Industrial Wear Applications

Si_3N_4

Ceralloy® Silicon Nitride has been used in a wide variety of industrial wear applications to improve product life and performance, manufacturing efficiency, and to reduce downtime. Silicon nitride is the leading advanced ceramic material for demanding applications found in today's industrial marketplace.

Ceradyne silicon nitride is produced using patented compositions and processing techniques. The result is an interlocking needle-like microstructure that provides excellent wear resistance and superior fracture toughness. The toughness of Ceradyne silicon nitride offers reliability above and beyond that of any other monolithic ceramic material. These properties prove beneficial in applications where wear resistance and durability are critical.

The unique combination of material properties in Ceralloy® Silicon Nitride allows applications to exceed the limits of conventional materials. It has been used for industrial solutions since the early 1990's to improve component performance and reliability.

Industry	Component	Silicon Nitride Benefits
Metal Forming	Cutting Tools	Improves machining rates (speeds and feeds) when machining cast iron.
	Metal Forming Rolls	Eliminates metal buildup when forming copper rod and stainless steel tubing.
	Weld Location Pins	Electrical insulator, resistant to molten metal slag. No coating required.
Paper Industry	Dewatering Foils	Increased wear resistance and thermal shock resistance. Increased thermal shock resistance and increased fracture toughness.
Chemical/Petrochemical	Tube Sheet Boiler Ferrules	Increased thermal shock resistance.
	Thermocouple Protection Tubes	Increased thermal shock resistance, chemical durability, wear resistance.
Aluminum Processing	Riser Tubes, Thermocouple Protection Tubes	Increased chemical resistance and mechanical durability.
Surface Preparation	Sand Blast Nozzles	Increased wear resistance and mechanical durability.

Properties

- Lightweight (60% Lighter than Steel)
- Excellent Wear Resistance
- High Fracture Toughness
- Low Coefficient of Friction
- Thermal Shock Resistant
- Corrosion Resistant
- Electrical Insulator

Applications

- Metal Forming
- Paper Processing
- Petrochemical
- Cutting Tools
- Molten Metal Processing
- Tube Sheet Boiler Ferrules
- Sand Blast Nozzle Liners

ceradyne, inc.®
ADVANCED TECHNICAL CERAMICS

Industrial Wear Applications

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Property	Ceralloy® 147-1B	Ceralloy® 147-31E	Ceralloy® 147-31N	Ceralloy® 147-A	EKasin® S, EKatherm®
Process	Reaction Bonded	Sintered Reaction Bonded	Sintered Reaction Bonded	Hot Pressed	Gas Pressure Sintered
Density (g/cc)	2.3	3.3	3.2	3.18	>3.24
% Theoretical Density	70	>99.5	>99.5	>99.5	>99.5
% Open Porosity	30	0	0	0	0
Purity (% Si_3N_4)	>98	>92	92	>99.4	>92
Mechanical Characteristics					
Flexural Strength (MPa) @ RT	190	700	700-800	700	700
Weibull Modulus	10	10-15	15-50	10-20	25
Elastic Modulus (GPa)	175	310	310	310	310
Poisson's Ratio	0.21	0.28	0.27	0.23	0.25
Hardness HV (0.3) Kg/mm^2	800	1450	1450	1650	1450
Fracture Toughness ($MPam^{1/2}$)	2.5	6.0	6.0	4.5	7.0
Abrasive Wear Resistance Parameter**	360	825	825	860	891
Thermal					
Thermal Expansion Coeff. 10^{-6}/ºC: (RT-1000ºC)	3.2	3.1	3.1	3.2	3.6
Thermal Conductivity (W/mK) @ 25ºC	14	42	26	42	22
Thermal Schock Parameter (ºC)***	330	524	610	517	605
Electrical					
Electrical Resistivity (ohm-cm)	10^{14}	$>10^{14\text{-}15}$	10^{16}	10^{16}	10^{12}
Dielectric Constant	-	8	8	9	-
Key Features	High Purity, Net Shape Fabrication	Impact Strength, Net Shape Fabrication	Strength, Hertzian Contact Strength, Structural Reliability, Net Shape Fabrication	High Purity, Excellent Mechanical Properties	High Temperature Resistance, High Thermal Shock Resistance, Electrically Insulating
Applications	Industrial Applications, Electrical Insulatiors, Sputtering Targets	Cutting Tools, Wear Components	Automotive Components, Bearings, Wear Components	Semiconductor Components, Wear Components	Molten Metal, Processing Chemical Processing

** Property values are typical and should not be considered specifications.*
*** Abrasive Wear Resistance Parameter = Fracture Toughness $^{(0.5)}$ * Hardness $^{(1.43)}$ * Elastic Modulus $^{(-0.8)}$*
**** Thermal Shock Parameter = [Strength * (1-Poisson's Ratio)] / (Elastic Modulus * Thermal Expansion Coeff.)*

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Ceradyne Advanced Technical Ceramics

Ceradyne, Inc. (NASDAQ:CRDN) is a publicly traded corporation specializing in development and production of advanced technical ceramics. Manufacturing facilities are based in California, Georgia, Kentucky, Michigan, Germany and France. Ceradyne's advanced ceramics are sought for the most demanding applications in automotive, wear, semiconductor, orthodontic and armor industries.

Ceralloy® 147 Silicon Nitride components are produced in fully dedicated facilities using patented compositions and processing techniques. Plentiful raw materials are coupled with conventional, time-tested ceramic manufacturing processes that produce high quality, cost effective silicon nitride components.