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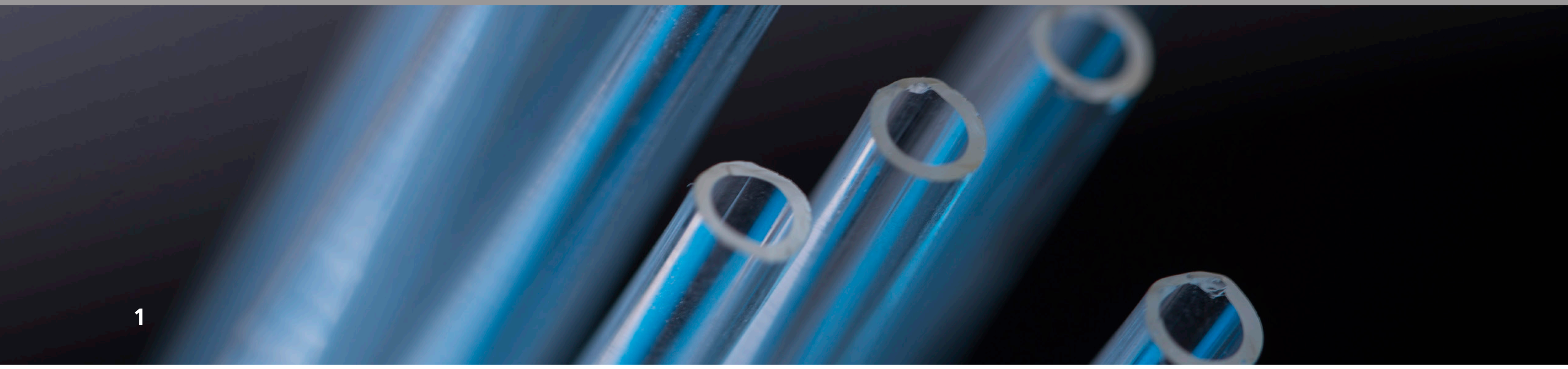
FRAUNHOFER INSTITUTE FOR SILICATE RESEARCH ISC



1 *Porous glass moldings on silicate basis to transport fluids and enable interactions with dissolved substances.*

DRAWING OF REHEATED SPECIAL GLASS

Motivation

Micro-components, layered systems, tubes and rods of preciscely defined geometries and compositions made of glass are used in many applications. Their production requires glass-technical know-how and elaborate equipment. For research, prototyping, and small series production of such components, there are no commercial suppliers.

We offer

We produce glassy preforms with complex cross-sections, holes or geometry. Also, composite structures made of different glasses can be produced. We develop individual preforms which maintain the external and internal geometry during redrawing especially for small scale production. During the thermal redrawing process, the preform is annealed to the softening temperature and drawn.

Due to relatively low temperatures, the cross-sectional shape geometry is not affected while geometric dimensions can be reduced by up to three orders of magnitude. For this purpose, the Fraunhofer ISC established a pilot plant which can be used for the production of small batches of individual glasses for customers. The obtained parts can even preserve optical quality.

We supply custom-made rods or fibers with a thickness of 3 mm to
50 microns or already cut parts in quantities of up to 10 kg / month. For special applications, we can also develop new glass systems to meet your individual requirements.

Typical Applications

- Glass parts for micro technique (e.g. components, gears, …)
- Capillars and capillary systems
- Micro optical components

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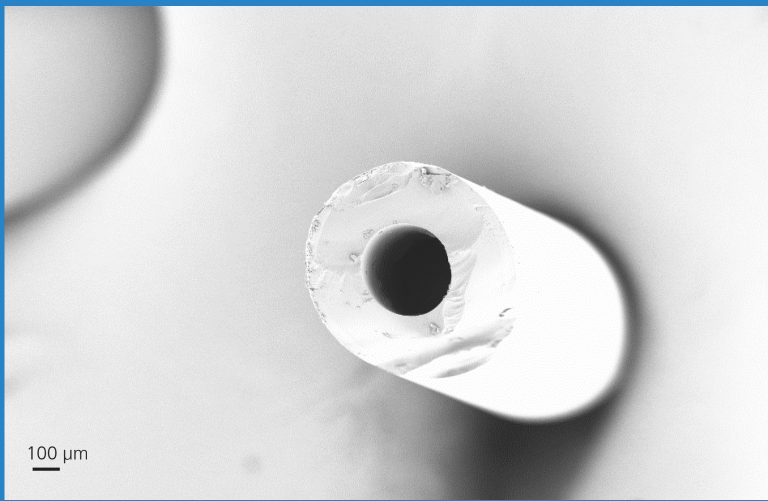
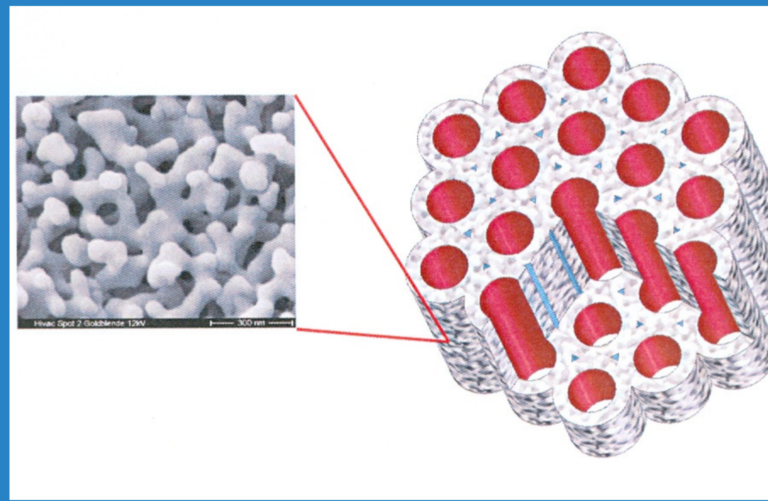


2 *SEM-image of a glass tube*



3 *Decomposed and leached out bundle of Vycor-fibers (TU Ilmenau)*

Project: Anisotropic hierarchically structured porous glass materials (ANIMON)

In many applications, such as in sensors, it is necessary to transport liquid media in a tube or capillary while allowing interactions of solutes with sensorially active molecules on the capillary walls at high flow rates. For these requirements, monolithic carrier systems that show hierarchical porosity distributions, are very well suited. Such hierarchical forms are composed of large, geometrically oriented pores (transport pores) and small pores (functional pores) emanating therefrom without preferential direction. Through this hierarchy and the simultaneous pore orientation of the transport pores, the flow conditions are substantially improved, while at the same time sensor-active molecules can be made available via the functional pores. However, all monoliths available to date have several disadvantages. These may relate to the stability and reproducibility (e.g. of washcoats) or the size and orientation of the macroporous transport pore structure (e.g. sol-gel monoliths).

As part of an AIF-ZIM cooperation project, anisotropic, hierarchically structured porous glass moldings based on silicates were to be developed.

At the Fraunhofer ISC, the process chain for the production of hierarchically structured, porous glass tubes made of leachable glass materials was developed. Based on the glass system of the Vycor glasses, i.e. sodium borosilicate glasses, it was possible to produce glass tubes directly from the melt with a specially adapted puller. With the help of a specially designed platinum needle it was possible to move glass tubes (Fig. 1) with variable diameters and wall thicknesses from the outlet of a platinum crucible downwards. A particular challenge was the spinodal thermal segregation of the Vycor glasses in two phases, which can take place even at unfavorable cooling rates during production. By optimizing the drawing speeds, the orientation of the needle and the crucible temperatures, it was possible to suppress this segregation to such an extent (Fig. 2) that the tubes could then be further processed into fiber bundles in the further production process.

Afterwards, the glass tubes drawn at the Fraunhofer ISC were assembled into monoliths and further processed using thermal recovery techniques to obtain small semi-finished products while preserving their geometry. Through targeted thermal segregation, the functional pores could then be generated in the glass. In the subsequent leaching, the glass monoliths were obtained with the desired hierarchically structured porosity (Figure 3), which consist essentially of almost pure SiO_2 glass.

A key unique selling point of the new glass monoliths is the high chemical resistance of the monolithic systems, the variety of functionalization options offered by the reactive surface and finally the flexible adjustment of the porosity as well as the size of transport and functional pores and the base glass system.