

- 1 Screen printed structure
made of stainless steel
- 2 Bipolar plates

THREE-DIMENSIONAL SCREEN PRINTING OF METALS

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Metallic 3D screen printing structures

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

Advantages are:

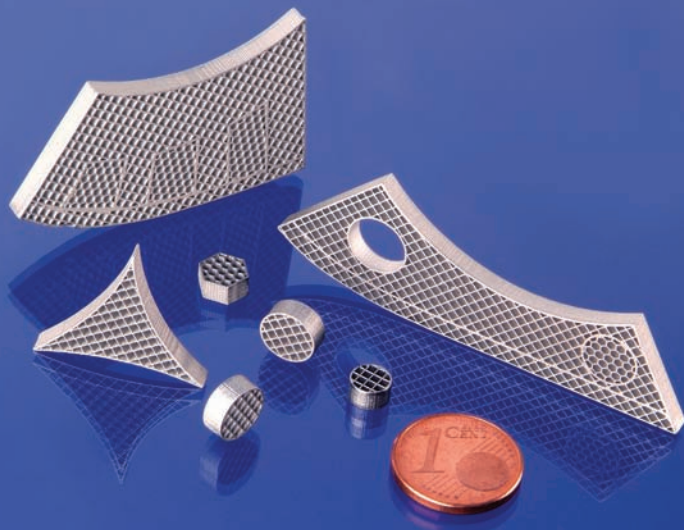
- Production of complex structured parts
- Production of different parts simultaneously
- Structures down to micrometer scale
- Application of various material systems
- High aspect ratio
- High reproducibility
- Suitable for mass production

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.

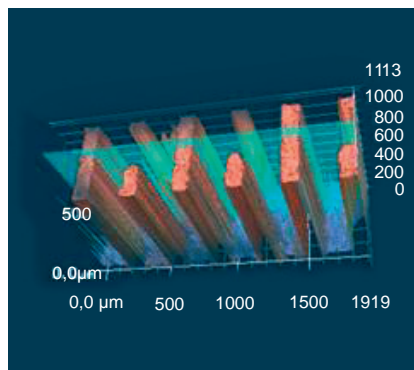
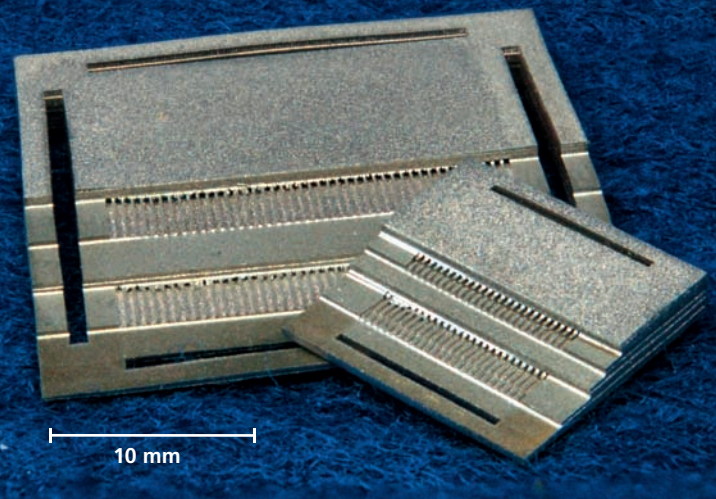


Fig. 1 Elevation profile of a micro flow field

Material systems

All metal materials which are available as powder, especially:

- Stainless steel
- Copper
- Titanium
- Hard metals
- PM sintered metals
- PM light alloys



Technologies and lab equipment

- Screen printing machine (250 - 300 mm printing range)
- 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 0.1 mm to any user defined size
- Cell height: several millimeter to a few centimeters
- Wall thickness 50 – 1000 μm

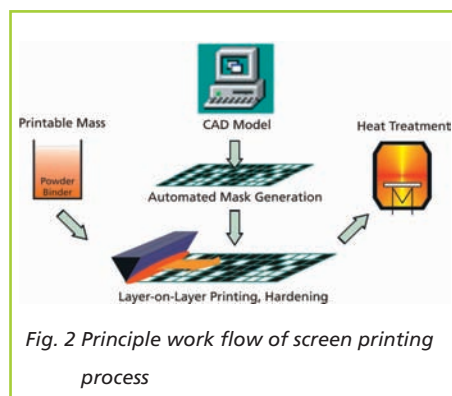


Fig. 2 Principle work flow of screen printing process

R&D services

- Screening Tests
- Material evaluation
- Material development
- Component design
- CAD design
- Printing slurry development
- Small series production

Customer benefits

Three-dimensional screen printing is a highly promising process for the manufacturing of small, precise and cost effective metallic 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

1 Screen printed structures made of stainless steel

2 Samples with closed channels for heat exchangers