

## Welding- and Forming Technology



FCT Ingenieurkeramik GmbH represents 25 years of experience in the field of processing, fabrication and materials technology for high performance ceramics and composite materials.

### Silicon nitride material for welding and forming applications

Our silicon nitride ceramic material combines following properties:

- low density
- excellent bending strength and fracture toughness
- high stiffness
- good thermal shock behaviour
- high hardness
- electrically conducting or insulating
- corrosion and wear resistant
- long lifetime durability

In forming technology silicon nitride materials are established or under evaluation for many application areas:

#### Welding Technology

- Welding rolls and positioning pins
- Welding and brazing gages

#### Rolling Mills

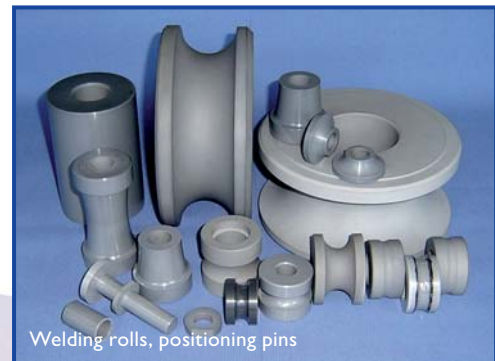
- Caliber rollers for wire manufacturing
- Spinning rollers for steel wheel rims
- Cylinder rolls for sheets and foils

#### Forming Technology

- Deep drawing dies
- Ceramic tools for thixo forming process
- Forging mandrels and punches

#### Miscellaneous

- Sizing rolls and calibration components for tubes
- Guiding rolls and plates
- Deflection rolls



Welding rolls, positioning pins



Continuous tube welding process



Spinning rollers for steel wheel rims



Material		HPSN		GPSN		GPSN	HPSN	NSiC	SSiC	LPSiC
		HP	HP	ISO	SG	TiN	BN			
Sintering process		HP	HP	GPS	GPS	GPS	HP	RS	S	LPS
FCT-grade		FHNM	FHNY	FSNI	FSNS	FSNT	FSNB	FSNC	FSC	FSCL
Microstructure										
Bulk density	[g/cm <sup>3</sup> ]	3,22	3,23	3,26	3,21	4,35	2,4-3,0	2,8	3,15	3,25
Open porosity	[%]	0	0	0	0	0	2-12		<3	<1
Mechanical Properties										
Compressive strength	[MPa]	2.600	3.000	3.000	2.500	3.000	1.000	600	2.500	3.000
Bending strength $\sigma$ RT	[MPa]	700	850	750	650	850	500	180	400	500
1.200 °C	[MPa]	450	500	450	400				400	450
Weibull modulus m		>18	>20	>20	>20	>20	>20	20	15	15
Fracture toughness K <sub>IC</sub>	[MPa.m <sup>1/2</sup> ]	7	8	8	7	8	9	4	3,5	5
Youngs modulus E	[GPa]	315	320	320	310	350	250	220	400	410
Poisson Ratio $\nu$		0,29	0,28	0,28	0,28	0,20	0,25	0,20	0,20	0,20
Hardness (Vickers)	[GPa]	16	16	16	16	18			26	23
Thermal properties										
Max. working temp.										
- inert gas	[°C]	1.200	1.200	1.200	1.200	1.200	1.400	1.800	1.900	1.600
- air	[°C]	1.200	1.200	1.100	1.100	1.000	1.000	1.400	1.650	1.500
T melting/decomposition	[°C]	1.600	1.600	1.600	1.600	1.600	1.600	1.600	2.400	2.300
Thermal conductivity $\lambda$ RT	[W/mK]	30	30	30	30	30	50	20	100	90
CTE $\alpha$	[10 <sup>-6</sup> K]	3,2	3,2	3,2	3,2	6,0	3,0	5,0	4,5	5,0
Thermal shock param. R <sub>1</sub>	[K]	495	598	527	472	324	500	110	177	195
Thermal shock param. R <sub>2</sub>	[W/m]	14.839	17.930	15.820	14.150	9.714	25.000	2.530	17.700	17.560
Electrical properties										
spec. resistance RT	[ $\Omega$ cm]	10 <sup>10</sup>	10 <sup>10</sup>	10 <sup>11</sup>	10 <sup>11</sup>	10 <sup>5</sup>	10 <sup>10</sup>		10 <sup>1</sup>	10 <sup>5</sup>
1.000 °C	[ $\Omega$ cm]	10 <sup>7</sup>	10 <sup>7</sup>	10 <sup>7</sup>	10 <sup>7</sup>					

### Production of components

We produce ceramic components by cold isostatic pressing or slip casting of preforms, then subsequent green machining by turning, milling, drilling cutting with conventional and CNC- equipment before firing.

FCT Ingenieurkeramik offers the economic production of components with large dimensions, high complexity and narrow tolerances as prototype and in series. Diameters up to 450 mm and lengths up to 1300 mm were already produced and are state of the art.

We help you with materials selection, design and implementation into a metallic, refractory or plastic aggregate.

We produce components corresponding to customers design from different gas pressure sintered and hot pressed silicon nitride, nitride bonded silicon carbide and sintered, recrystallized and C-fiber-reinforced silicon carbide composites.

For very specific applications we even develop tailor made materials according to your requirements.

### Services

Additionally we offer services in sintering, hot pressing, cold isostatic pressing and ceramic processing.

**Ask your questions about ceramics – we find solutions for you!**