nanoker ADVANCED CERAMICS

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"MAKING THE SMALL PROFITABLE"

TECHNICAL CERAMICS BEYOND THE STANDARD

Nanoker Research specializes in manufacturing technical ceramic components, from custom powder mixtures to the final product.

Nanoker handles every stage of ceramics production, including material selection, processing, sintering, and finishing.

22 People

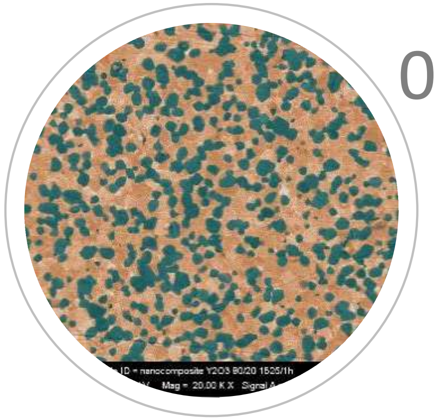
- 30% of our workforce are experts dedicated to innovating new materials and products

6 patents under exploitation

- The patents, owned exclusively by CINN-CSIC, are licensed to Nanoker and encompass innovations in new nanomaterials, nanocomposites, electroconductive ceramics, ultrahard ceramics, and high-thermal conductivity composites

BUSINESS MODEL

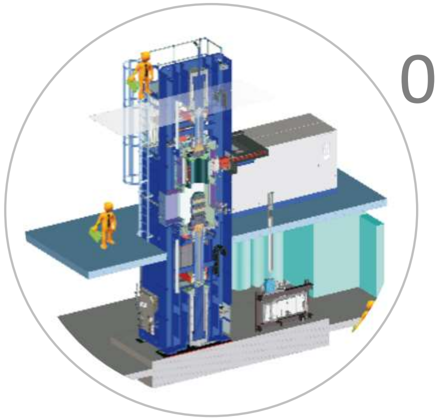
We specialize in the manufacture of high-value premium components. Our three key competitive edges are:



01

Innovation in the design of proprietary materials

Expertise in the synthesis of ceramic materials and blends.
Protection of our technology with six active patents.



02

Leveraging cutting-edge production technologies for optimal results

Adoption of advanced and digital fabrication methods such as spark plasma sintering, pressure casting, and precision green machining..

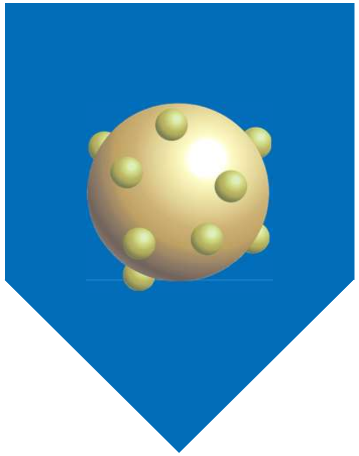
03

Expertise in precise, cost-effective manufacturing

Precision machining of pre-sintered green bodies.
Efficient production of intricate designs.

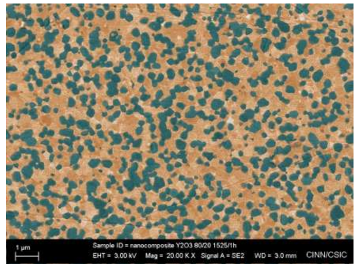
NANOKER PROPRIETARY MATERIALS

Oxides and metal-ceramic nanocomposite powders production Line



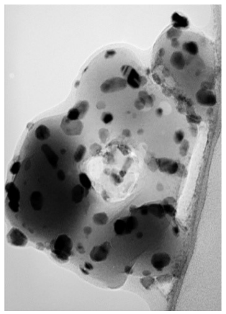
Multifunctional Powders

Functional nanocomposite and glass-ceramic powders.

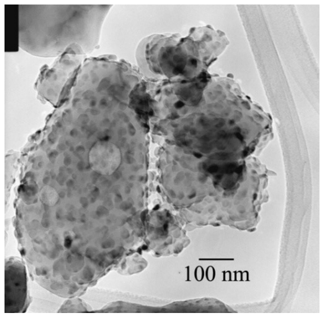


From commercial Powders & Precursors
To
Nanostructured Raw Materials & Nanocomposites

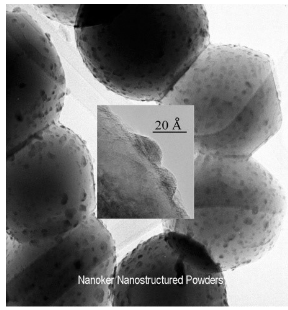
Ni-based



W-based



CeO2 ZrO2-based



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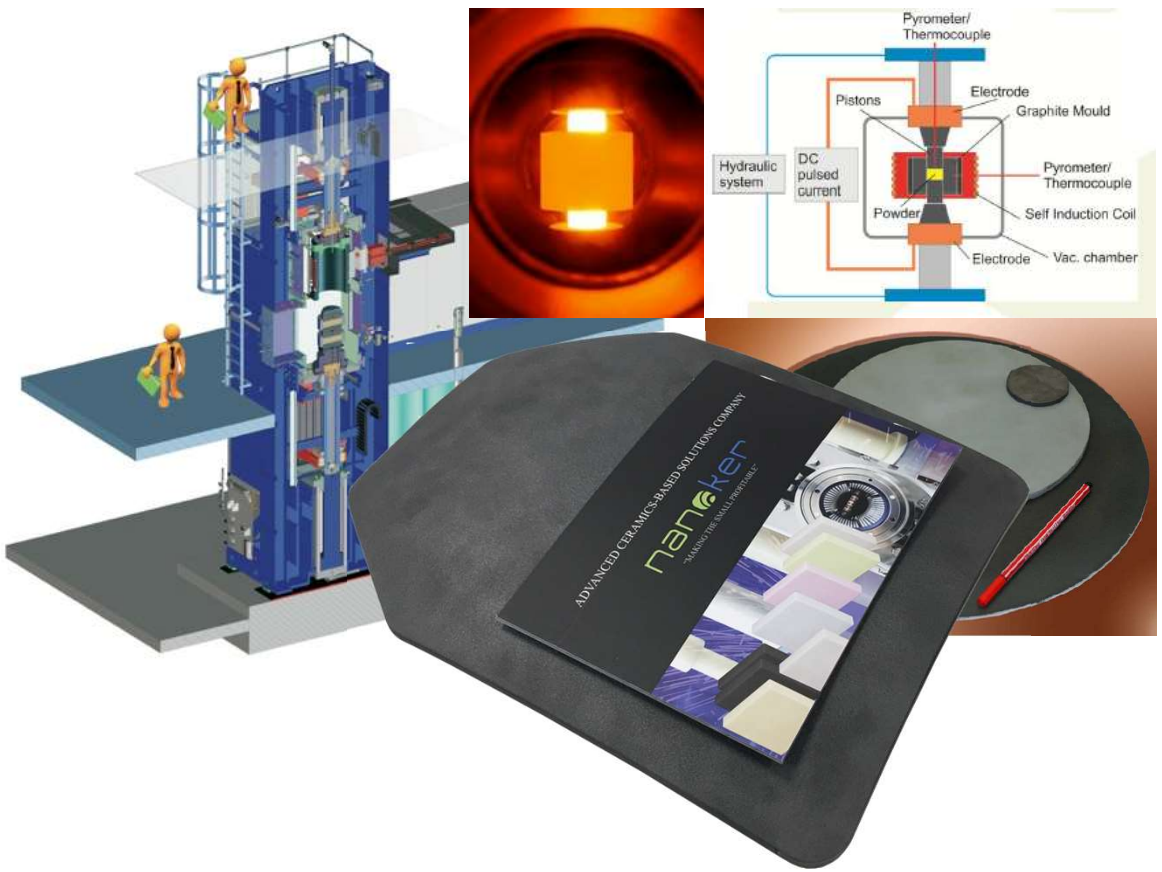
NANOKER ADVANCED PRODUCTION TECHNOLOGIES



Spark Plasma Sintering

The most advanced production technology for ceramic, metal, composites and advanced nanomaterials and nanocomposites

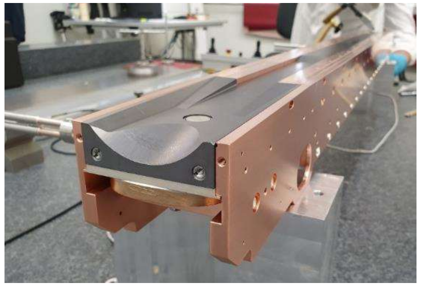
Alumina-TiC-SiCw, Zirconia TZP-TiN
Electroconductive tough ceramics

Alumina-SiCw, B_4C, SIC
Low density, high hardness

Graphite-Mo, Cu-Diamond, KALMAN, KBNC
Heat Sink composites

Alumina-LAS, LAS-SiC, LAS-SiC-CNF
Very low or tailored CTE

NANOKER ADVANCED PRODUCTION TECHNOLOGIES



CERN

iter
china eu india japan korea russia usa

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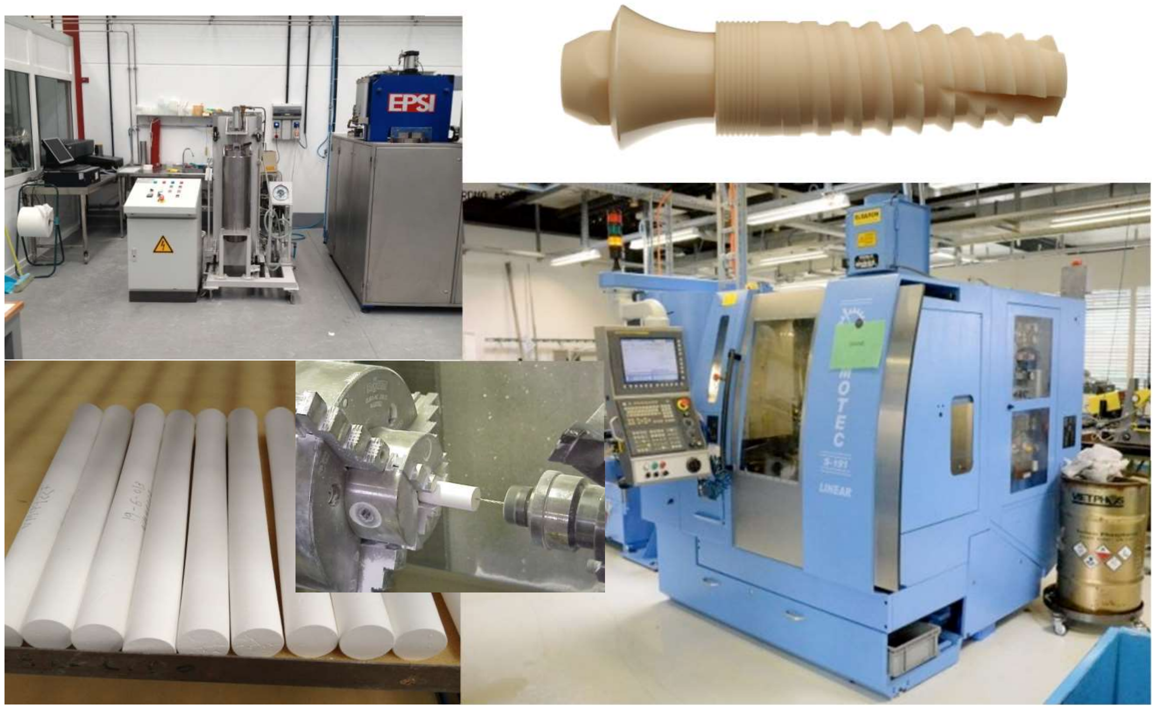
ADVANCED CERAMICS

NANOKER UNIQUE KNOW-HOW IN DIRECT MANUFACTURING



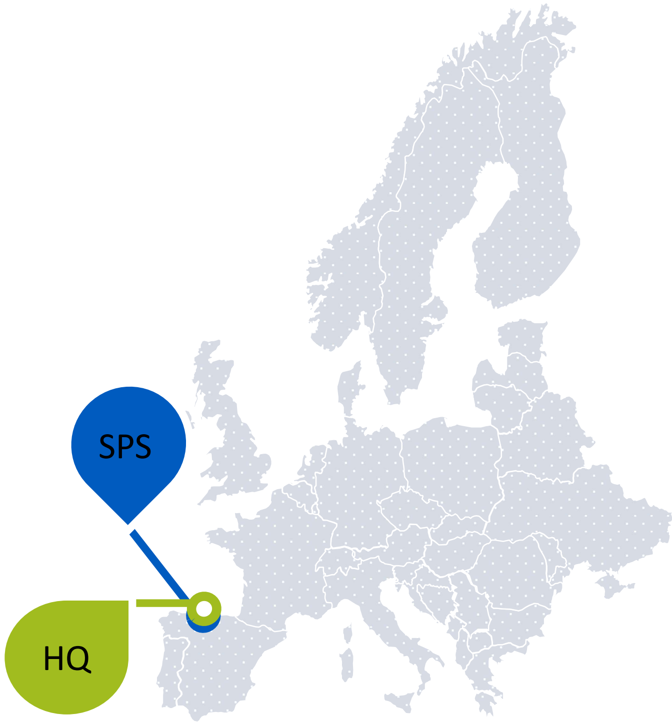
CAD-CAM from green bodies

4 axis NC of cold isostatic pressed bars

CAD-CAM NC of complex shaped parts

Complex structures can be produced by machining cold isostatic pressed bars and subsequently sintered at high temperatures

PRODUCTION FACILITIES

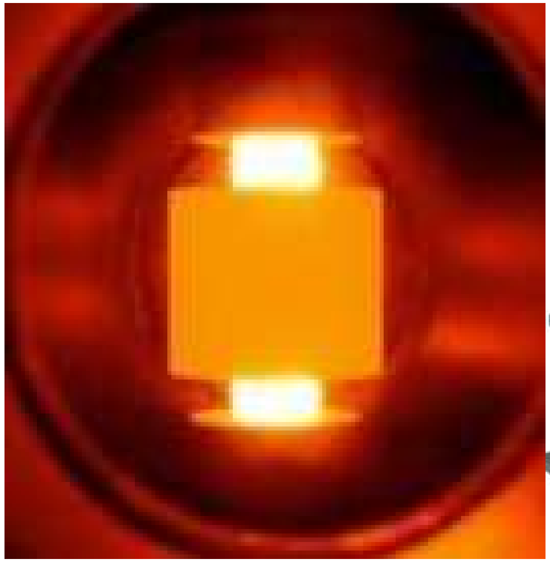


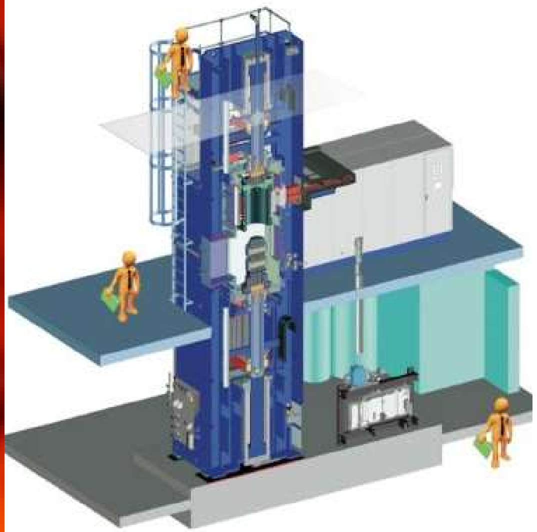
Headquarters
Olloniego, Asturias, Spain
1500 m²
Industrial and bioceramics

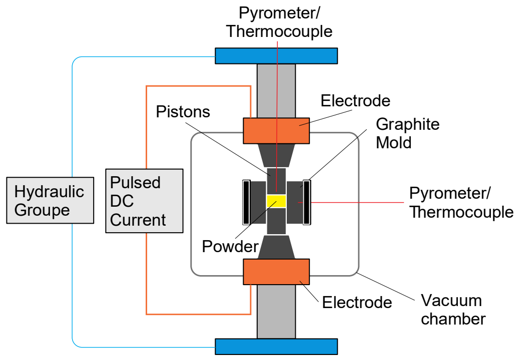
SPS / R&D materials
Sotrondio, Asturias, Spain
1200 m²
Spark Plasma Sintering
Big science

ABOUT INDUSTRY MEDICAL DEVICES BIG SCIENCE USM SEMICONDUCTORS

BIG SCIENCE ➡ SPECIAL MATERIALS ➡ SPARK PLASMA SINTERING







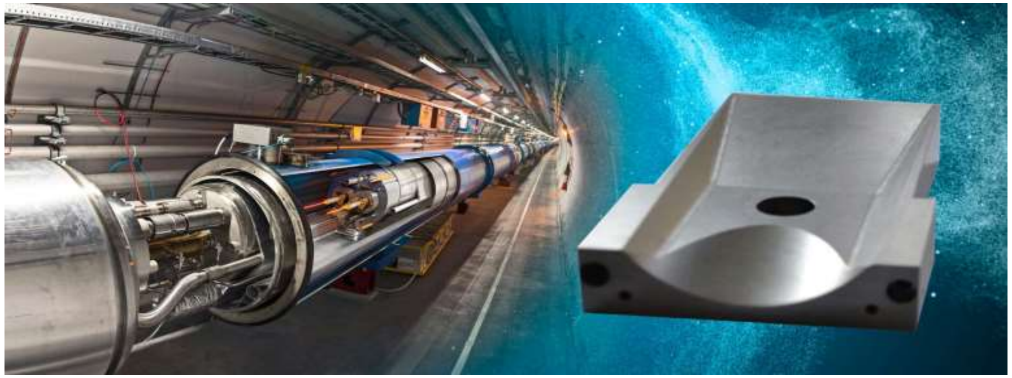
Hybrid HP-SPS sintering, FAST

Thermal management

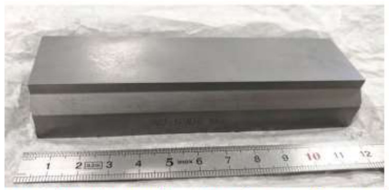
Boron nitride composites

UHTCMC´s (Ultra-high Tª ceramics)

THERMAL MANAGEMENT



Primary collimator. Picture courtesy of CERN



Block for collimator (position tolerance of 5 micron)

Physical properties		
Parameters	Units	X,Y | Z [*1]
Density	g/cm^3	2.57
Flexural Strength	MPa	102.1 | 16.9
Flexural Strain to rupture	µm/m	2580 | 5900
Young Modulus	GPa	69.7 | 5.5
Thermal conductivity (@20ºC/300ºC)	W/m·k	650/310 | 45/23
Thermal Diffusivity (@20ºC/300ºC)	mm^2/s	390/110 | 27/8
CTE average (20-1000ºC)	$10^{-6}K^{-1}$	6.5
CTE [*2] (20-1000ºC)	$10^{-6}K^{-1}$	2.4 | 14.7
Specific heat	J/g·K	0.65
Electrical conductivity	MS/m	0.8
Dimensional stability	%	0 | 0.1

All properties measured at 20ºC unless otherwise stated

[*1] XY - Parallel to the grain direction; Z - Perpendicular to the grain direction

[*2] CTE adjustability according to chemical composition

KTM-650 GRAPHITE-METAL CARBIDE COMPOSITES

Electrically conductive

- TC (in plane) – 650 W/M K
- Anisotropic. Homologated by CERN for primary collimators, specially approved for outgassing conditions.

Other applications

Heat sinks for electronics

Thermal dissipation with a CTE-matched with Si, SiC, GaN, and low density.

Rocket Nozzles

Outperforming the results of conventional graphitic material

KALMAN (MACHINABLE AlN)

KALMAN

Machinable Aluminum Nitride

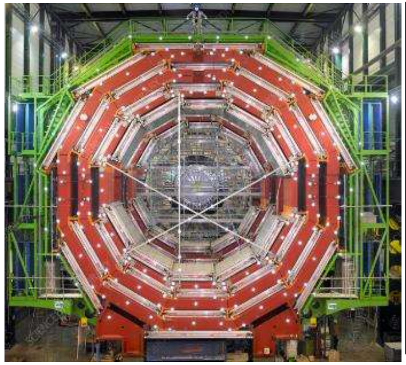
Physical properties		
Parameters	Units	Value
Density	g/cm³	2.94
Flexural Strength	MPa	261
Compressive strength	MPa	737
Hardness	HB 2.5/62.5	285
Porosity	%	0
Thermal Expansion Coefficient (@20-400ºC)	10^{-6}·K^{-1}	5.2
Thermal Conductivity (@100ºC)	W/m·K	99.2
Volume Resistivity (@25ºC, DC)	Ω·cm	$5·10^{11}$
Dielectric Strength** (50 Hz, AC)	kV/mm	26.7

* All properties measured at 20ºC unless otherwise stated
** Measured in a wall thickness of 2 mm

F4E-OPE-1150; "Final Design and Supply Of In-Divertor Electrical Services (IDES) and Supply of In-Vessel Supports (IVS) for Mineral Insulated (MI) Cabling for ITER Diagnostics Systems"

- Electrical insulator
- TC – 100 W/m·K
- Machinable with WC tools
- Isotropic
- Homologated by ITER

PURE AlN FRAMES CMS DETECTOR - CERN



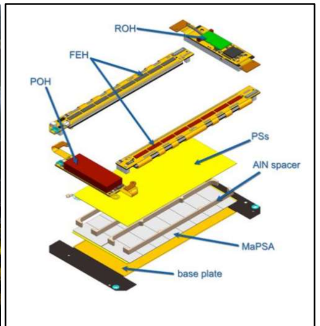


Fig. 1: Exploded view of a PS module.

IT 4671: "Supply of spacers and stiffeners of AlN machined by micro-water jet cutting"

Material: Pure AlN. Scope: 61.000 pieces

- High electrical insulation
- CTE – 5 ppm/ºC (matching Si)
- 180 W/m·K
- High rigidity

BORON NITRIDE COMPOSITES

Picture courtesy of Nasa. HERMeS: NASA's SPT Thruster. Inner and outer wall of BN composite.

Physical properties		
Parameters	Units	Value
Density	g/cm^3	2.90
Strength (3 point bending)	MPa	160
Hardness Knoop	Kg/mm^2	85
Thermal conductivity (in-plane XY)	W/m·k	50
Thermal conductivity (out-plane Z)	W/m·k	10
Thermal Expansion Coefficient (XY)	$10^{-6}K^{-1}$	4.0
Maximum use temperature (Oxidizing/Inert)	ºC	800/1500

*All properties measured at 20ºC unless otherwise stated

Blanks and properties of boron-nitride composites obtained by Nanoker.

High Temperature Refractory BN Composites

A top-end boron nitride composite with extreme resistance to thermal shock up to 1500ºC under inert or vacuum environments. High refractoriness thanks to the formulation of specific compositions.

Dielectric wall of Hall-effect Thruster
An ideal material for critical parts of the thruster in electrical propulsion systems

Components for non-metal ferrous industries

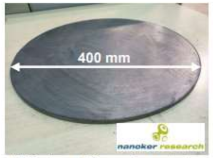
ABOUT INDUSTRY MEDICAL DEVICES BIG SCIENCE USM SEMICONDUCTORS

ZrB2-SiC-Cf ULTRA HIGH TEMPERATURE CERAMIC COMPOSITES (UHTCMC)

C3HARME, Next generation Ceramic Composites for Combustion HARsh environMEnts and space

- Thermal Shock Resistant
- Ablation Resistant
- High Temperature Resistance (>2000ºC)

Property	Value	Comment
Vol % of fibers	up to 50%	Conventional ceramic processing enables to incorporate high amount of short fibers
Density (kg/m³)	3.9 - 4.2	Variation of porosity and fiber volume fraction impact on the final density
Fracture toughness (RT)	4 - 5	The presence of the fibers improves the damage tolerance of the UHTC matrix
CTE (10^{-6} K^{-1}) (20-1500 °C)	4.7 – 5.5	CTE is reduced as compared to the UHTC matrix
Thermal conductivity (W/m K), 20-1500°C	50-33	Efficient heat dissipation is guaranteed by high thermal conductivity up to high temperatures
Thermal diffusivity (mm²/s) (20-1950°C)	22-7	Measured close to 2000°C. Material is completely stable up to this temperature
Bending strength (MPa)	130-140	This value depends on fiber amount and length.



UHTC piece (40 cm diameter). Piece fabricated at NANOKER

Subscale nozzles machined after sintering. Both EDM and conventional machining are possible.

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