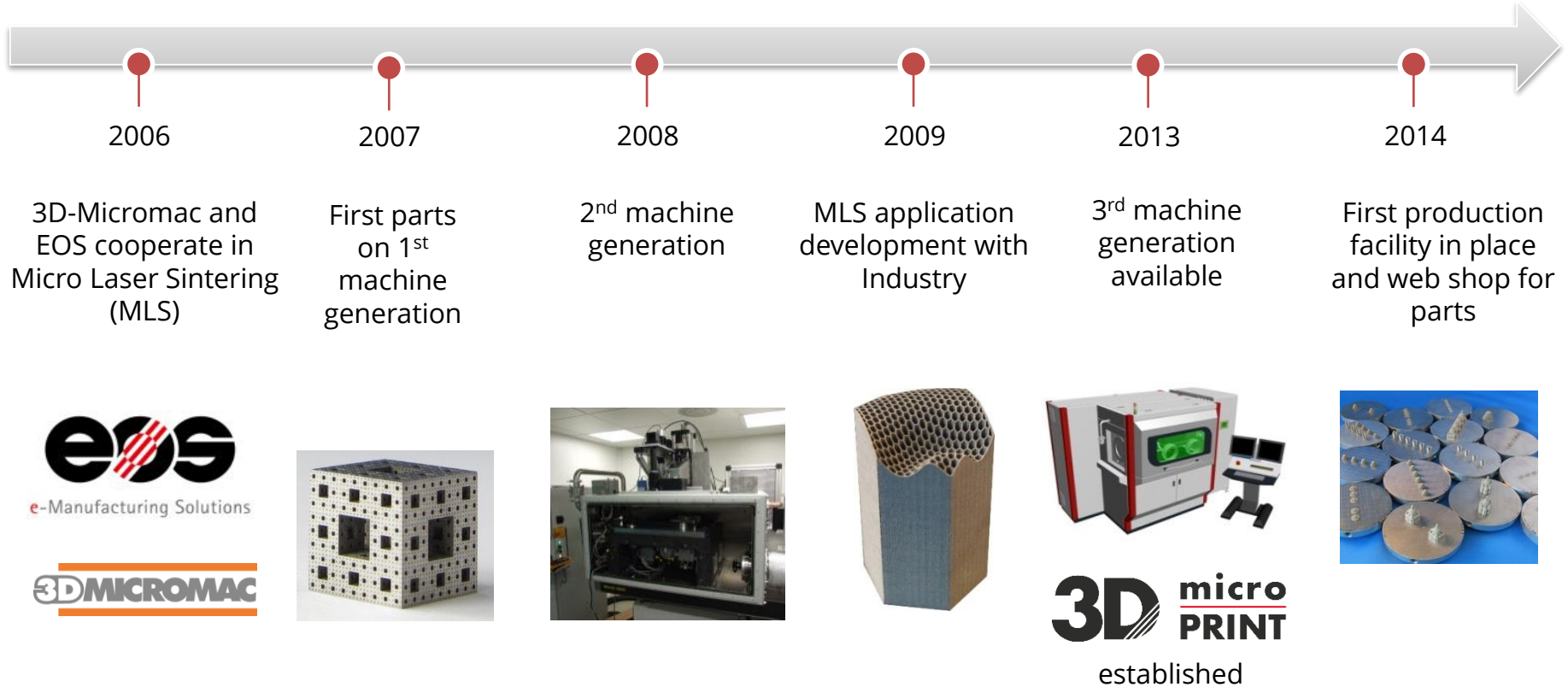


# Industrial Production of Micro Metal Parts by Micro Laser Sintering

**materials** valley

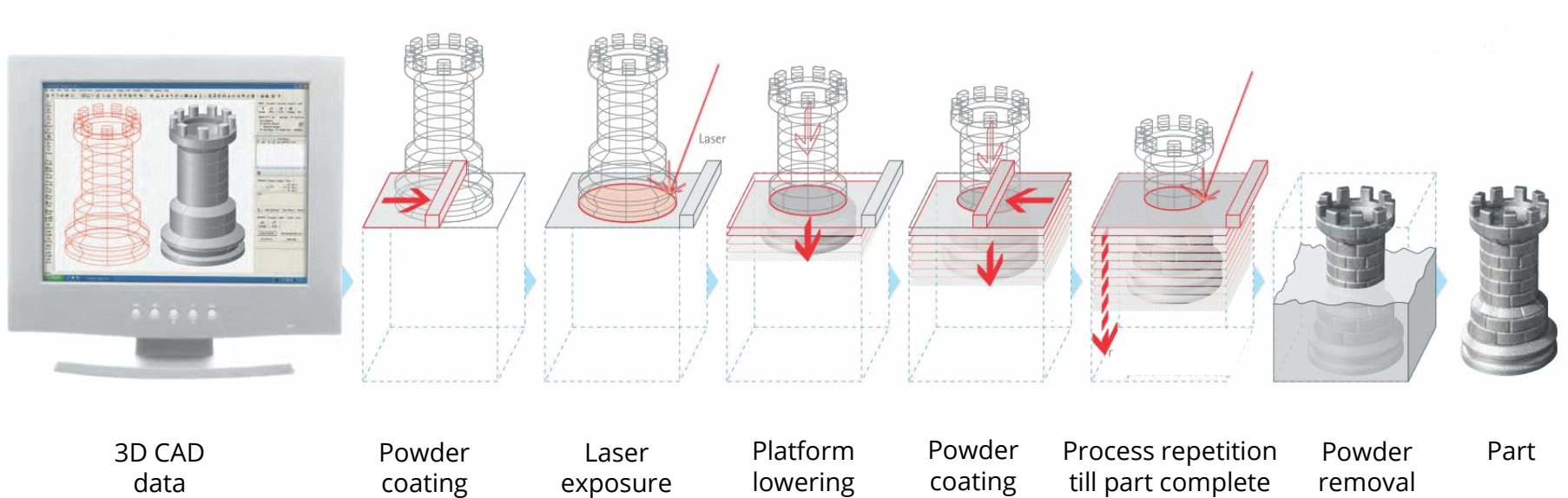
Workshop Lasertechnologie Einsatz in der Materialverarbeitung  
Hanau den 26.02.2015

# 3D MicroPrint at a glance



- Established in June 2013 by 3D-Micromac AG and EOS GmbH
  
- Equipped with
  - Staff: > 20 man years in Micro Laser Sintering
  - Know how: Additive Manufacturing, Precision Engineering
  - IP: Own patents & licenses from EOS, 3D-Micromac  
→ more than 550 patents
  
- Contact
  - 3D MicroPrint GmbH, Technologie-Campus 1, 09126 Chemnitz, Germany
  - [www.3dmicroprint.com](http://www.3dmicroprint.com)
  - [info@3dmicroprint.com](mailto:info@3dmicroprint.com)

# Micro Laser Sintering – the principle

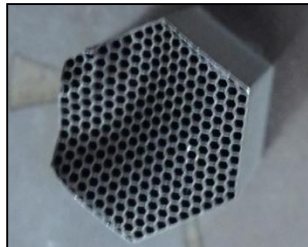


# Advantages of additive technologies

## Freedom of design

### Lightweight

- Static: weight of parts
- Dynamic: moving, accelerated parts
- Lattice structures without extra cost

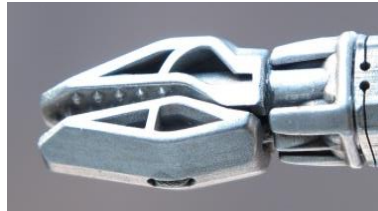


Lattice structure

## Cost advantages

### Integrated functionality

- Embedded functionality without assembly
- No need for molds
- Economical small lots



Grabber

## Customization

### Individualized parts

- Customer specific adaptations
- Medical implants



Jewelry

## Time to market

### Prototyping and production

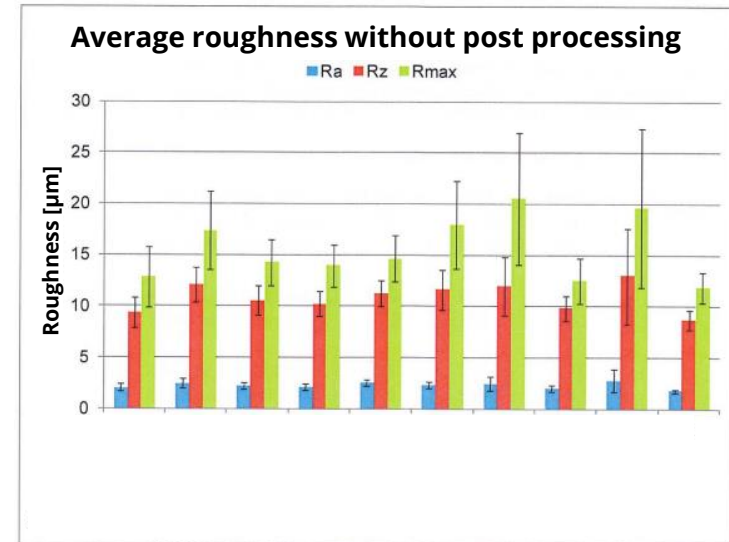
- Fast feasibility feedback
- Cost efficient small series
- Customization



Just print it

- Fine detail resolution
  - Powder particle size  $\leq 5 \mu\text{m}$  (D90)
  - Laser spot  $\varnothing$  size  $\leq 30 \mu\text{m}$
  - Layer thickness from 1 to 5  $\mu\text{m}$
  - 32  $\mu\text{m}$  wall thickness so far – 15  $\mu\text{m}$  imaginable
  - Accuracy  $\pm 5 \mu\text{m}$  up to 10 mm
- Get the desired surface & density
  - Without post processing: Ra 2,0  $\mu\text{m}$ ; Rz 13  $\mu\text{m}$
  - After post processing: Ra 0,7  $\mu\text{m}$ ; Rz 2,7  $\mu\text{m}$
  - Create surface pattern, structure

- Safety
  - Gas tight design & gas cleaning included
  - Air locks and Rapid Transfer Ports



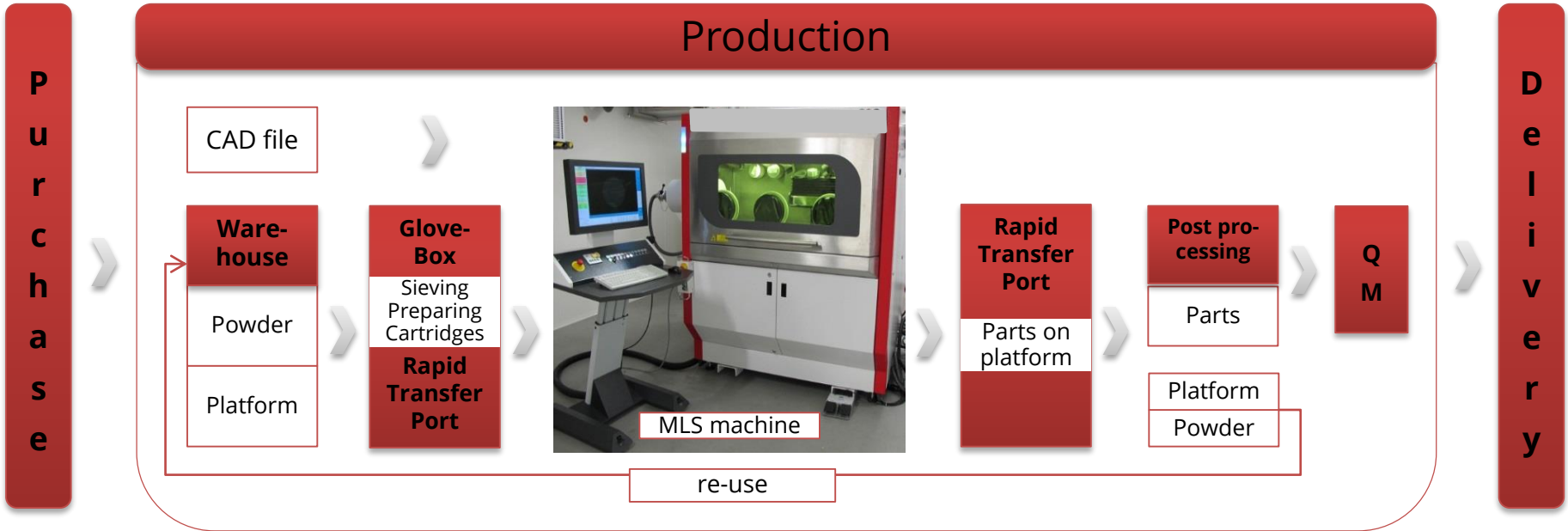
- Almost any metal
  - So far stainless steel 316L, Molybdenum, Tungsten (melts at 3.422°C)
  - Next Titanium, hardenable steel, high-alloy steel
  - Research level: Cu, Silver and more, even ceramics
  - Selection is market driven

- Machine and glove box details
  - Build envelope Ø 57 x 30 mm height
  - Argon atmosphere: < 1 ppm H<sub>2</sub>O & O<sub>2</sub>
  - Stepping resolution platform: < 1 µm
  - Safe pre- and post processing glove box
  - Remote access for quick service

## Research level



# Production Flow

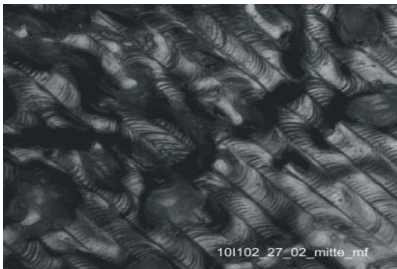




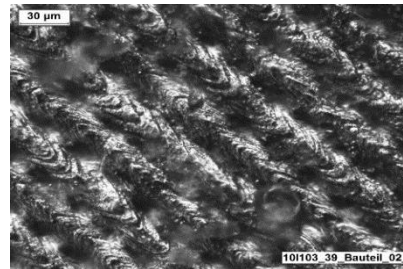
Cross-section polish of 316 L part



Examples for smooth and patterned surfaces



Ra 2 µm



Ra 15 µm

## Density & Surface

### Challenge

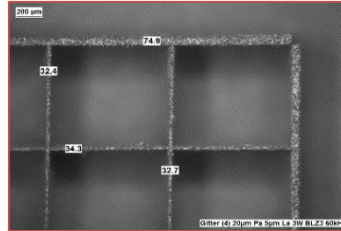
- Many applications require full density and low surface roughness – some require porosity & surface structures

### Solution

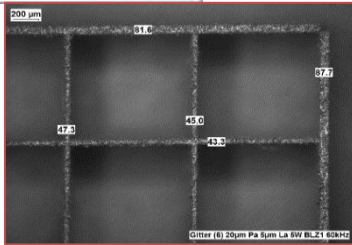
- The combination of pulsed and cw exposure in one part enables a large variety of target properties

### Advantages

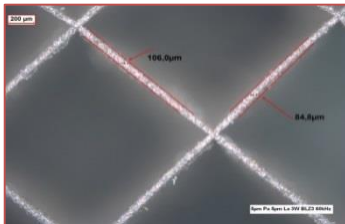
- MLS enables mold exhaust without bores
- Get different properties within one part
- Get smooth surfaces or surface patterns



32µm



45 µm



90 µm

## Square holes & lattice structures

### Challenge

- Radiation applications from medical devices to space research need structures to guide or shield radiation

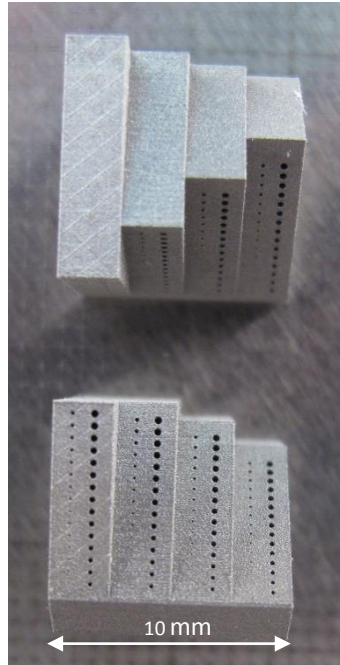
### Solution

- Square holes and even changing cross sections
- Wall thickness down to 15 µm imaginable today

### Advantages

- MLS enables certain solutions for the first time
- Lattice structures, a few micron “thick” can be manufactured much cheaper with MLS than with e.g. etching

Horizontal holes



Vertical holes

## Capability of small holes

### Potential

- MLS technology ensured small size holes
- Size < 100  $\mu\text{m}$

### Solution

- Circular or freeform shape
- Straight or curved
- Main direction or slanted

### Applications

- Head exchangers, jigs, parts with required patterns
- Sensors, fluidic
- In body drug delivery systems

Complete part



Cross-section

## Fluid mixing chamber

### Challenge

- Mixing solution required for 3 liquids; applied mechanical load has to be minimized

### Solution

- Spiral shaped pipes with 150  $\mu\text{m}$  wall thickness and 200  $\mu\text{m}$  inner diameter

### Advantages

- Applied load is minimized, no moving parts required for mixing
- mixing ratio can be modified by pipe diameter, flow ratio and design of the mixing chamber

Ring & bracelet



Hollow structure as design element



Several ring designs



## Personalized rings

### Challenge

- Individualization versus increasing material cost versus unique selling points

### Solution

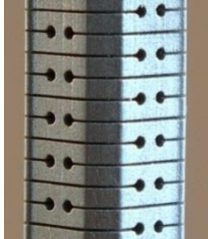
- Hollow structures save material
- Plasma polishing enhances surface finish

### Advantages

- Jewelry can be personalized without extra cost
- Structures are a unique design feature
- Assemblies made in one piece



Flexure hinge arm



Grabber details



## Micro Grabber

### Challenge

- For handling applications, a flexible yet strong arm with a mounted grabber is required

### Solution

- Flexure hinge designed for optimal mechanical response
- Hinges with 300  $\mu\text{m}$  gap width

### Advantages

- Functional integration: hinges are integrated in the main body
- Miniaturization of grabber mechanics
- Grabber head assembly manufactured in one piece

# MLS satisfies Industry requirements

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- |                                                                              | MLS |
|------------------------------------------------------------------------------|-----|
| ▪ Medical Device Industry                                                    |     |
| ▪ Biocompatibility                                                           | ✓   |
| ▪ Materials: 316L, Ti, tempered and high-alloy steel come soon ...           | ✓   |
| ▪ Accuracy & roughness                                                       | ✓   |
| ▪ Small parts: manufacturability, freedom of design & functional integration | ✓   |
| ▪ Jewelry & Watches, Consumer goods                                          |     |
| ▪ Details, accuracy, roughness, materials                                    | ✓   |
| ▪ Freedom of design, customization, availability                             | ✓   |
| ▪ Heat Exchanger, Reactors, ...                                              |     |
| ▪ Large surface area in a small volume: fine detail resolution, materials    | ✓   |
| ▪ Mechatronics, Automotive, Aerospace... and more to explore                 |     |

- Services
  - Know How Transfer
  - Feasibility study Joint projects → first Experience, first Parts
  - Potential analysis, Consultation, Solution development
  - Production rollout
- Production of micro parts
  - Contract manufacture
  - Quick and easy technology entry
- Supply of MLS machines
  - Rental, Operator model, Purchase
  - Including: Consumables, machine and technology support





- Capital stock almost 1.000.000 Euro
- Large patent portfolio > 550 patents enables world wide business
  - Own patents
  - Licenses from 3D-Micromac AG, EOS GmbH
- Current production capacity of > 10.000 h / year
  - Process chain from design to production, post processing and quality assurance
  - Design to support you to optimize your part geometries and MLS in house
  - Partner network for post processing – secured by NDA's
  - Blasting, plasma polishing, tumbling
  - Measuring microscope, roughness measurement etc.
- When will you order your Micro Parts?

Thank you very much for your attention!  
...questions?

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