Ceramic microchannel pores for innovative filtration applications

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Microchannel pores can be manufactured using a number of different production methods, e.g. through machining (laser drilling), freeze casting or molding processes. Molding by burning off materials, a method known as "lost mold process", involves manufacturing a model from a material that can be burnt off. Following the forming, the model is burnt, resulting in a hollow mold. Careful selection of the opening materials (the materials to be burnt off) allows to produce materials with accurate hollow spaces and defined pores. They are used as innovative materials in medical engineering, filtration equipment or for the production of light yet stable structures and excel through particularly precise cut-off points and lower back pressures.

Table 1: Fibers to be burnt off, and their diameters

Fiber material	Type	Fiber diameter [µm]
Polyester fibers	PET	10–25
Polyamide	Nylon	10–30
Aramid	Kevlar	12–15
Flax	Natural fiber	10–100
Carbon	HM/HS	5–10

Using this approach, Fraunhofer IKTS has produced materials with a uniform pore size in the shape of continuous channels by using continuous fibers for opening materials. Depending on the application case, it is possible to create pores sized between 4 µm and 100 µm. For example, in order to produce a particularly fine microchannel structure, the researchers used the thinnest carbon fiber type available on the market – Toho Tenax UMS45. These fibers, with a diameter of 4.7 µm, were brought into shape and infiltrated with an Al_2O_3 suspension. The specifically developed suspension with sub-micrometer particles enables the full coating and individual separation of each fiber. After curing, the components were sintered and the fibers were burnt off under air atmosphere. The structures obtained show good mechanical strength and contain continuous channels whose diameter corresponds to the size of the fibers used (Figures 1 and 2).

Fig. 1: Formed components with microchannel structure (from slip casting).

Fig. 2: Wound mold with microchannel structure.

This work shows that using fiber strands with a defined number of fibers and uniform fiber diameter allows the production of a targeted pore channel structure with a uniform pore diameter and defined pore surface (Figures 3 and 4).

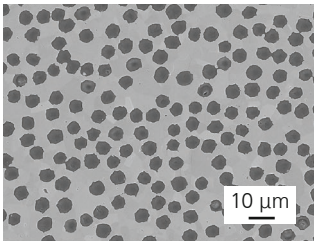

Fig. 3: Directionally aligned microchannel structure, transverse section.

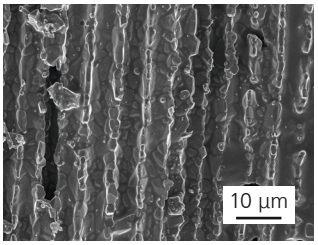

Fig. 4: Directionally aligned microchannel structure, longitudinal section.

Services offered

- Development of materials with defined pore structure
- Development of methods for various material systems
- Characterization of pore structures (pore structure, back pressure)

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