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LITHOZ®

Manufacture the future.

– OPEN SYSTEM FOR ALL MATERIALS –

LCM TECHNOLOGY MATERIAL OVERVIEW

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LITHOZ®

AVAILABLE MATERIALS FOR THE LCM TECHNOLOGY

Lithoz offers its customers various materials for the additive manufacturing of high-performance and bioresorbable ceramics. Each raw material has been developed to perfectly suit Lithoz's technology and to facilitate the production of high-quality parts. Learn more about our standard materials on the following pages:

- Alumina
- Zirconia
- Silicon nitride
- Tricalcium phosphate
- Silica-based material
- Hydroxyapatite

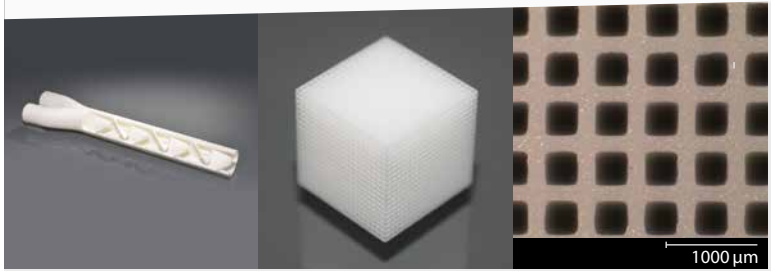
TAKE ADVANTAGE OF OUR OPEN SYSTEM

With the LCM technology, Lithoz has created an open system through which many different ceramic materials can be handled. This provides the opportunity to process customer-specific powders without the need for any system modification, meaning that our LCM technology is suited for processing sinterable powders. In the past few years, we have successfully processed the following materials (amongst others) using the LCM technology:

- Alumina toughened zirconia
- Zirconia toughened alumina
- Cermets
- Cordierite
- Magnesia
- Porcelain
- Glass-ceramics
- Transparent ceramics
- Bioglass
- Piezoceramics

LITHOZ | **LithaLox**
HP 500 and 350

TECHNICAL DATA



Alumina (Al_2O_3) is one of the most important oxide ceramic materials and is characterized by high levels of hardness as well as good corrosion and temperature resistance. Components made from alumina are electrically insulating and puncture-proof and are therefore suitable for a wide range of applications, such as substrates in the electronics industry, thread guides in textile engineering, protection in thermal processes and many others.

LithaLox HP 500 is a high-purity aluminum oxide (99.99 %) with outstanding material properties. It is characterized by a high density (99.4 % relative density), a high fourpoint bending strength (430 MPa) and a very smooth surface ($R_a \approx 0.4$ µm).
LithaLox 350 is a high-purity aluminum oxide (99.8 %) with outstanding material properties which has been developed to manufacture highly complex components with small channels and holes.
Both materials can be used not only for industrial applications but also in medical engineering for permanent implants or devices due to high biocompatibility.

POWDER	HP 500	350
Purity [%]	99.99	99.8
SLURRY		
Solids loading [vol%]	49	
Dynamic viscosity[1] [Pa·s]	12	8.5
SINTERED CERAMIC		
Theoretical density [g/cm³]	3.985	
Relative density [%]	99.4	98.4
Porosity [%]	0.6	1.6
Four-point bending strength [MPa]	430	
Three-point bending strength [MPa][2]		395
Surface roughness R_a [µm]	0.4	0.9
Relative permittivity	9.8 - 10.0	9.0 - 9.8
Dielectric loss tanδ	1×10^{-6}	
TYPICAL PROPERTIES[3]		
Elastic modulus [GPa]	300	
Compressive strength [MPa]	2000 - 2600	
Poisson's ratio	0.27	
Fracture toughness [MPa·m$^{1/2}$]	4 - 5	
Hardness HV10	1450	
Max. working temperature [°C]	1650	
Coefficient of thermal expansion [ppm/K]	7 - 8	
Thermal conductivity [W/(m·K)]	37	
Specific electrical resistivity [Ω·cm]	$\approx 10^{14}$	

[1] Value was determined at a constant shear-rate of 50 s^{-1} at 20 °C.
[2] As fired.
[3] Typical values for this type of ceramic. These values have not been determined for LithaLox 350.

LITHOZ | **LithaCon**
3Y 210 and 3Y 230

TECHNICAL DATA

Zirconia is used for applications with extreme demands on the material. High-end metal forming, valves, bearings and cutting tools are some of the applications which benefit from the mechanical properties of zirconia. The biocompatibility of zirconia facilitates its use in medical applications, such as dental applications and as part of permanent implants.

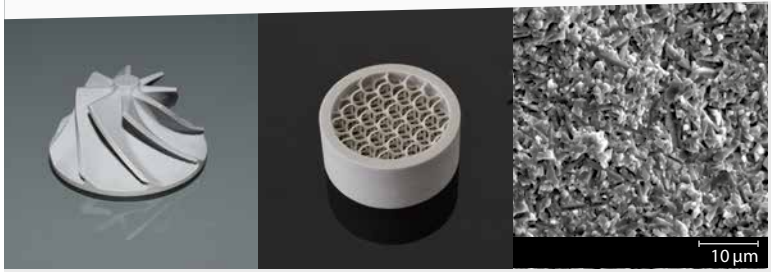
LithaCon 3Y is a 3 mol% yttria stabilized zirconia. Some of the mechanical highlights of this material include its excellent flexural strength, fracture toughness, resistance to abrasion and thermal shock resistance. These properties, in combination with its chemical resistance even at elevated temperatures, make zirconia the perfect material for structural elements. LithaCon 3Y suspensions have a low viscosity which makes them easy both to process in the CeraFab printers and also to clean. LithaCon 3Y 210 was tailored for the manufacture of delicate and complex parts. LithaCon 3Y 230 was tailored for the manufacture of bulky parts and also decreased shrinkage during sintering.

SLURRY	3Y 210	3Y 230
Solids loading [vol%]	39	45
Dynamic viscosity[1] [Pa·s]	15	21
SINTERED CERAMIC		
Theoretical density [g/cm^3]	6.088	
Relative density [%]	99.4	
Porosity [%]	0.6	
Four-point bending strength [MPa]	930	890
TYPICAL PROPERTIES[2]		
Elastic modulus [GPa]	205	
Compressive strength [MPa]	2300	
Poisson's ratio	0.3	
Fracture toughness [MPa·m1/2]	10	
Hardness HV10	1500	
Max. working temperature [°C]	1500	
Coefficient of thermal expansion [ppm/K]	10	
Thermal conductivity [W/(m·K)]	2.5 - 3.0	
Specific electrical resistivity [Ω·cm]	> 1010	
Relative permittivity	29	
Dielectric loss tanδ	0.001	

[1] *Value was determined at a constant shear-rate of 50 s^{-1} at 20 °C.*
[2] *Typical values for this type of ceramic. These have not been determined for LithaCon 3Y 210 and 3Y 230.*

LITHOZ | LithaNit 720

TECHNICAL DATA



Silicon nitride is a beta-SiAlON type ceramic. It exhibits superior material properties such as high strength, high toughness, thermal shock resistance and good chemical resistance to corrosion from many acids and alkalis.

LithaNit 720 has a wide range of applications including insulators, springs, impellers and more. Furthermore, it can be used for the medical engineering of permanent implants due to its osseo-integrative potential and anti-infective properties. Additionally, LithaNit 720 parts can be used at temperatures up to 1200 °C.

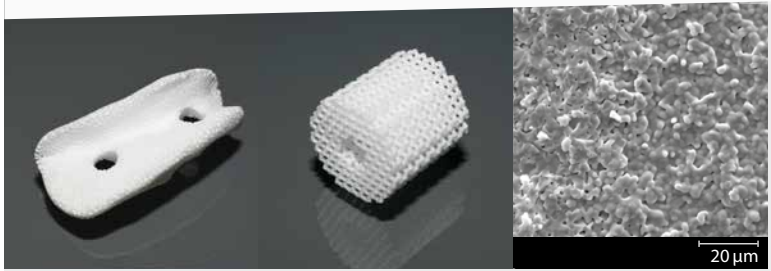
SLURRY	
Solids loading [vol%]	40
Dynamic viscosity[1] [Pa·s]	5
SINTERED CERAMIC	
Theoretical density [g/cm³]	3.23
Relative density [%]	99.8
Porosity [%]	0.2
Four-point bending strength [MPa]	760
Hardness HV10	1500
Surface roughness R_a [µm]	0.6
Cytotoxicity	Not cytotoxic according to ISO 10993-5
Skin irritability	No skin irritation according to ISO 10993-10
TYPICAL PROPERTIES[2]	
Elastic modulus [GPa]	290 - 300
Compressive strength [MPa]	> 3500
Poisson's ratio	0.23
Fracture toughness [MPa·m$^{1/2}$]	7.1
Max. working temperature [°C]	1200
Coefficient of thermal expansion [ppm/K]	3
Thermal conductivity [W/(m·K)]	28
Specific electrical resistivity [Ω·cm]	10^{10}
Relative permittivity	8.1
Dielectric loss tanδ	0.0019

[1] Value was determined at a constant shear-rate of 50 s^{-1} at 20 °C.

[2] Typical values for this type of ceramic. These have not been determined for LithaNit 720.

LITHOZ | **LithaBone TCP 300**

TECHNICAL DATA



Tricalcium phosphate (TCP) exhibits excellent biocompatibility, bioresorbability and osteoconductivity, and is therefore a well-established material for bone replacement in regenerative medicine. Due to its properties, it is possible to manufacture patient-specific resorbable implants with defined pore structures and geometries using this material. During the healing phase, these implants will be resorbed by the body and replaced by native bone tissue, meaning that a second surgery for the removal of the implant is not necessary.

The material LithaBone TCP 300 is based on the ceramic beta-tricalcium phosphate (β-TCP) and, under certain sintering conditions, a density of up to 98 % can be achieved.

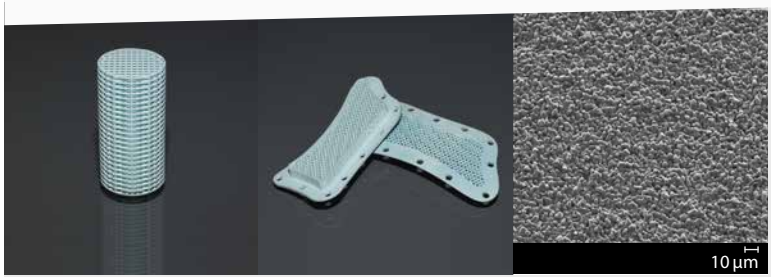
Lithoz aims to support the validation process of your medical product in the best way, and therefore only ASTM F1088 - 04a certified (suitable for human implants) TCP powder is used in LithaBone TCP 300. Sintered parts made from LithaBone TCP 300 are proven not to be cytotoxic according to the ISO 10993 - 5:2009 standard.

POWDER	
Complies with the specification for β-tricalcium phosphate as implant material (ASTM F1088 - 04a)	yes
Purity [%]	≥ 95
Heavy metal content [ppm]	max 50
SLURRY	
Solids loading [vol%]	47
Dynamic viscosity[1] [Pa·s]	< 12
SINTERED CERAMIC	
Theoretical density [g/cm³]	3.065
Relative density [%]	98.0
Porosity [%]	2.0
Cytotoxicity	Not cytotoxic according to ISO 10993 - 5
Skin irritability	No skin irritation according to ISO 10993 -10

[1] *Value was determined at a constant shear-rate of 50 s^{-1} at 20 °C.*

LITHOZ | **LithaBone**
HA 400

TECHNICAL DATA



POWDER	
Purity [%]	≥ 95
Heavy metal content [ppm]	max 50
Complies with the specification for hydroxyapatite as implant material (ASTM F1085 - 03)	yes
SLURRY	
Solids loading [vol%]	46
Dynamic viscosity[1] [Pa · s]	6.0 - 12.0
SINTERED CERAMIC	
Theoretical density [g/cm³]	3.16
Relative density [%]	85.0
Porosity [%]	15.0
Cytotoxicity	Not cytotoxic according to ISO 10993 - 5

[1] *Value was determined at a constant shear-rate of 50 s^{-1} at 20 °C.*

Hydroxyapatite (HA) is a naturally occurring mineral that forms the main component of bones. Due to its similarities to the inorganic components of bone, HA possesses excellent biocompatibility and osteoconductivity and has a number of potential applications as a bone substitute. In comparison to tricalcium phosphate, hydroxyapatite takes far more time to be absorbed into the body, therefore giving the body more time to heal. Using HA, we can manufacture patient-specific, bioresorbable implants, which have defined pore structures and geometries. These implants will be reabsorbed by the body and will be replaced by native bone tissue, meaning that the implant does not need to be removed once the healing process is finished.

LithaBone HA 400 is a ceramic which is based upon hydroxyapatite.
Due to its relative density of 85% and a corresponding porosity of 15%, LithaBone HA 400 is especially suitable for bioresorbable applications.

In order to best support you throughout the validation process of your medical device, LithaBone HA 400 exclusively uses HA powder certified according to ASTM standard F1085- 03 (which is suitable for implants in human use). Sintered parts made of LithaBone HA 400 are not cytotoxic according to ISO 10993-5:2009 standard.

LITHOZ | LithaCore 450

TECHNICAL DATA

LithaCore 450 is mainly based on silica with addition of alumina and zircon. It is used for the production of casting cores for investment casting. Typical applications include single crystal casting of turbine blades.

LithaCore 450 is developed for the additive manufacturing of precise ceramic cores with fine details and high accuracy.

Sintered ceramic cores made from LithaCore 450 have very low thermal dilatation up to 1500 °C, a high porosity, outstanding surface quality and a very good leachability.

SLURRY	
Solids loading [vol%]	63
Dynamic viscosity[1] [Pa·s]	45
SINTERED CERAMIC	
Theoretical density [g/cm^3]	2.44
Relative density [%]	72.0
Porosity [%]	28.0
Three-point bending strength [MPa]	10
Three-point bending strength (impregnated) [MPa]	18
Surface roughness R_a [µm]	<3
Max. grain size sintered [µm]	100
Cristobalite content [wt%]	20 - 40
Leachability	very good
Max. working temperature [°C]	1575
Dilatation @ 1000°C [%]	< 0.2
Dilatation @ 1500°C [%]	< 0.5

[1] *Value was determined at a constant shear-rate of 50 s^{-1} at 20 °C.*

FEASIBILITY STUDIES FOR CUSTOMER-SPECIFIC MATERIAL DEVELOPMENTS

Can't find the material you want?

Then use our customer-specific material development service!

Lithoz offers a customer-specific material development service! If you would like to find out more about our customer-specific material development service and feasibility studies, write a short email to **Mr. Peter Schneider** at **pschneider@lithoz.com** or call **+43 1 9346612 - 206** who will be happy to assist you.

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