

HI-NICALON™ Type S CERAMIC FIBER

COI Ceramics, Inc. (COIC) is a leading supplier of ceramic reinforcements and ceramic matrix composites (CMC). COIC began operations in 1999 and employs a highly technical staff with extensive experience and knowledge in high performance ceramics. Our San Diego, California facility manufactures CMC's while our Salt Lake City, Utah facility serves as a worldwide fiber distribution and technical support center. For more information on ceramic fiber capabilities and cost, contact our technical staff at (801) 922-8111 or, (801) 251-8049 or browse the web at www.coiceramics.com. Send written requests to 7812 West 4100 South, Magna, Utah 84044.

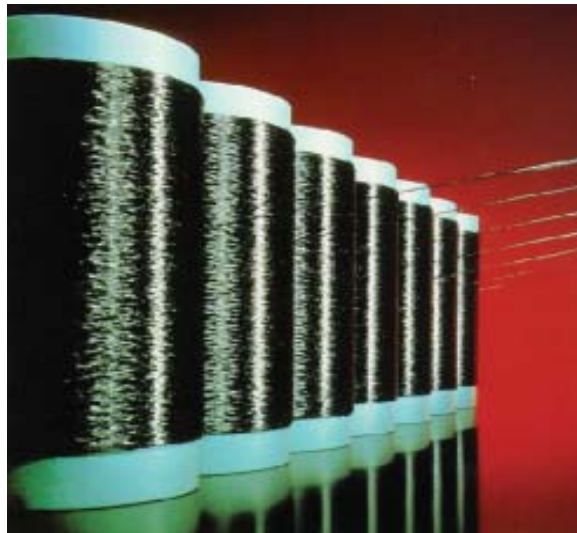
GENERAL DESCRIPTION

HI-NICALON™ Type S ceramic fiber is a multi-filament silicon carbide-type fiber manufactured by Nippon Carbon Co., Ltd. (NCK) of Japan. NCK is known worldwide as the leading manufacturer and innovator of multi-filament silicon carbide-type fibers. HI-NICALON™ Type S is a stoichiometric beta-SiC fiber manufactured near-oxygen-free using decarbonization pyrolysis and electron-beam curing. It has higher modulus, creep resistance and oxidation resistance than Hi-NICALON™.

HI-NICALON™ Type S is highly resistant to oxidation and chemical attack and is available in a variety of product forms, depending on the intended use.

USES

HI-NICALON™ Type S ceramic fiber is primarily designed to be used as reinforcement for high



temperature ceramic composites. It can also be used as a reinforcement for plastic, and metal matrix composites. Surface treatments are normally recommended to facilitate processing and maximize composite properties. The fiber can also be used to form fibrous products such as high temperature insulation, filters, etc. Its resistance to chemical attack allows the fiber to be used in harsh environments. Typical fiber properties are shown in Table 1.

PRODUCT FORMS

HI-NICALON™ Type S ceramic fiber is available in several physical forms to offer the user application flexibility. The fiber is coated with polyvinyl alcohol (PVA) sizing for improved handleability.

Continuous Fiber

Supplied as multi-filament tow, spooled on 3 inch ID bobbins to 500 meters in length (100 grams in weight). Also available in random lengths at a reduced price.

Woven Cloth

Available as Plain Weave, 5HS Weave or 8HS Weave, as identified in Table 2, HI-NICALON™ Type S cloth is typically supplied as 30 centimeter-wide continuous rolls of specific lengths. Other widths, weave or braid styles can be made available. Contact COI Ceramics to discuss specific needs.

Chopped Fiber

Available as 1-mm length chopped multi-filament tow. Longer lengths also available. Contact COI Ceramics to discuss specific needs.

HOW TO USE

Ceramic Matrix Composites

HI-NICALON™ Type S fiber can be incorporated as the reinforcement for a variety of ceramic composites. Standard CMC processing techniques, such as sol-gel, chemical vapor infiltration, melt infiltration, or polymer infiltration can be used, depending on the user's needs and capabilities. Candidate matrix materials include silicon carbide, silicon nitride, alumina, glasses, and others. Fiber surface treatments are generally removed before making CMC's, such as by heating to 600C for 30 minutes. Fiber interface coatings, such as BN, are generally applied to the fiber to achieve optimum CMC properties. The specific fiber type and the specific CMC processing technique is best determined by the user.

Polymer or Metal Matrix Composites

Please contact COI Ceramics for additional information on Nicalon™ ceramic fiber, which is well suited for PMC and MMC applications

Weaving, Braiding, and Coating

As textile grade yarns, HI-NICALON™ Type S fiber can be readily incorporated into a large variety of woven tapes, braides, etc. Specialty interface coatings such as BN (often recommended for optimum CMC mechanical properties) may be applied to the tow or cloth. A network of US contractors exists to respond to customer needs. Contact COI Ceramics to discuss specific needs and receive further information.

SPECIAL PROPERTIES

CMC's reinforced with HI-NICALON™ Type S ceramic fiber offers distinct advantages over other materials. Oxide fiber and superalloys generally lose mechanical properties above 800C. SiCO fiber generally loses properties above 1000C. 100 micron diameter monofilament SiC fiber is generally not weavable. HI-NICALON™ Type S ceramic fiber overcomes these drawbacks.

AVAILABILITY & ORDERING

HI-NICALON™ Type S ceramic fiber is available exclusively in North America from COI Ceramics, Inc. For more information, contact the COI Ceramics, Magna, UT Sales & Customer Service Office at 801-251-8111.

SAFE HANDLING INFORMATION

Product safety information required for safe use is NOT included. Before handling, read the product Material Safety Data Sheet. An MSDS is available from COI Ceramics.

LIMITED WARRANTY

COI Ceramics (COIC) believes that the information contained herein is an accurate description of the typical properties and uses of the products, but it is your responsibility to test the material to determine its performance and safety for your application.

COIC's sole warranty is that the product meets current sales specs. Specification writers should contact COIC for sales specifications. COIC specifically disclaims any other express or implied warranty.

TABLE 1: TYPICAL PROPERTIES at RT

	Hi-Nicalon Type S
Fiber Denier	1620
Density, g/cc	3.10
Composition, wt.% Si:C:O	69:31:0.2
C/Si Atomic Ratio	1.05
Filaments per Tow	500
Filament Diameter, μm	12
Tensile Strength, GPa	2.6
Tensile Modulus, GPa	420
Vol. Resistivity, ohm-cm	0.1
Thermal Conductivity, W/m.K	
At 25C	18.4
At 500C	16.3
Specific Heat, J/g.K	
At 25C	0.70
At 500C	1.15

TABLE 2: STANDARD WEAVE SIZES

Weave Style	Yarn Count (ends/inch) (warp x fill)	Arial Weight
Plain Weave (PW)	16 x 16	250 g/m ²
5 Harness Satin (5HS)	16 x 16	250 g/m ²
8 Harness Satin (8HS)	22 x 22	380 g/m ²

CERAMIC FIBER - CONTACTS:

Hugh Spilker, Engineer
PH:801.251.8111,FX:801.251.8031
Mobile: 858.922.0877
Hugh.Spilker@atk.com

Jay Curtis, Manager
PH: 801.251.8049, FX: 801.251.8031
Mobile: 619.993.3009
JayA.Curtis@atk.com