

# 3DCERAM

3DMIX, ceramics for 3D printing

Technical datasheets



The leading Ceramics Additive Manufacturer

27 rue du Petit Theil - 87280 LIMOGES

Tél. +33 (0) 5 55 04 10 90 - [info@3dceram.com](mailto:info@3dceram.com)

# Alumina toughened Zirconia (ATZ)

## ✔ Properties

The ceramic ATZ combines both Alumina (20%) and Zirconia (80%) ceramics in one. The mix of these two combined offers several properties :

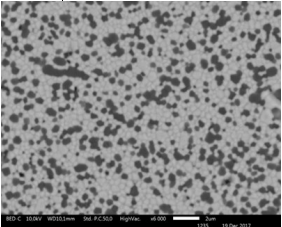
- ✔ Great hardness and tenacity
- ✔ Biocompatibility
- ✔ Resistance to wear and thermal shock

## ✔ Applications

- ✔ Implants
- ✔ Teeth
- ✔ Wear resistant parts



# Alumina toughened Zirconia (ATZ)

		Values
<b>Microstructure</b>		
Densification rate	%	>99
Density	g/cm <sup>3</sup>	>5,2
Size of grains after sintering	μm	<0,5
SEM picture		
<b>Mechanical properties at ambient temperature</b>		
Flexural strength	MPa	1094
Weibull modulus		5,8
Theoretical Young modulus	GPa	220
<b>Thermal properties from -50°C to 60°C</b>		
Thermal conductivity at ambient T	W/m/K	5,4
Thermal expansion coefficient (10 <sup>-6</sup> )	at -50°C	7,50
	at 20°C	7,94
	at 60°C	8,33

Non contractual data for reference only - V19102018

# Cordierite

## ✔ Properties

The cordierite is a magnesium alumina silicate material and has different properties :

- ✔ Low CTE
- ✔ Low thermal conductivity
- ✔ Wear resistant
- ✔ Good for vacuum application

## ✔ Applications

- ✔ Optical parts for aerospace
- ✔ Metrology



# Cordierite

Values

## Microstructure

Densification rate

%

>98

Density

g/cm<sup>3</sup>

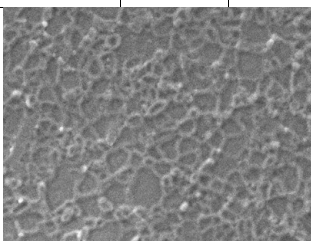
>2,5

Size of grains after sintering

μm

0,89

SEM picture



## Mechanical properties at ambient temperature

Flexural strength

MPa

150

Weibull modulus

6,5

Theoretical Young modulus

GPa

140

## Thermal properties from -50°C to 60°C

Thermal conductivity at ambient temperature

W/m/K

3,8

Thermal expansion coefficient (10<sup>-6</sup>)

at -50°C

-0,87

at 20°C

K<sup>-1</sup>

-0,10

at 60°C

0,22

Non contractual data for reference only - V19102018

# Zr8Y

For non medical use

## ✔ Properties

✔ Ionic conductivity

## ✔ Applications

✔ Fuel cell

Values

### Microstructure

Densification rate

%

>99

Density

g/cm<sup>3</sup>

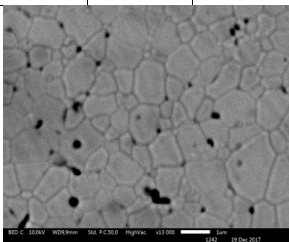
5,79

Size of grains after sintering

μm

0,73

SEM picture



### Analysis

Ionic conductivity

$\sigma.T = 17S.cm^{-1}.K$   
(T = 800°C)

$\sigma.T = 3S.cm^{-1}.K$   
(T = 600°C)

Non contractual data for reference only - V19102018

# TCP

## Tricalcium phosphate

### ✔ Properties

- ✔ Biocompatible
- ✔ Bioresorbable

### ✔ Applications

- ✔ Implants

Values

### Microstructure

*Density can be adjusted according to customer's needs*

Densification rate

%

80,7

Density

g/cm<sup>3</sup>

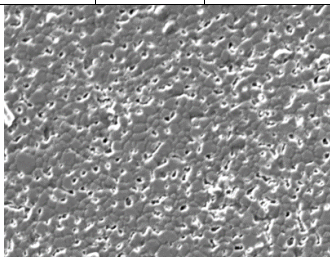
2,47

Grain size after sintering

μm

2,8

SEM picture



SED 10.0kV WD10.0mm High P.C.50.0 HighVac. x1 300 10um 06 Apr 2018

### Analysis

- presence of hydroxyapatite measured by X ray diffraction between 0% and 5%
- no calcium pyrophosphate seen by infra-red analysis
- Ca/P ratio = 1,503

Non contractual data for reference only - V19102018

# FUSED SILICA

## ✔ Properties

✔ Good leachability

## ✔ Applications

✔ Foundry cores

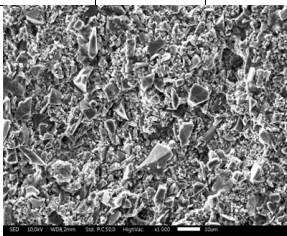
Values

### Microstructure

*Porosity can be adjusted according to customer's needs*

Densification rate	%	60
Density	g/cm <sup>3</sup>	1,36

SEM picture



### Mechanical properties at ambient temperature

Flexural strength	MPa	16,7
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### Analysis

% cristobalite (mass)	%	2
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Roughness (Ra)	µm	1,28
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Shrinkage	Dilatation TR -1150°C	%	0,07
	before stage		-4,61
	At stage		-0,11

Non contractual data for reference only - V19102018



# ZIRCONIA

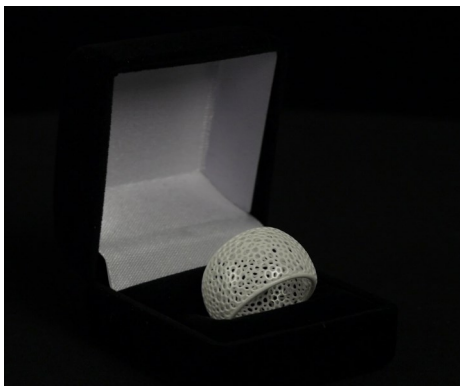
For non medical use

## ✔ Properties

- ✔ Excellent mechanical properties
- ✔ Chemical inertness
- ✔ High hardness

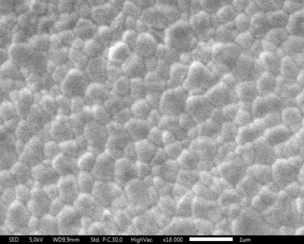
## ✔ Applications

- ✔ Jewelry
- ✔ Watches
- ✔ Biomedical devices
- ✔ Biomedical implants
- ✔ Electronic equipment



# ZIRCONIA

For non medical use

		Values
<b>Microstructure</b>		
Densification rate	%	>99,5
Density	g/cm <sup>3</sup>	>5,95
Grains' size after sintering	μm	<0,5
SEM picture		
<b>Mechanical properties at ambient temperature</b>		
Flexural strength	MPa	950
Weibull modulus		9
Therical Young modulus	GPa	200
Vickers hardness	GPa	12,6
Shear modulus	GPa	79,8
Compressive strength	Mpa	2070
<b>Thermal properties from -50°C to 60°C</b>		
Thermal conductivity at ambient T	W/m/K	3,3
Thermal expansion coefficient (10 <sup>-6</sup> )	at -50°C	8,59
	at 20°C	9,10
	at 60°C	9,34
Non contractual data for reference only - V19102018		

# HAP

## Hydroxyapatite

### ✔ Properties

- ✔ Biocompatibility
- ✔ Excellent bioactivity
- ✔ Good osseointegration

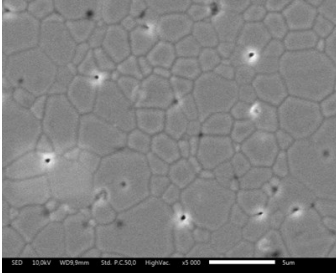
### ✔ Applications

- ✔ Tibial osteotomy wedges
- ✔ Interveterebral cages
- ✔ Cranial implants
- ✔ Bone substitute
- ✔ Spine implants
- ✔ Orthopedic implants



# HAP

## Hydroxyapatite

		Values
<b>Microstructure</b>		
Densification rate	%	>96
Density	g/cm <sup>3</sup>	1,5
Grains' size after sintering	μm	2
SEM picture		
<b>Mechanical properties at ambient temperature</b>		
Flexural strength	MPa	107
<b>Analysis</b>		
Ca/P ratio		1,65 to 1,82
Foreign phases (CaO, TCP, alpha, TCP beta, TTCP)	%	≤5
Cristallinity	%	>95
Heavy metals	ppm	<30
Non contractual data for reference only - V19102018		

# ALUMINA

## ✔ Properties

- ✔ Good mechanical strength
- ✔ Good thermal conductivity
- ✔ High electrical resistivity
- ✔ High hardness
- ✔ Good wear resistant
- ✔ Chemically inert

## ✔ Applications

- ✔ Electrical insulators
- ✔ Laboratory devices
- ✔ Telecommunication equipment
- ✔ Electronical devices
- ✔ Spatial
- ✔ Foundry cores
- ✔ Optical instruments



# ALUMINA

Values

## Microstructure

Density

g/cm<sup>3</sup>

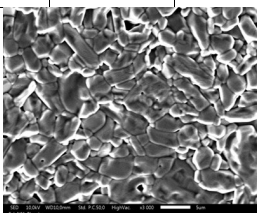
>3,9

Grains' size after sintering

μm

2,2

SEM picture



## Mechanical properties at ambient temperature

Flexural strength

MPa

397

Weibull modulus

14,9

Theoretical Young modulus

GPa

300

Vickers hardness

GPa

16,4

Fracture toughness

MPa.m<sup>1/2</sup>

4

## Thermal properties from -50°C to 60°C

Thermal conductivity at ambient T

W/m/K

23,3

Thermal expansion coefficient (10<sup>-6</sup>)

at -50°C

3,74

at 20°C

K<sup>-1</sup>

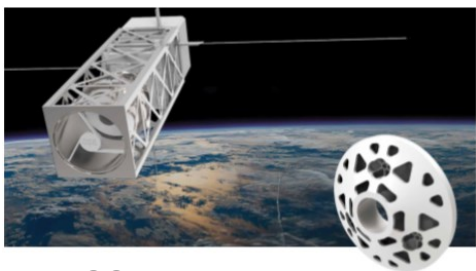
4,98

at 60°C

5,51

Non contractual data for reference only - V19102018

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