SLM Solutions Group – a leader in metal based 3D printing

“The use of Metal powders in Additive Manufacturing, a view into the associated machine technology”

A presentation by Hendrik Schonefeld, Area Sales Manager at Titanium Europe 2014 Hilton Sorrento Palace Italy
Agenda

1. SLM-Solutions GmbH
2. SLM-Technology
3. Titanium Applications
4. Conclusion
Location and global sales, application and service footprint

Source: Company information
SLM Solutions Group – a leader in metal 3D printing

Key products

- **SLM 125**
- **SLM 280**
- **SLM 500**

A leading metal 3D printing company

- Historical origins in rapid prototyping technology
- Paved the way for today’s primary focus: 3D printing for industrial volume production and prototyping
- A leader in selective laser melting technology
- Installed base of 133 SLM systems as per 31-Dec-13
- 28 SLM machines sold in 2013
- >80 employees in 2 locations as of 31-Dec-13

(a) As subsidiary of MCP group  |  (b) Number of machines brought to market via SLM \( ^{HL} \): 76 thereof 4 demo machines, via Fockele & Schwarze: 5, via MTT: 6, 46 Realizer machines were brought to market and serviced by SLM Solutions Group

Source: Company information
SLM Solutions Group has a blue chip customer base and its global reach is expanding...

- SLM Solutions Group has exposure to attractive end markets and has longstanding relationships with blue chip customers.
- The market continues the shift from rapid prototyping to industrial applications.
- SLM Solutions Group is well positioned to capitalise on this trend given SLM Solutions’ technology and customer base.

Source: Company website
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Direct Manufacturing with Selective Laser Melting (SLM®)

Additive Layer Manufacturing (Selective Laser Melting) by the use of metal powders

Periodic process:

- Adding of powder
- Exposure
- Lowering building plate by the value of one layer thickness
### Available Material Parameters

<table>
<thead>
<tr>
<th>Material Type</th>
<th>Grades/Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stainless Steel</td>
<td>1.4404, 1.4410</td>
</tr>
<tr>
<td>Tool Steel</td>
<td>1.2344, 1.2709</td>
</tr>
<tr>
<td>Co-Cr Alloys</td>
<td>2.4723 / ASTM F75</td>
</tr>
<tr>
<td>Super Alloys</td>
<td>Inconel 625 and 718, HX</td>
</tr>
<tr>
<td>Titanium</td>
<td>Grade 1 - 2</td>
</tr>
<tr>
<td>Titan Alloys</td>
<td>TiAl6Nb7, TiAl6V4</td>
</tr>
<tr>
<td>Aluminium Alloys</td>
<td>AlSi12, AlSi10Mg, AlSi7MgCu</td>
</tr>
</tbody>
</table>

**Specifications:**
- Spherical particles
- $10 \mu m < \phi < 45 - 63 \mu m$
- Good flowability
- Dryness
- Pureness (chemistry)
Quad Scan-Head (clone and independent)

Optical Design for multiple QUAD production

Fibre laser 4x 400 and / or 1000 W
SM „Gaus“ Profile
Focal point 70 and / or 80 µm
3D Scan-Optic without F-Theta
Next step: Integrating SLM machines into complex production processes

Example: PSX – automated powder handling
- Inert atmosphere
- Safe powder handling
- Short processing times
- Closed-loop powder cycle
- Automatic sieving and feeding

PSA 500 prototype – fully automated powder handling

Example: Process set up

Schematic of process enhancing integration

Source: Company information
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Source: Royal Perth Hospital, Hip implant from Ti
Medical Application

SLM CASE STUDY MEDICAL
acetabular cup for Hip implants
Courtesy of Royal Perth Hospital

digital model

requirements

CAD-model

qualification / QS

SLM

application
Successful Conclusion
- Theatre Images -

Material: TiAl6V4
Part Volume: 25 ccm
Build Time: 8 hr.
Layer thickness: 50µm

Images captured by Robert Day
Aircraft Application

Smart (internal) Structures and Designs

lightweight parts substitution of solid mass to boost production
Engineered materials

Re-designed aircraft bracket
Height 342 mm
Material: Al and Ti
Build time for two parts: 41:23h

Original design

Courtesy of LZN-Hamburg-Germany and Airbus
Internal Air System for Aviation

Challenge:
- small holes on the half-shell
- Support of overhang with thin wall thickness

Solution:
- use of special know how in
  - support generation
  - process control

Material: TiAl6V4
Part Volume: 178 ccm
Build Time: 27 hr.
Layer thickness: 30µm
Multifunctional Structure in Titanium

action $\rightarrow$ reaction

Material: TiAl6V4
Part Volume: 43 ccm
Build Time: 10 hr.
Layer thickness: 50µm

„bouncing-ball“ in titanium
Additive Manufacturing makes the impossible possible

Advantages of using SLM-Technology

• lightweight parts
• reduction of time to market
• reduction of development cycle
• fast production of spare parts
• reduction of storage costs
• customizing by a lot size of 1
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“It is not necessarily faster” but ” [...] It is “a simplification of the manufacturing process” and you can realize geometries with 3D printing that could not be made by other means. He also is excited by the fact that their designers “are spoilt..with (being able to make) hundreds of designs” and that they “change designs weekly.”
Many thanks for your kind attention!

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