

- 1 *Screen printed structure  
made of stainless steel*
- 2 *Flow field of micro cooler  
(prototype; dimensions down  
to 100  $\mu\text{m}$ )*

## THREE-DIMENSIONAL SCREEN PRINTING OF MATERIALS

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### 3D Screen Printing Structures

The Fraunhofer IFAM Dresden has developed a new and innovative manufacturing process which allows the mass production of small metallic high precision parts. This clearly distinguishes 3D screen printing from the classic rapid prototyping technique.

Advantages are:

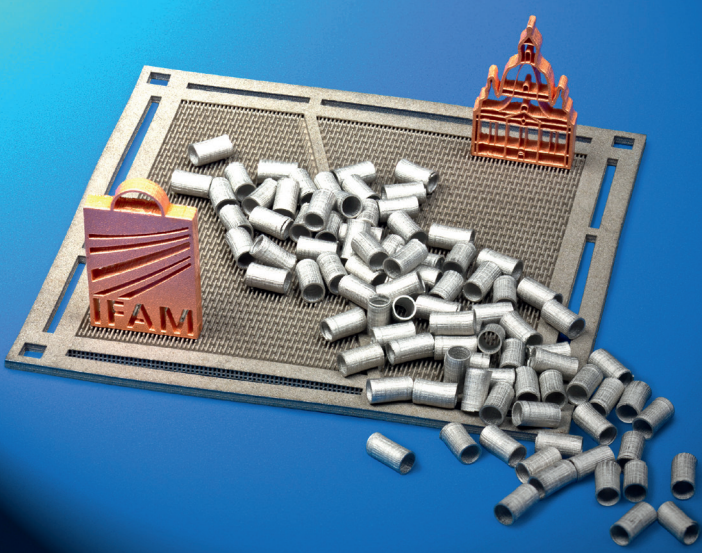
- Production of complex structured parts
- Production of different parts simultaneously
- Structures down to micrometer scale
- Application of various material systems
- High aspect ratio
- Supreme reproducibility
- Suitable for mass production
- Materials combinations
- High surface quality

### Applications

- Microsystems technology
- Energy and heat management
- Mechanical engineering
- Biotechnology
- Electronics
- Aerospace industry
- Automotive engineering

Examples:

- Fuel cell components
- Catalyst carriers
- High precision light weight construction
- Micromechanics
- Heat exchanger and insulation
- Abradable sealings
- Structurally optimized parts
- Electrodes
- Bio-implants
- Jewellery



### Example of Use

Bipolar plates were developed in a joint project with the center of fuel cell technology Duisburg. These plates have significant advantages compared to such produced with conventional manufacturing processes. The developments regarding bipolar plates focus on achieving high mechanical strength combined with a new micro flow field in the range of micrometer dimensions.

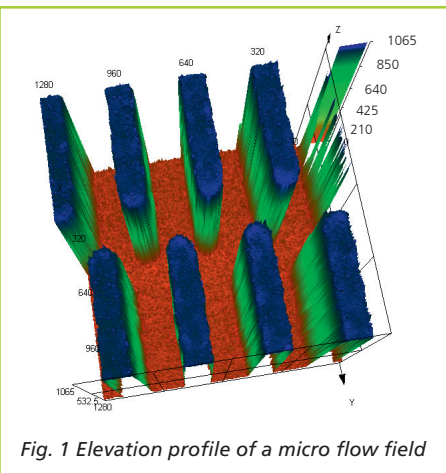


Fig. 1 Elevation profile of a micro flow field

### Material Systems

All materials which are available as powder, especially:

- Metals, e.g. steel, copper, titanium, rare earth, refractory metals
- Ceramics
- Glass
- Plastic

### Technologies and Lab Equipment

- Screen printing machine (300 x 300 mm printing area)
- Rheometer RheoStress 6000
- Powder characterization and testing of sintered parts according to DIN/ISO
- Thermal analysis (DTA, DSC, TGA, thermal conductivity)
- High temperature - oxidation testing
- Elementary analysis (C, O, N)
- Thermotechnical laboratory

### Manufacturing

Powdermetallurgical process:

- Production of a powder/ binder slurry
- Layer-by-layer screen printing for 3D structures
- Heat treatment

Typical cell dimensions:

- Cell diameter from 60  $\mu\text{m}$  to any user defined size
- Cell height: several millimeter to a few centimeters
- Wall thickness 50 - 1000  $\mu\text{m}$

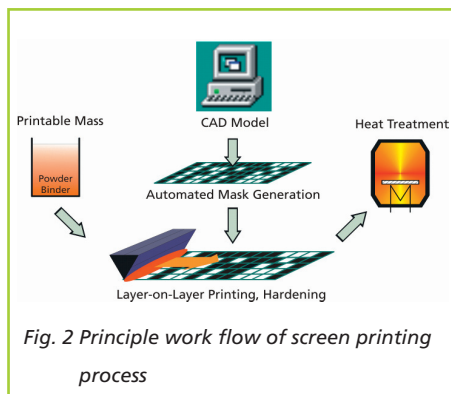


Fig. 2 Principle work flow of screen printing process



### R&D Services

- Screening tests
- Material evaluation
- Material development
- Component design
- CAD design
- Printing paste development
- Small series production

### Customer Benefits

Three-dimensional screen printing is a highly promising process for the manufacturing of small, precise and cost effective parts with closed structures.

Advantages:

- Variable geometry including 3D structures
- Unical technology for near net shape parts
- High variety in materials (combination of materials possible)
- Light and multifunctional parts
- Components can be used directly without further treatment
- High reproducibility
- High accuracy
- Easy upscaling for mass production

3 Screen printed structures

4 Brand-new facility at Fraunhofer IFAM Dresden - the latest generation in 3D Printing