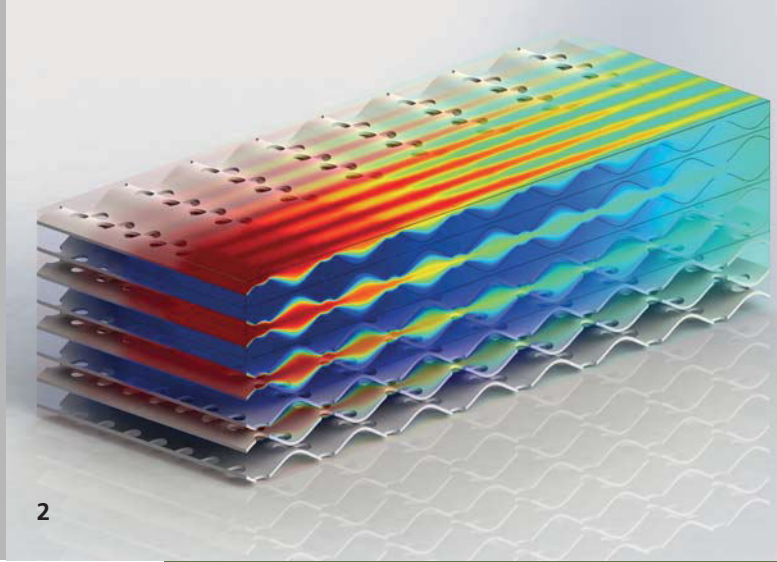


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CERAMIC SUPPORT STRUCTURES FOR APPLICATIONS IN HETEROGENEOUS CATALYSIS

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Due to the upcoming change in energy and material base, there is an increasing interest in decentralized plants for energy generation and synthesis of chemical products. The development of new processes for these small-scale plants or the transfer of well-known processes to this scale necessitates the application of novel reactor concepts. To reach an efficiency comparable to highly integrated large-scale processes, the improvement of the single process step efficiency is essential. Innovative ceramic support structures may contribute to this development target.

The catalyst support structures that are used in industrial applications today only allow a limited adjustment of mass transfer and pressure drop properties. While, for instance, pellets are characterized by good mass transfer properties, the associated high pressure drop is a major disadvantage. In contrast, honeycomb catalysts offer low pressure drops but also poor mass transfer properties. So far, a specific adjustment of these properties is only possible for metal supports. However, the application of a long-term stable coating with active material remains challenging for these structures. Novel ceramic manufacturing techniques allow the preparation of tailor-made catalyst supports that combine desired properties, like mechanical and thermal stability with the applicability of well-adhered washcoats. Therefore, these structures are advantageous especially for highly exothermic or mass transfer-limited reactions, such as methanation and Fischer-Tropsch synthesis. A possible manufacturing route towards these structures is offered by the application of ceramic tape technology. Raw material in form of powder is casted to tapes. Green tapes can be manufactured continuously and can be shaped, wrapped and joint to yield three-dimensional structures. The manufacturing process also allows the production of composites of different materials. This enables the realization of material and property gradients within the sintered material. Particularly the possibility of integrating metal layers is a promising approach for the improvement of thermal conductivity. By means of simple manu-

facturing steps, turbulence promoters can be introduced to the channels of the structure. The continuous manufacturing process allows an easy transfer to an industrial scale.

A manufacturing process with a very high degree of freedom regarding the producible shape is additive manufacturing. Although it is – due to higher manufacturing costs – by now only of minor interest for a broad industrial application, it might be an interesting option for special applications, like the production of high-priced fine chemicals. The possibility to increase selectivities might justify the higher production cost in this case.

Both manufacturing processes share the various possibilities for the structuring of the catalyst support. Connections between process design (e.g. mixing, catalytic reaction) and process parameters (e.g. velocity, composition, temperature, pressure) are too complex for an intuitive analysis and design. The application of simulation tools offers the potential to identify advantageous structures for specific applications.

Services offered

- Development and manufacturing of application-specific catalyst support structures
- Catalyst coating and screening
- Reactor and process design
- CFD and multiphysics simulation

1 Computed tomography image of a ceramic tape structure with turbulence promoters.

2 Simulation of the concentration profile.