Selective Laser Melting

Visions become Reality

REALIZER SLM

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In 1990, the physicists Dr. Matthias Fockele and Dr. Dieter Schwarze founded the F&S company. As pioneers of Rapid Prototyping, they were globally among the first to develop and produce stereo lithography equipment (STL) for the production of plastic prototypes.

In 1995, the company began with the development of SLM™ technology (Selective Laser Melting) for the production of components made of metallic materials. As early as 1997, the first patents were applied for. In 1999, the company delivered the world's first SLM™ machine for metals to the Forschungszentrum Karlsruhe. In 2004, Dr. Matthias Fockele founded ReaLizer GmbH, another enterprise which focuses on the development and production of SLM™ machines for the manufacture of metal workpieces.

Innovation and Partnership

As a technology leader in the area of Selective Laser Melting, ReaLizer GmbH was the first company to develop an innovative and novel technology, which has been in practical use now for ten years. We apply our expertise and long-time experience to innovatively and creatively continue the optimization and development of this technology.

We attach particular importance to a partnership-based cooperation with our customers, and they in turn appreciate our dedication; we don't waste time with lengthy discussions when it is time to find a solution, we take creative, committed and pragmatic action.

Many tasks and objectives can only be realized in close and trusting cooperation with our customers. In this case, absolute confidentiality during the exchange of information and knowledge goes without saying. Because a productive cooperation is not a one-way street, we enjoy our customers close involvement in the problem solving and development processes.

"The only way to attain our goals is to proceed together..."

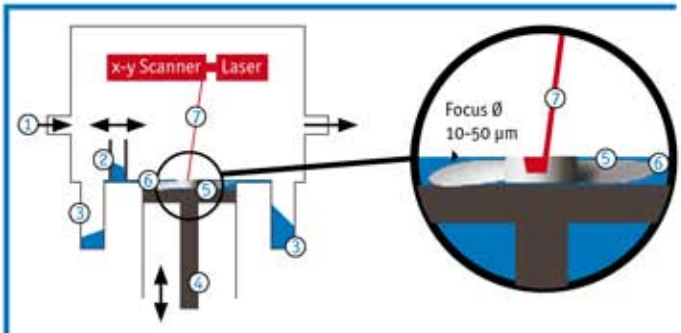
SLM™ – The Technology

Layer by layer on the way to the functional workpiece

Selective Laser Melting (SLM™) is a generative production method in which the desired components are produced directly from 3D data. Based on the data at hand (standard format STL), even highly complex parts can be produced from different metallic materials.

With the SLM™ method, the workpiece is constructed in a three-dimensional layer structure. To accomplish this, the metal is applied in thin layers of very fine powder and, using a laser beam, melted onto those areas where the workpiece will be developed. Depending on the surface quality and production speed requirements, the powder is automatically applied with layer thicknesses of 20 to 100 µm. In the following step, a powerful fibre laser selectively melts the designated areas. Sharp focusing provides the laser beam with a very high power density by which the material is melted in a very precise manner. Thus, workpieces with an absolute density can be produced with wall thicknesses from 40 µm on up.

When the melting process is finished for the particular layer, the platform is lowered by the respective thickness, and another layer of powder can be applied. The workpiece is fabricated layer by layer in this manner. The duration of the process, which takes place in closed inert gas atmosphere, is dependent on the amount of



1 *Inert gas (Argon)*
2 *Recoater (or wiper)*
3 *Powder container*
4 *Height adjustable work platform*
5 *SLM™ component*
6 *Powder bed*
7 *minimum laser focus*

material used and the number of layers – rather than the complexity of the component.

The layer structure facilitates the production of highly complex lattice or honeycomb structures, which cannot be produced using other methods. With the SLM™ process, the material is therefore only built up where required by the intended use and future strain requirements. One of the benefits here is for example the minimization of weight due to the optimized material usage.

Optimized material usage

Components of absolute impermeability and mechanically heavy duty quality are produced by means of SLM™, the material properties of which nearly equal those of conventionally produced components. Depending on the intended use and just like the conventionally produced components, they can be reworked using any other method.

This is what makes SLM™ technology a sensible alternative...

- When a functional metal component has to be produced from three-dimensional construction data in the shortest possible time. SLM™ makes prototypes available using the CAD draft and without any lengthy detour via toolmaking. This process is not only faster, but also the most economic way to generate a perfectly functional sample.
- When, for example, complex components with very complicated hollow or lattice structures cannot be manufactured or only manufactured by utilizing very complex methods using conventional processes. SLM™ technology, unlike other methods, still only affects the cost marginally when considering the complexity of the component to be produced.
- When only a limited number or unique pieces are to be produced.

ReaLizer in Action

SLM-100

Precision and Perfection

The ReaLizer SLM-100 is designed specifically for the production of „smaller" components, whereby high precision and surface quality are of utmost importance.

This machine has a 100 mm-high cylindrical construction area with a diameter of 125 mm. This base area permits the use of optics to focus the diameter of the laser beam down to 20 µm. With the corresponding scan strategy, this machine can produce components with delicate structures, minimal wall thickness down to 60 µm, and high surface quality.

With its compact design and the ergonomically designed workstation at the swivel arm, the Realizer SLM-100 is especially suited for use in laboratories or similar environments.

SLM-100 D

The ReaLizer SLM-100D is a good choice if space is limited and a separate workstation is available for data preparation. It was specifically designed for use in milling centres and dental laboratories.

This machine is not controlled via a workstation at the swivel arm, but via an integrated 19" touch screen display with an alpha-numeric keypad.

SLM-100 specifications	
Construction volume	Platform diam. 125 mm Max. overall constr. height 100 mm
Layer thicknesses	20-100 µm
Laser type	Fibre laser 20 to 200 W
Power supply	16A, 400V
Power input	1.5 kW
Argon consumption	app. 35 l/h
Dimensions	W900 x D800 x H2400 mm, SLM100A additional display support arm
Weight	500 kg
Software	ReaLizer control software
Materials	Tool steel H 13, titanium, titanium V4, aluminium, cobalt chrome, stainless steel 316 L, Inconel, Gold, ceramic materials under development

ReaLizer in Action

SLM-250
The All-Round Talent

The ReaLizer SLM-250 was designed for all-round use – it is suited for laboratories as well as the industrial production of components.

The construction space measuring 250mm x 250mm x 220 mm accommodates the production of correspondingly sized components. The space within the processing area can also be utilized to stack several pieces on top of each other or next to each other and thus produce the maximum number of pieces. If a high piece output is the main focus of deployment in an industrial production process, the SLM-250 can also be outfitted with a specifically high-capacity laser of up to 400 W. Minimum laser focus of the machine is 45 µm. Realizer also offers a fully automated sieving machine with powder extraction system, which optimally recycles the powder from the processing area. An exchangeable lens module is optionally available for applications requiring a higher level focus. This model may lower the available maximum construction space, but the laser beam can be focused to 20 µm to produce structures with high surface quality.

The sieving machine

The sieving machine by ReaLizer facilitates the optimal recycling of excess metal powder. The Realizer PS-01 is a fully automated vibration sieving machine with processing area powder extraction system. Extraction, sieving and automatic return to a powder container take place in a fully inert gas atmosphere. The powder can then be directly returned into the work process.

With the stand alone vibration sieving machine ReaLizer PS-02, the extracted excess metal powder can be filled into ReaLizer stainless steel powder bottles.

SLM-250 specifications	
Construction volume	250 x 250 mm , maximum construction height 220 mm
Layer thicknesses	20-100 µm
Laser type	Fibre laser 100, 200 or 400 W
Power supply	16 A, 400 V
Power input	2.5 kW
Argon consumption	app. 70 litres/h
Dimensions	W1800 x D1000 x H2200 mm w/o sieving machine
Weight	800 kg
Software	ReaLizer control software
Materials	Tool steel H13, titanium , titanium V4, aluminium, cobalt chrome, stainless steel 316 L, Inconel

SLM™ in action

Versatile, fast, economical

As a rule, SLM™ processes are **more economical** than conventional processes if production of unique pieces, customized parts, or serial production with a low quantity of pieces is required. In this type of production, the cost benefit is usually higher when the number of produced pieces is low, and the complexity of the unique piece is high and the material use is low.

Selective laser melting **facilitates** the production of **more complex workpieces**, which cannot be produced with other production processes or only with great (manual) effort. This way, delicate lattice, mesh or net structures, porous structures, or channels running through the workpiece in irregular patterns can be produced without a problem.

In the SLM™ machines by ReaLizer, functional metal pieces are produced directly from the CAD construction data in **next to no time**, and their mechanical properties equal the characteristics of conventionally produced workpieces.

"Great cost benefit in low number productions"

SLM™ technology can also be utilized to instantaneously produce customized human implants from **medical 3-D data** supplied by a CT or MRT, for example.

Dental prostheses

With SLM™ technology, customized and accurately fitting dental pieces, e.g. framework, caps, or brackets made from cobalt-chromium, titanium, or gold, can be produced economically. The components are absolutely true to size and require only minimal post processing. The absolute impermeability of the parts guarantees that no bubbles will form during veneer application due to outgassing. The picture illustrates the production process in a dental laboratory: From the workpiece directly from the machine to processing and the finished veneer.

Vehicle parts

Besides other fields, the development departments of the automobile, motorcycle, aerospace, and astronautics industries use Selective Laser Melting to produce functional prototypes from aluminium, titanium, or steel quickly and near-series without having to manufacture any tools beforehand. The process is especially suited for the production of intricate parts, such as metal sheets with large free form areas, unique specimens, or small series.

BMW Group,
Test vehicle construction

Tools

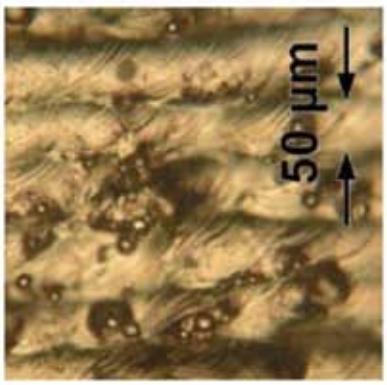
Fully operational tools, such as tools for the production of small series, can be produced with the SLM™ process quickly and economically. For injection moulding tools, the technology is deployed in the production of tool inserts with contour-close cooling channels.

Prostheses and implants

Human implants, such as joint or bone prostheses made from titanium, are manufactured with the SLM™ process. On the one hand, this involves customized and individually fitted implants based on CT or MRT data. On the other hand, serial pieces with intricate lattice structures are produced into which the bone can grow perfectly and thus – e.g. in the case of hip and knee implants – is able to form a durable and long-term fusion.

SLM™ – The Materials

The great variety of metals

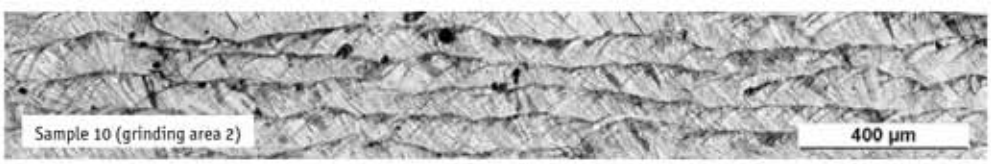


Detail view of laser melting process: Top view shows a melting track width of 50 µm (above)

Lateral view of a sample ground surface shows a layer thickness of 100 µm (right)

In principle, all metals relevant to the production of components can be worked with SLM™. There are already standardized work parameters and data for the material testing of the most commonly used metals at hand. The range of materials like stainless steel, tool steel, titanium and titanium alloys, cobalt chrome, aluminium and gold alloys is continuously augmented with new work powders.

ReaLizer's SLM™ machines process standard alloys free of binders or other additives. Metal powders of the currently deployable standard metal alloys are always available ex stock.



Should a special material be required that has not been standardized yet, ReaLizer will develop the corresponding work specifications in cooperation with the customer.

ReaLizer and its customers
Know-how, Service, and Trust

As a matter of course, we are happy to assist our customers during the development and implementation of the SLM™ production processes with our long-term experience. Lastly, we do not only want to provide innovative hard and software, but also competently assist our customers in the implementation and optimization of the process. Within the scope of a cooperative and trusting cooperation, we will share our knowledge of this trendsetting technology with you at any time.

"Discover new and innovative possibilities with us!"

We are pleased to support you with...

- the optimization of process parameters for your application and the material utilized,
- developing an optimum result considering the required surface quality, precision, and production speed,
- the optimal design of the parts to be produced,
- the start-up phase and reliability up to achieving the necessary process, as well as the development of test methods for quality assurance.

The innovative way into the future

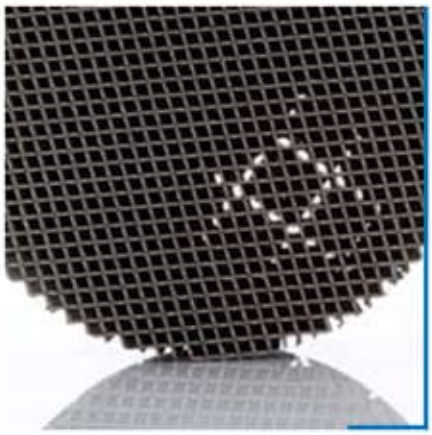
Chances and possibilities

The future belongs to SLM™ technology; it is not only faster and more economical than conventional processes in many areas, it also enables us to realize many great ideas. There are no limits to creativity in the development of new deployment possibilities.

With the growing number of standardized applications and materials, this innovative process will continue on its way out of the research labs and development divisions and move into the production halls. Already today, there are ReaLizer SLM™ machines which have been integrated into industrial production. Developers from all industries will not only see the technical possibilities of the SLM™ technology in the construction of metal parts, but also include this in their plans for serial production.

After all, Selective Laser Melting generally is more economical and faster when material volumes and lot sizes are small. What is more, SLM™ technology facilitates the production of intricate lattice and honeycomb structures that are impossible to produce with other methods. This alternative renders completely new possibilities where the mass of components has to be reduced while stability is maintained. Human and dental medicine will also find unique ways for the production of even more effective, customized implants and dental parts with SLM™ technology.

With the advancement of SLM™ technology, even the production of larger parts, for example in air and space industries, will no longer be a vision of the future.



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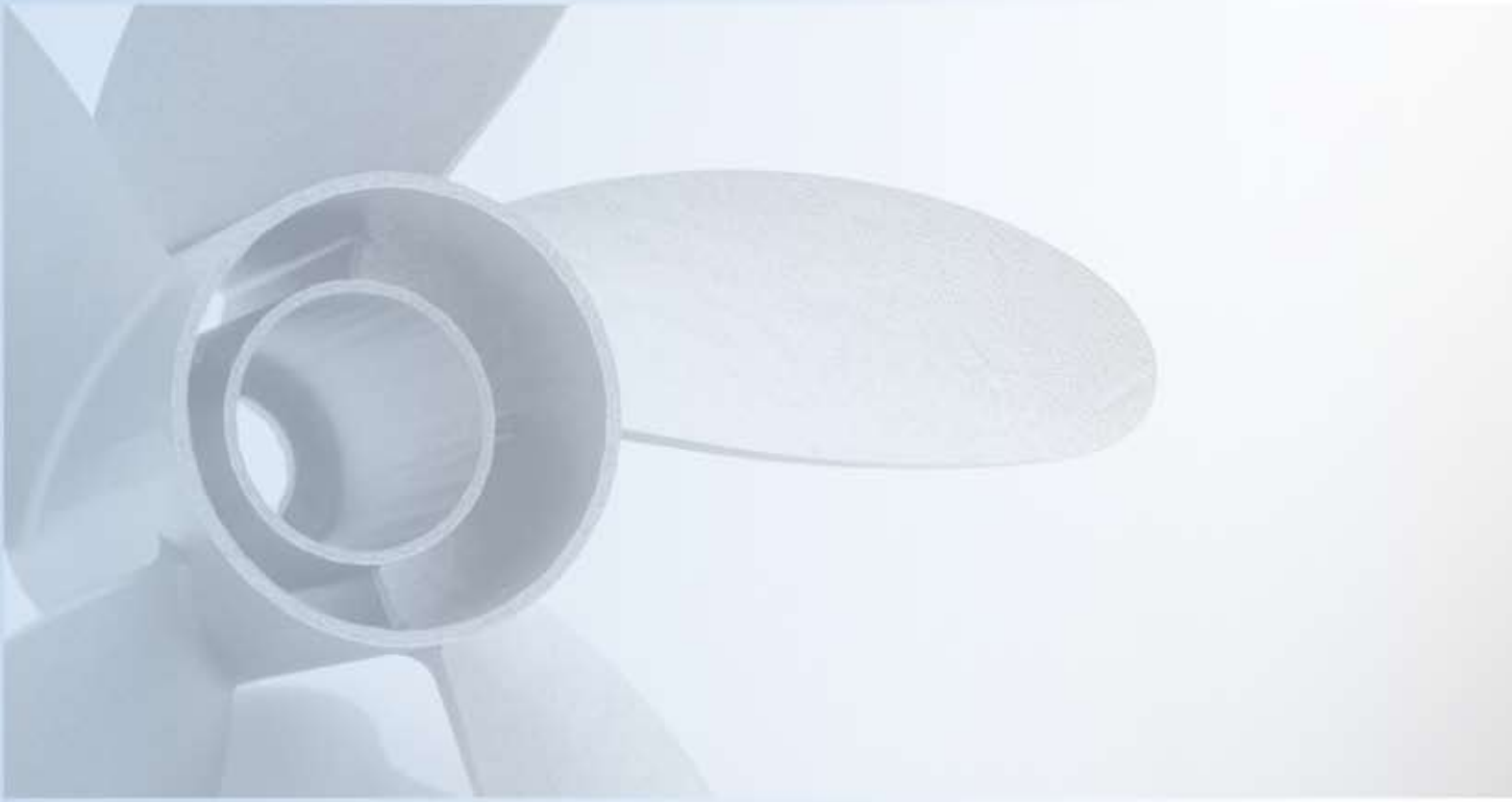

REALIZER SLM

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