

1 Processing route using metallic foam and powder metallurgical methods for alloy foam formation

## METAL FOAMS FOR ELECTRODES

### Fraunhofer Institute for Manufacturing Technology and Advanced Materials IFAM Branch Lab Dresden

Winterbergstrasse 28  
01277 Dresden | Germany

#### Contact

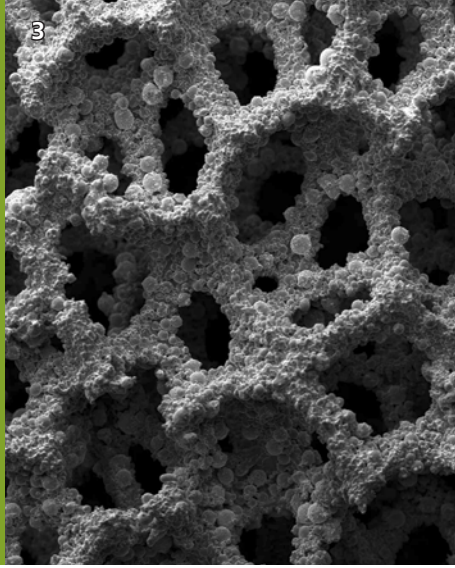
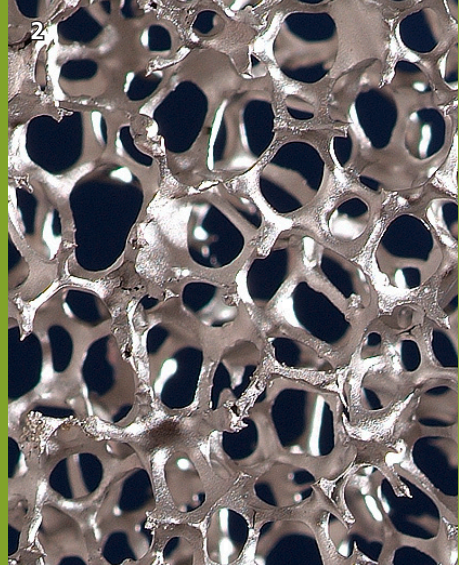
Dipl.-Ing. Gunnar Walther  
Phone +49 351 2537 340  
Fax +49 351 2537 399  
E-Mail: Gunnar.Walther@ifam-dd.fraunhofer.de

[www.ifam-dd.fraunhofer.de](http://www.ifam-dd.fraunhofer.de)

Open porous metallic foams have an outstanding potential to combine material properties with a functionality resulting from their specific morphology. Fraunhofer IFAM Dresden developed in cooperation with ALANTUM Corp. a powder metallurgical coating and sintering process to transform a commercially available pure metallic foam into an alloy foam, which enlarges the market for metal foam applications. This patented technology is established in a commercial production line. Special heat treatment procedures were developed to establish passivation or functional layers to ensure an outstanding durability high reactivity. Further foam alloys are continuously in development with respect to customer requests.

#### Advantages

- Thick electrodes for applications in batteries and supercapacitors
- Cost efficient due to larger electrodes giving higher efficiency and lower packaging effort
- Three-dimensional metal foam structure results in excellent contacting between electrodes and active materials
- Good heat conductivity and heat distribution
- Remaining pores after infiltration of active material achievable by electrolyte
- Easy to infiltrate by active materials
- High surface area available
- Geometry and shape can be applied as necessary



- Commercial production for customer tailored solutions available
- High design flexibility and workability
- Foam alloy is adjustable for the respective application and operation conditions (e.g. corrosive electrolytes or interactions with active materials)

#### Product Characteristics

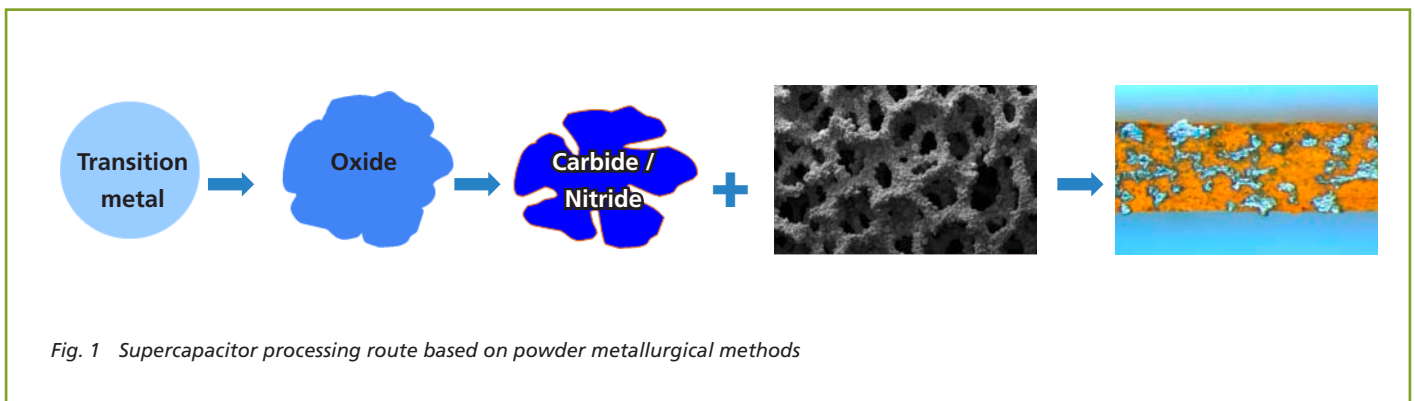
- Ni, Fe, Cu foams as well as alloys based on these:
  - Ni-Basis Superalloys e.g. INCONEL 625®

- NiCrAl, NiFeCrAl, FeCrAl, NiAl Monel
- 316L, 310SS
- Further metals and alloys can be developed
- Alantum foam is available as sheet material
- Up to 400 mm width and 1500 mm length, thickness 1.6 to 4.5 mm depending on pore size
- Pore sizes: 450 to 3000  $\mu\text{m}$
- Porosity >92%
- Density 0.4 - 0.7  $\text{g/cm}^3$
- Infiltration possible by powder based techniques
- Surface area after infiltration adjustable by powder characteristics

- Pore sizes tunable by infiltration as well as post processing
- Possible active materials for batteries and supercapacitors:
  - Carbon modifications
  - Transition metal nitrides or carbides (e.g. VN, Mo<sub>2</sub>N)

#### Application Potential

- Electrodes for batteries and supercapacitors
- Electrodes for fuel cells and electrolysis



- 2 Metallic foam
- 3 Alloy foam
- 4 Metallic foam material used as electrodes in supercapacitors