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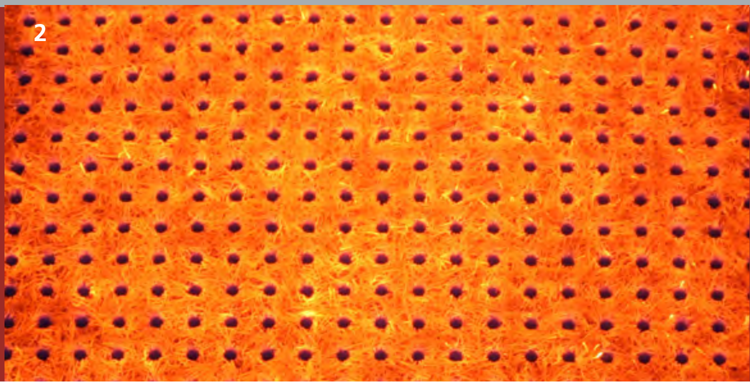
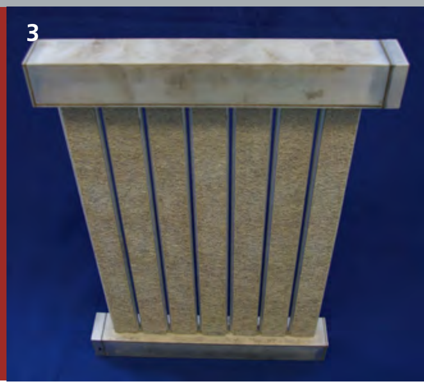
FRAUNHOFER INSTITUTE FOR MANUFACTURING TECHNOLOGY AND ADVANCED MATERIALS IFAM, BRANCH LAB DRESDEN





1 *Crucible melt extraction facility*
2 *Porous burner*
3 *Heat exchanger*

METALLIC FIBERS MADE FROM ANY KIND OF METAL OR ALLOY

The crucible melt extraction (CME) process allows the manufacturing of short metallic fibers from almost any fusible material. To this end, a rotating wheel with a notched surface is placed over a melt pool.

The rotating extraction device is water cooled and, thus, generates a high solidification rate. As a result, a homogeneous distribution of the alloying elements, small grain size, reduced segregation and extended solubility, as well as the formation of metastable phases can be achieved.

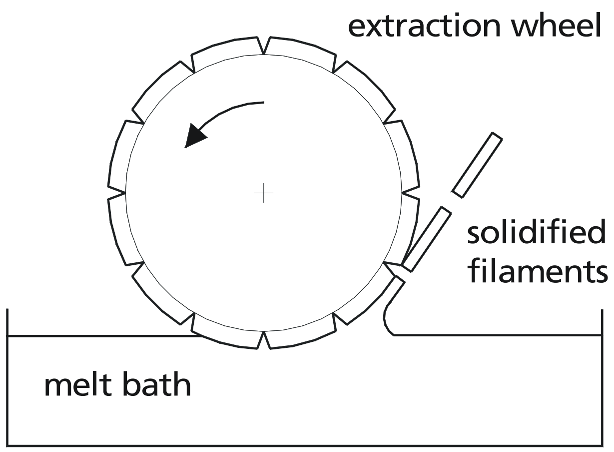


Fig. 1
Principle of crucible melt extraction

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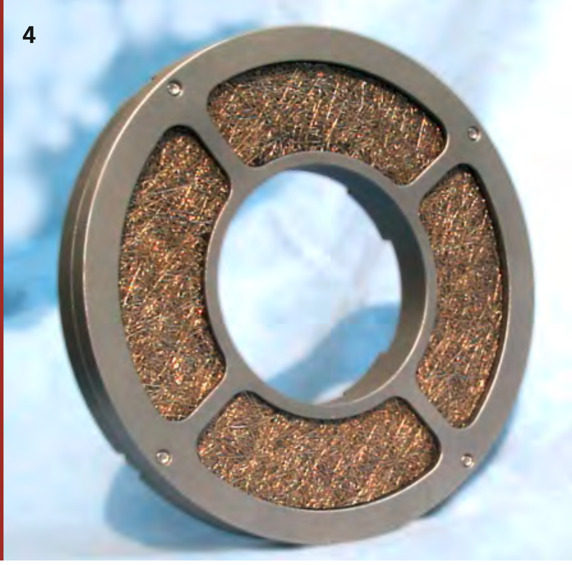

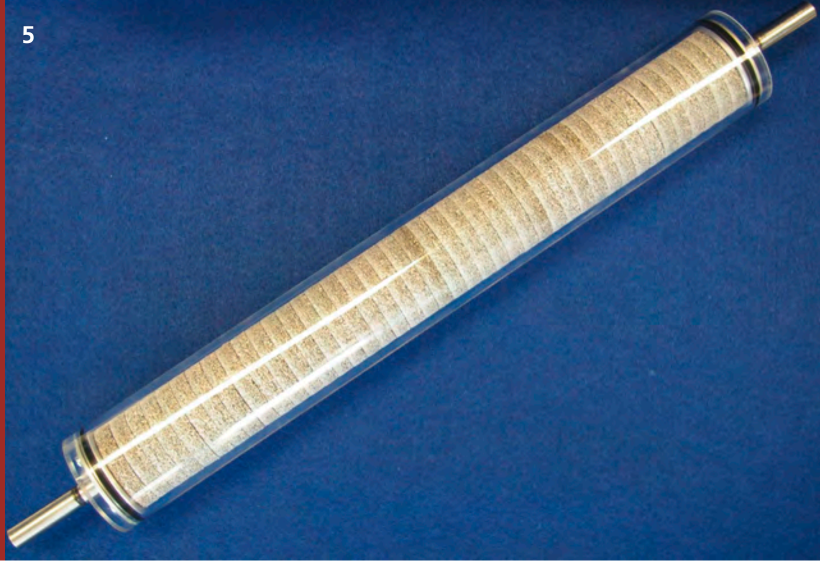

Fraunhofer IFAM Dresden has improved the CME process in order to produce fibers of mean equivalent diameter in the range of 50 to 250 µm. The fiber length can be set from 3 to 25 mm. The current state-of-the-art CME facility is shown in Picture 1. It allows for the extraction of fibers under vacuum or protective atmosphere (argon, nitrogen) with a pressure of up to 10 bar for improved secondary cooling.
The range of fibrous materials produced in the past for various customers include platinum and gold alloys, nickel-based superalloys, nickel aluminides, titanium aluminides, iron chromium aluminium alloys, stainless steels, copper alloys, aluminium alloys, and a variety of other specialties such as magnetostrictive nickel-gallium fibers.

Open-porous Parts Made From Sintered Metallic Fibers

Plates, rings and cylinders can be manufactured from the melt-extracted fibers by sintering and machined to the desired dimensions. The preferred cutting method is laser cutting which is suitable for cutting of plates of up to 10 mm thickness. Additionally, machining via high-speed milling is possible. The porosity of the fiber structures can be set to anywhere between 50 and 90 % and is completely interconnected, allowing for free through-flow of fluids which is important in many applications.

4 Flame-stop element

5 Phase change heat storage device

The pore size usually lies between 10 and 250 µm, depending on the porosity and the fiber diameter, and can be tailored to meet the demands of the individual application.

Typical Properties

Sintered fiber structures made from an enhanced FeCrAl material containing 15 % aluminium show superior high-temperature oxidation resistance and are thus suitable for application in high-power porous surface burners with significantly increased service life time. The high specific surface area of fiber structures (5,000 to 50,000 m^2/m^3, depending on the fiber diameter and total porosity) makes them suitable for application as electrodes or catalysts. Heat exchangers or flame-stop elements for explosion prevention do also benefit from a tailored combination of open porosity and high specific surface area.

The latest development, sintered aluminium fiber structures, can be used to significantly enhance the heat transfer e.g. of phase change heat storage devices and, thus, bring down the charging / discharging time from one hour to a few minutes.

R&D Services

- Application oriented studies related to materials and manufacturing solutions for a specific customer problem
- Materials and component characterisation with respect to thermophysical, mechanical and fluid flow properties including manufacturing of test samples and components
- Development of joining and machining solutions for open-porous materials
- Prototype and small series production
- Know-how transfer for industrial production.

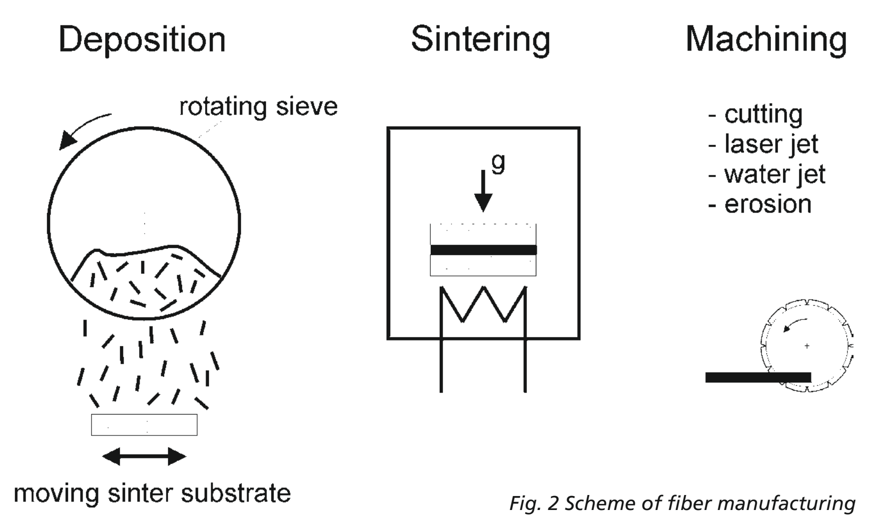

Fig. 2 Scheme of fiber manufacturing