Enhancing heat management in compact Fischer–Tropsch reactors via structured internals with POCS design

Martino Panzeri[a], Carlo Giorgio Visconti[a], Gianpiero Groppi[a], Enrico Tronconi[a]

[a] Laboratory of Catalysis and Catalytic Processes, Politecnico di Milano, Milan, Italy

E-mail: enrico.tronconi@polimi.it

Fischer-Tropsch synthesis (FTS) is growing in attention for its role in the sustainable production of synthetic fuels and chemicals from hydrogen and alternative carbon sources such as biomass and CO_2. To this aim, new compact tubular reactor technologies are required to efficiently upgrade those distributed resources. The design of compact FTS reactors is challenging due to strong exothermicity and temperature sensitivity. To tackle this issue, conductive structured internals are considered as a possible solution [1]. Structured internals are elements with a well-defined geometry inserted in tubular reactors: they can be washcoated with catalyst or packed with catalyst pellets, offering an effective heat-transfer pathway in the very proximity of the heat source [2]. By manufacturing them with highly conductive materials, it is possible to enable enhanced heat transfer rates from the catalyst to the reactor cooled walls. Recently, we have proposed aluminum Periodic Open Cellular Structures (POCS) with skin [2-3] as reactor internals due to their interesting properties. Our results demonstrate that properly designed POCS internals dramatically improve the FTS reactor performance over conventional packed beds, Fig.1. We have demonstrated CO conversions exceeding 70% per pass under representative industrial conditions in a semi-pilot reactor, with a marked reduction in axial temperature gradients. Our findings contribute to the broad field of process intensification and offer a promising pathway for compact, efficient FTS systems suitable for decentralized chemicals production.

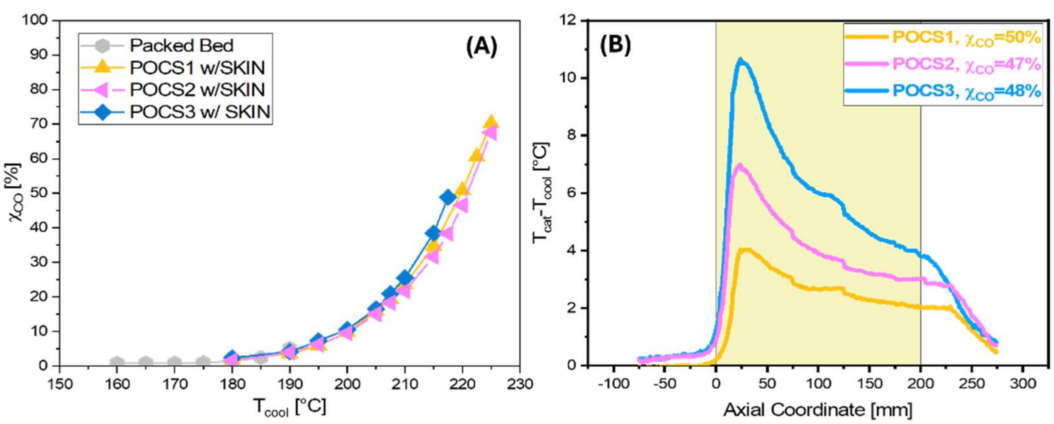

Fig 1. (A) CO conversion in packed bed and packed POCS, (B) axial T-profiles in packed POCS

Keywords: *Fischer-Tropsch synthesis, Structured reactor, Aluminum 3D printed internals*

1. F. Kapteijn, J. Moulijn, Cat. Today **2022**,383, 5-14
2. L. Fratalocchi, G. Groppi, C.G. Visconti, L. Lietti, E. Tronconi, *Cat. Today* **2022**, 383, 15-20.
3. C.G. Visconti, M. Panzeri, G. Groppi, E. Tronconi, *Chem. Eng. Journal* **2024**, 481, 148469.