STRUCTURED CATALYST SUPPORTS TAILORED TOWARDS OPTIMAL REACTOR PERFORMANCE USING ADDITIVE MANUFACTURING

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Keywords: heterogeneous catalysis, additive manufacturing, POCS, optimization, heat transfer

Metallic Periodic Open Cellular Structures (POCS), produced by additive manufacturing, are a promising alternative to conventional fixed bed reactors with random particle packings [1]. The high thermal conductivity offers great potential for process intensification, especially regarding strong exo- or endothermic reactions. Additive manufacturing enables various opportunities for the optimization of POCS with high design flexibility. In this respect, two approaches are presented in this contribution.
The first approach addresses a rigorous geometric optimization of POCS, tailored to the needs of the oxidation of methanol to formaldehyde. For this, reliable models of heat transfer and reaction kinetics are crucial. Heat transport characteristics of POCS with diamond unit cell (Fig. 1) were investigated experimentally. Based on the two-dimensional α_W-model, heat transfer coefficients were determined and correlated using the Nusselt-Reynolds approach to allow for generalization [2]. Further, a fundamental model of intrinsic reaction kinetics was developed. Based on these models, the geometrical parameters of diamond POCS were optimized to achieve a maximum space-time yield of formaldehyde.
Another novel approach, which is pursued in interdisciplinary research collaboration with material scientists, is aiming at auxetic POCS with shape memory effect, yielding optimal heat transfer properties. First insights into morphological and heat transfer characterization were gained.

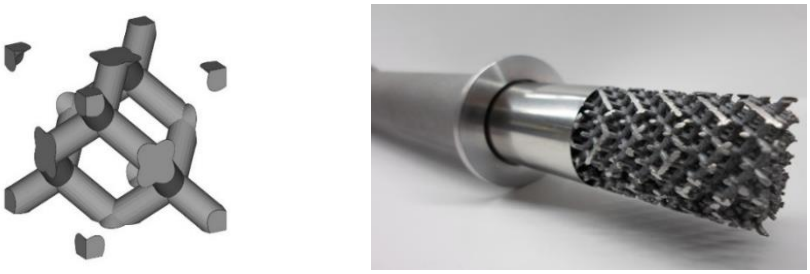

Fig. 1. Investigated Diamond unit cell (left) and resulting full geometrical structure in a tube (right)

References

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