CFD simulation of methanation reaction over 3D-printed monolithic catalysts: A comparative study

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Abstract

Exothermic methanation reaction from syngas to synthetic natural gas (SNG) in fixed-bed reactor suffers from hot-spot formation caused by limited heat transfer area and relatively poor radial heat transfer of catalyst particle packings. To address this issue, monolithic catalyst with excellent transport and mechanical properties is under development. In this contribution, CFD simulations of methanation reaction from syngas to SNG over three types of 3D-printed monolithic catalysts were performed. The simulation results are in good agreement with experimental ones. Compared with monolithic catalyst with honeycomb-shaped straight-channel structure or tetrahedral periodic structure, bio-inspired monolithic catalyst having the same characteristic of cancellous bone was found to be promising due to its lower pressure drop, better heat transfer, superior mass transfer and thus higher conversion of syngas. The mechanism and promising applications of 3D-printing bio-inspired monolithic catalyst are discussed.

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