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3D Printing for High Performance Cermics

Individual items, small series and prototypes – even sophisticated geometries in 'injection moulding quality'

In contrast to plastics and metals, ceramics have been regarded as unsuitable for 3D printing processes for a long time. Since ceramics are used where other materials fail, the quality of the produced components (density, strength and precision) are particularly important. Previous attempts to produce high performance ceramics by additive production failed mainly regarding the mechanical characteristics, such as impact strength and flexural strength.

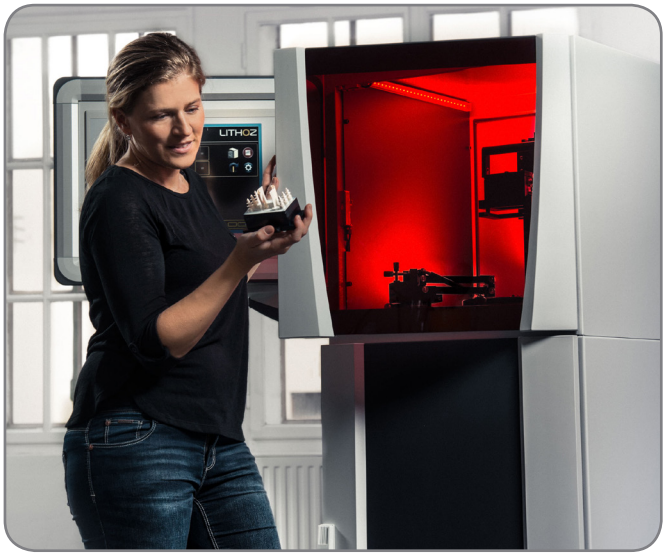
Objective

Lithoz GmbH, a TU Wien spin-off, was founded to make the results of many years of research into generative production of ceramics accessible to a wide range of users. The system offered by Lithoz was to be the first to render the tool-free production of high performance ceramics components possible at the highest level. In particular regarding density, strength and precision the components had to satisfy the exacting requirements of the ceramics industry and research laboratories.

Approach

The technology of *Lithography based Ceramic Manufacturing* (LCM) developed by TU Wien and Lithoz is based on the selective mask exposure of a photosensitive resin which contains homogeneously dispersed ceramic particles. Due to the exposure to LED light the resin is cured and forms the green body – a composite of ceramic powder and the organic polymer matrix. The photopolymers constitute the backbone of the component and act as a binder between the ceramic particles. During debinding, the photopolymers are removed by pyrolysis and the ceramic particles are then sintered into a compact part. These two process steps are also used in conventional ceramic moulding. In the processing of ceramic materials, the optimisation of debinding and sintering profiles, exposure strategy, cleaning steps and process parameters are crucial.

By increasing the degree of powder filling and optimising the slurry, the sintering shrinkage and debinding time can be considerably improved. TU Wien and Lithoz GmbH filed for several patents for this method.



User friendly CeraFab 7500 3D printers for high performance ceramics

Results

The CeraFab 7500 3D printer is a reliable, user friendly plug & play network printer that can be used to process aluminium oxide, zirconium oxide, tricalcium phosphate and many other materials.

The CeraFab 7500 is designed to allow layers of the thickness between 25 µm and 100 µm, depending on the requirements. With CeraFab 7500 very fine layers of up to 25 µm can also be manufactured in very high quality. In addition, very good repeatability of the layer thickness (± 1 µm) is ensured. Due to mask exposure, the construction speed is independent of the cross section to be exposed and therefore also independent of the number of components.

Furthermore, the CeraFab 7500 can be used to produce individual bone transplants with cell structures of controlled porosity and defined channels of c. 200 µm in one piece (scaffold). The biaxial strength of ceramic components is the same as that of conventionally produced components (500 MPa). With Al_2O_3 a density of >99.4% can be achieved.

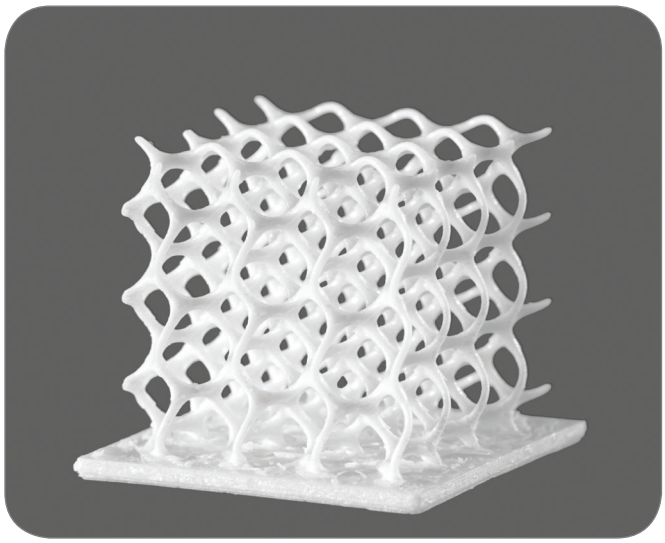
Casting cores for turbine blades

Due to tool-free concurrent production operational components of „batch size 1" can be produced cost-efficiently and in premium quality.

In 2013, Lithoz was awarded the prize „Phönix" as best spin-off company in Austria. TU Wien also was honoured for its contribution to this successful start-up. Today, Lithoz specialises in the development and production of materials and generative production systems for the tool-free and cost-efficient production of high performance ceramics. In addition to the CeraFab 7500 standard product, Lithoz also offers customised developments as well as consulting services.

Benefits for you

- Tool-free production of individual parts and concurrent production of small batch series or various individual parts up to series of hundred parts
- High performance ceramics with the same material characteristics as in serial production
- Wide-ranging, even very sophisticated geometries in injection moulding quality that cannot be produced with conventional manufacturing methods
- High density, high strength and high precision
- Excellent surface quality with no post-processing necessary
- Sparing of resources through waste-free, material-saving production
- Small minimum filling volume (10 ml), lowest possible material consumption – therefore minimum capital commitment
- Direct production from CAD data
- No tooling and set-up costs
- No costs for design changes or versions
- Low energy consumption, low safety and operating costs due to the use of LED technology



The most sophisticated geometries in injection moulding quality

CeraFab 7500

Lateral resolution	40 µm (635 dpi)
Layer thickness	25 – 100 µm
Number of pixels (X, Y)	1920 x 1080
Installation space(X,Y,Z)	76 mm x 43 mm x 150 mm
Data format	.stl (binary)
Light source	LED
Construction speed	up to 100 layers per hour or 2.5 to 10mm per hour

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