WHY 3D PRINTING?

Future production processes will be digitally controlled and run automatically. In addition, they're seen to be resource-saving and produce products that are as completely recyclable or biodegradable as possible.

Generative processes such as 3D printing or two-photon polymerization can meet these requirements in combination with the right material concepts, and therefore have great potential in certain application areas that are not driven by mass production. Another advantage of generative processes is the simple and cost-effective personalization of individual components and entire systems - keyword **"**batch size 1**"**.

This also applies, in particular, to the use of biological materials and their system integration – especially in the field of medical technology and medical device development (for example of biofunctionalized carrier materials or individualized implants). Additionally, the production of specific (micro-)electronic and (micro-) optical components or innovative material composites in the field of high-temperature lightweight construction benefit from the variability of additive production processes.

The Fraunhofer Institute for Silicate Research ISC uses a series of processes in combination with tailor-made material concepts for a wide variety of applications.

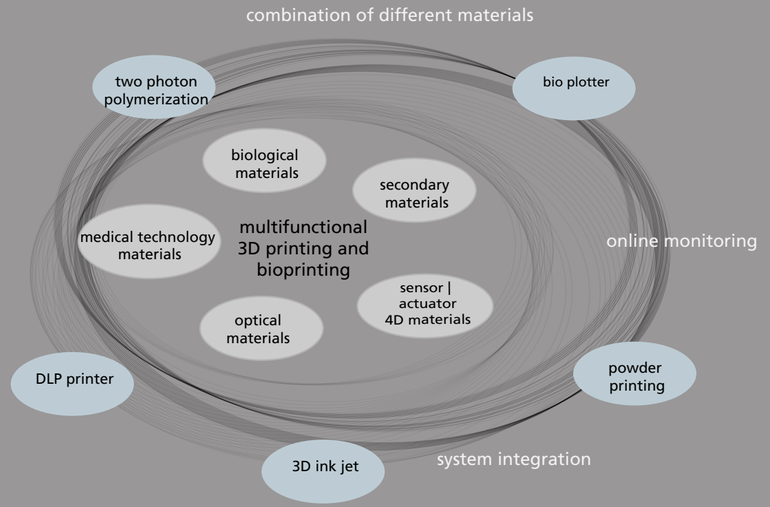
PROCESS

Common 3D printing processes build workpieces layer by layer. Depending on the material, chemical (2K) or physical (temperature, light) initiation is used. Most common 3D printing processes are implemented as stand-alone systems. For industrial 3D printing processes, however, concepts for automation of process chains with integrated 3D printing are required. Depending on the product, various 3D printing processes may have to be combined in order to achieve optimally adapted material combinations and functions. 3D structures should cover a size range from < 1 µm to < 1 m.

The Fraunhofer ISC works on behalf of its customers on integrated systems with different 3D printing techniques in one device, and develops process-accompanying measuring and monitoring systems:

- Digital Light Processing (DLP Principle)
- Two-Photon Polymerization (2PP)
- Binder-Jetting and Lithography-based Ceramic Manufacturing (LCM) for processing ceramics or metal-ceramic composites and specialty glass

In addition, ink jet 3D, melt layering (FDM), stereolithography (SLA) and selective laser sintering (SLS) are available if required.



Contact

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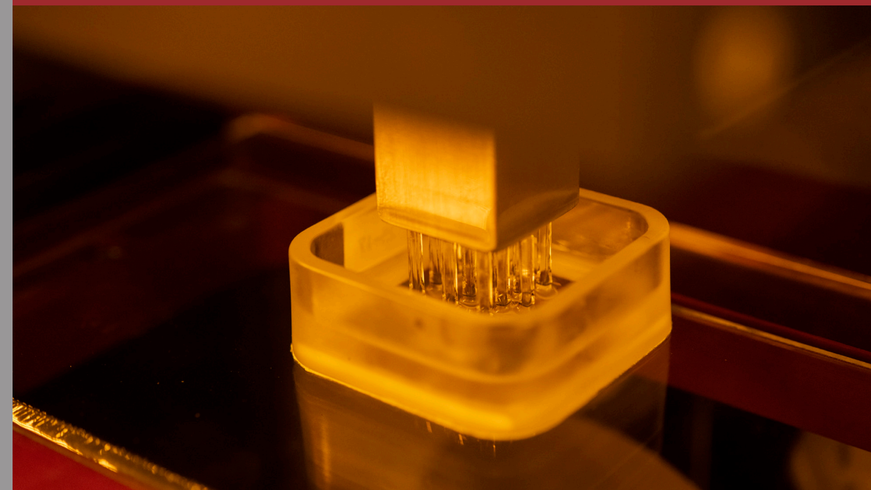
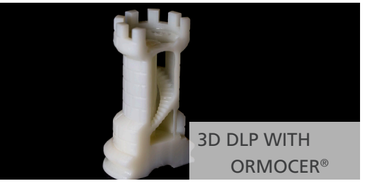
Fraunhofer ISC

FRAUNHOFER INSTITUTE FOR SILICATE RESEARCH ISC

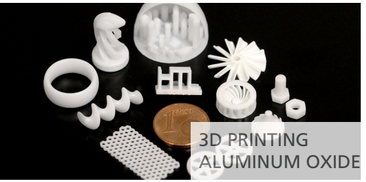
MULTIFUNCTIONAL 3D PRINTING AND BIOPRINTING

WITH FUNCTIONAL MATERIALS

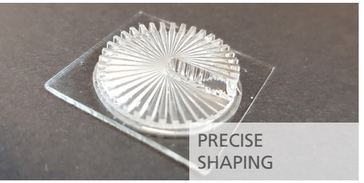




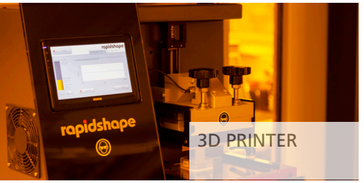
3D DLP WITH ORMOCER®



3D PRINTING ALUMINUM OXIDE



PRECISE SHAPING



3D PRINTER

AREAS OF APPLICATION

OPTICAL COMPONENTS

The production of optical components requires particularly homogeneous, transparent and light-stable 3D mold bodies that are free of internal interfaces and have a very high surface quality. Aspheres and gradient index (GRIN) optics can only be produced with conventional methods at great expense. 3D printing offers optical designers the opportunity to design and quickly test new components as free-form surfaces beyond the usual spherical and rotationally symmetrical geometries.

BIOMEDICINE, MEDICAL DEVICES

In addition to dental products and individual earmoulds made from established materials, new biodegradable and/or 3D-printable materials offer solutions for biomedicine, e.g. for the production of scaffolds or functional elements that are only needed temporarily, and which are then degraded naturally by the environment. The growth process and the behavior of cells and microorganisms can be specifically influenced with biocompatible and bioactive materials (stimulation, nutrient release, support of wound healing). The combination of 3D printing processes with living cells (bioprinting) can offer completely new possibilities for biomedical and pharmacological applications. For this purpose, careful printing technologies are being further developed in cooperation with various partners.

MATERIAL CONCEPTS

THE KEY TO GENERATIVE PRODUCTION

The Fraunhofer ISC is developing new inorganic and hybrid functional materials that can be flexibly adjusted in terms of composition and structure depending on the requirements of the manufacturing process and the end product. Fraunhofer ISC's portfolio for additive processing currently already includes

- Materials for the medical sector, e.g. hybrid polymer materials/composites (ORMOCER ®e) for dental applications, or scaffold materials for 3D tissue engineering,
- Materials for the optical/electronic sector, e.g. ORMOCER®e with low optical attenuation, high refractive indices and light resistance,
- Glass-based materials for individual and complex components
- Production of microfluidic structures
- Ceramic and metal-ceramic composite materials for high-temperature lightweight construction

Still not the right one? The Fraunhofer ISC works on the further development of various materials and material composites according to specification. With Fraunhofer ISC's experience, materials with multifunctional property profiles can be produced for a wide variety of applications that are not accessible with conventional materials.

3D PRINTING – THE FUTURE

SECONDARY RESOURCES

Highly specialized primary materials with precisely defined properties are required for the 3D printing process; Resource-saving use of recycled materials or secondary resources is not yet possible. With its chemical synthesis expertise, the Fraunhofer ISC is aiming to harness the potential of these valuable materials. The goal is to modify production waste or recycled materials so that they are available as secondary resources with the specifications required for 3D printing processes.

SENSORS, ACTUATORS

Miniaturized sensor and actuator elements should also be able to be integrated into the production process via 3D printing. The Fraunhofer ISC is developing the corresponding new material combinations that can be switched piezoelectrically, thermally, electrostatically, optically, chemically or mechanically responsively.

SYSTEM INTEGRATION, 3D PRINTING TECHNOLOGIES

The integration of different 3D printing techniques into a printing process should enable new cost-effective ways of processing complex functional elements. Here, issues such as automated material supply, post-processing (3D polishing), or the standardization of interfaces are the focus, in order to facilitate implementation in existing processes.

WHY COME TO US?

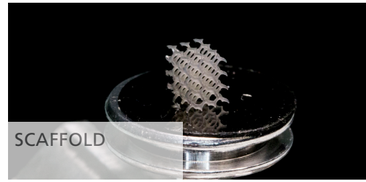
For decades, the Fraunhofer ISC has been working successfully on behalf of the industry to solve material-based problems. Our customers and development partners include not only large companies, but also a large number of small and medium-sized enterprises.

The Fraunhofer ISC supports the improvement of established products and processes, as well as the development of new products and processes, from consulting and analysis (in the case of production defects) all the way to completely new material and processing approaches.

Combined with an efficient network of outstanding research and development partners within and outside the Fraunhofer Society, we can also solve problems that exceed our own levels of expertise in materials and process development.

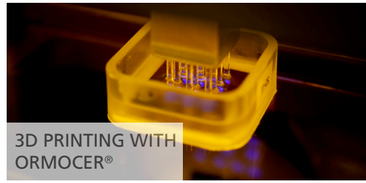
We support our customers in the development and implementation of materials and processes for the cost-effective and reliable production of highly customized products:

- Feasibility studies
- Consulting (material/process)
- Bilateral or joint projects for material and process development through to prototypes
- Upscaling and production-accompanying analytics

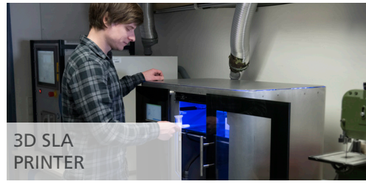


SCAFFOLD

3D-PATTERNED REFRACTIVE SURFACE



3D PRINTING WITH ORMOCER®



3D SLA PRINTER