Aerogels in action:
What can complex three-dimensional aerogel components achieve and how are they manufactured?

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Recently, interest in aerogels as efficient insulators rose significantly. Industry and users increased their interest in the direct application of aerogels and their composites. Aerogel application, e.g. in thermal insulation, promises potential energy savings based on the outstanding properties of aerogels. However, direct application of aerogels still remains challenging since dust formation might occur and scaling of the production is still an issue.

Besides construction related applications, aerogels have been applied commercially as insulting material in the automotive sector. The dust formation was described as problematic to handle that could only overcome by housing in vacuum-sealed bags. [1]

Within this work we demonstrate the application of monolithic aerogel composites as thermal insulation and protection of surrounding areas of an ICE exhaust system based on previously published synthesis protocols.[2, 3] Surface temperatures of the whole system were reduced from more than 800 °C to approx. 100 – 115 °C. In addition, temperatures of the exhaust gasses were increased which enables a more efficient. Three dimensional shapes have been realized in order to closely fit the insulation to the ICE structure. For this purpose, complex molds have been produced and the aerogels composites have been realized as depicted in figure 1.

Fig.1 top: 3D-rendering of the mold at different stages of filling and the overflow in the right depiction. Bottom: 3D model of one representative part.

1. Hartsock, D.L., et al., *Analytical and Experimental Evaluation of a Thermally Insulated Automotive Exhaust System.* SAE Transactions, 1994. **103**: p. 266-283.
2. Berkefeld, A., M. Heyer, and B. Milow, *Silica aerogel paper honeycomb composites for thermal insulations.* Journal of Sol-Gel Science and Technology, 2017. **84**(3): p. 486-495.
3. Heyer, M., et al., *Mixed Oxide Aerogels with High-Performance Insulating Properties for High-Temperature Space Application.* Advanced Engineering Materials, 2023. **25**(21): p. 10.