260 N | 800 g/l |
| Open cell foams | > 2 MPa | 200 g/l |

* Grain method per ASTM 4179 and 6175

Attrition for Ø 3 mm pellets: <1% (per ASTM D4058-96)

## Chemical resistance

Our material provides superior resistance in aggressive environments because it doesn't contain binders.

| Mechanical strength and BET surface area | HF (40 %vol.) | HCl (37 %vol.) | $HNO_3$ (68 %vol.) | NaOH (10 M) |
|---|---|---|---|---|
| stable after 2 weeks aging at 20°C | ✓ | ✓ | ✓ | ✓ |

## Thermal conductivity

SiC exhibits much higher heat transfert coefficient than oxides with similar pore structures.

## Thermal stability and oxidation resistance

Self bonded SiC offers strong thermal resistance. The mechanical strength and the BET surface area remain unchanged after thermal shocks, hydrothermal and oxidative aging:

- thermal shocks resistance: 5 successive shocks from 600°C to 20°C under air
- simulated regeneration conditions: 165 cycles from 600°C to 200°C under air
- stability* in hydrothermal conditions: 270°C, 55 bar steam during 4 months
- oxidation resistance: 500°C, Patm., 30 %vol. steam / 70 %vol. air during 1 month

* $S_{BET}$ drops from 28 to 18 $m^2/g$ after 15 days then remains stable

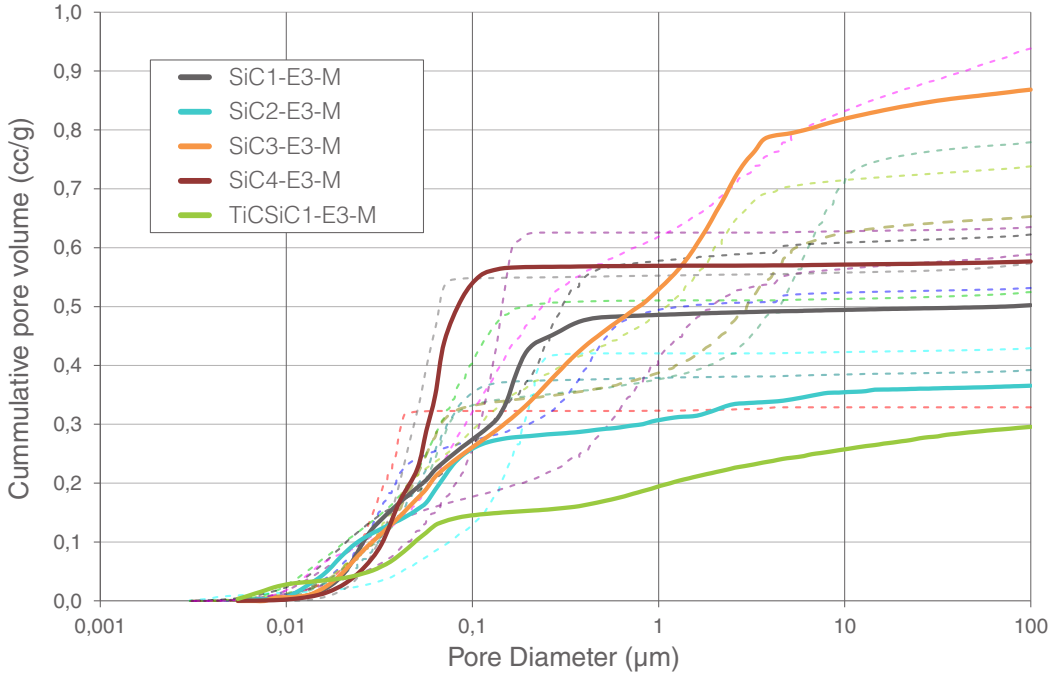
# CUSTOMIZED POROSITY

SICAT tailors the pore size distribution of its beta silicon carbide-based materials.

BET surface areas range from **10 to 130 m²/g**.

Pore size distribution and pore volume can be tailored with:

- monomodal, bimodal or trimodal distribution
- pore diameter from **10 nm to 10 µm**
- pore volume up to **1 cc/g**



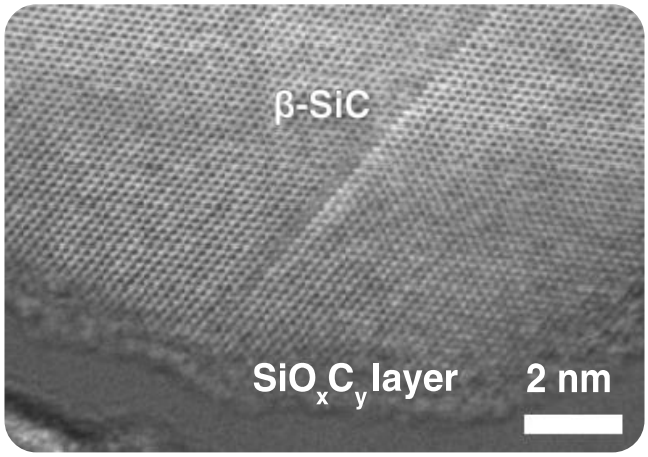

SiC1 to 4 and TiCSiC1 are standard products.
We can also design specific materials that meet your unique porosity needs.

| SiC Grade | BET Surface Area | Microporous Surface Area | Pore Volume* | Crushing Strength** |
|---|---|---|---|---|
| SiC1-E3-M | 25 m²/g | < 5 m²/g | 0.40 cc/g | 70 N/mm |
| SiC2-E3-M | 25 m²/g | < 5 m²/g | 0.30 cc/g | 40 N/mm |
| SiC3-E3-M | 25 m²/g | < 5 m²/g | 0.55 cc/g | 25 N/mm |
| SiC4-E3-M | 30 m²/g | < 5 m²/g | 0.50 cc/g | 50 N/mm |
| TiCSiC1-E3-M | 90 m²/g | 45 m²/g | 0.35 cc/g | 40 N/mm |

Typical properties of standard products
* measured by water absorption
** Grain method per ASTM D4179 & D6175

# CUSTOMIZED SURFACE CHEMISTRY

Silicon carbide is covered by an amorphous oxycarbide passivation layer whose properties are close to silica, allowing for an easy active phase deposition by conventional techniques.




We can develop new chemical functions to meet your needs:

- coatings: $Al_2O_3$, $TiO_2$, $ZrO_2$, $SiO_2$, Zeolites, C...
- composites: TiC-SiC, $TiO_2$-SiC, $ZrO_2$-SiC...
- doping

# CUSTOMIZED PURITY

| Elemental analysis (ppm) | Purity grades | | |
|---|---|---|---|
| | M | P | HP |
| Fe | 3 000 | 400 | 60 |
| Al | 1 000 | 700 | 15 |
| Ca | 400 | 150 | 80 |
| Na | 80 | 80 | 80 |
| K | 100 | 100 | 100 |
| S | 50 | 50 | 50 |

SiC1, SiC2 and SiC4 typical values

# JOINT DEVELOPMENT

Beta-SiC is a novel, groundbreaking material that we have designed and improved over the years.

We realize that no two porous materials are alike and we prioritize flexibility and options for our customers.

Our experienced production engineers work with our R&D scientists to develop manufacturing processes that let us customize our products while remaining competitive in price and quality.

This gives us unparalleled ability to adapt characteristics such as specific surface area, porosity, surface chemistry, shape, etc… according to our customer's needs and objectives.

We have a proven track record for reliability, innovation, problem solving approaches that help our customers improve their process performance and operating costs.

To further optimize and speed up the customization of a beta silicon carbide solution that will satisfy your requirements, we can set up a joint development project in which your experts work closely with our production engineers and R&D scientists.

# mesoC+™

## a synthetic carbon support

SICAT
BETA SiC CATALYST SUPPORTS

SICAT designed mesoC+™ carbon pellets with remarkable improvement of mechanical strength over current activated carbons.

Combined with its pore structure, high purity and well controlled shapes, its mechanical strength makes it ideally suited as catalyst support.

mesoC+™ is also a lower cost alternative to SICAT beta-SiC commercial materials for uses in non-oxidative conditions. mesoC+™ being part of the already widespread carbon family, users will find it easy to adopt.

### KEY FEATURES AND BENEFITS

- ***High attrition resistance,*** minimizing active phase loss, reactor plugging, product contamination …
- ***High purity,*** preventing the poisoning of the active phase
- ***Well controlled and tunable shape,*** enabling a homogeneous bed packing and optimized pressure drop
- ***Large volume of meso- and macropores,*** favoring mass transfer and maximizing the catalytic surface available for the reaction

| Typical values for 3 mm pellets | mesoC+™ pellets | Competitor carbon pellets* |
|---|---|---|
| Crushing strength (ASTM D4179) | 40 N/mm | < 10 N/mm |
| Attrition (ASTM D4058) | 0.4 % | > 1.5 % |
| Tapped bed density | 580 g/l | 350-450 g/l |
| BET ($N_2$ sorption) | 275 $m^2/g$ | 800-1000 $m^2/g$ |
| Pore volume 6-100 nm (Hg intrusion) | 0.48 cc/g | < 0.20 cc/g |
| Total pore volume (Hg intrusion) | 0.52 cc/g | 0.40-0.70 cc/g |

* range of values measured on three commercial pellets of activated carbon derived from coconut shell

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