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Topology optimized catalytic microfluidic reactors FRIDOLIN OKKELS, HENRIK BRUUS, Department of Micro and Nanotechnology, Technical University of Denmark — We show that catalytic microfluidic reactors, when optimally structured, share underlying scaling properties. The scaling is predicted theoretically and verified numerically. Analytically we show that the reaction conversion for optimal porosity scale with respect to $\sqrt{\tau_A\,\tau_R}/\tau_D$, where τ_A, τ_R and τ_D correspond to the characteristic timescales for advection, reaction, and diffusion, respectively. Furthermore, we show how to increase the reaction rate significantly by distributing the active porous material within the reactor [1] using a high-level implementation of topology optimization [2]. This optimization leads to a 20-fold increase of reaction rates as compared to corresponding optimal uniform reactors; an increase mainly due to a more efficient transport and distribution of the reactant by the pressure-driven buffer fluid. Our work points out a new, general, and potentially very powerful method of improving microfluidic reactors.

[1] F. Okkels and H. Bruus, http://www.arxiv.org/abs/physics/0608020
[2] L.H. Olesen, F. Okkels, and H. Bruus, Int. J. Num. Meth. Eng. **65**, 975 (2006)

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