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ABSTRACT:

3D Printed Catalytic Converters for Enhanced Exhaust Emissions Aftertreatment

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Catalytic convertor substrates with 3-dimensionally oriented channels were prepared using both extrusion and digital light processing technology (DLP) 3D printers and, following washcoating with a composite catalyst, were tested in the aftertreatment of emissions from a simulated diesel-methane engine. CAD software was used to design the substrates and printing was done with a self-developed photosensitive ink loaded with cordierite. All 3D printed substrates demonstrated significantly higher catalytic activity in methane oxidation than a 400 CPSI commercial honeycomb substrate prepared by extrusion [1,2]. This enhancement is attributed to the higher turbulence/mass transfer and surface area than that possible using conventional straight-channel substrates. The findings provide proof of concept evidence that 3D printing is a suitable means of preparing a catalytic converter prototype with higher reaction activity than a conventionally extruded structure. This has significant implications for the design and potential mass production of new catalytic converters with enhanced efficiencies.

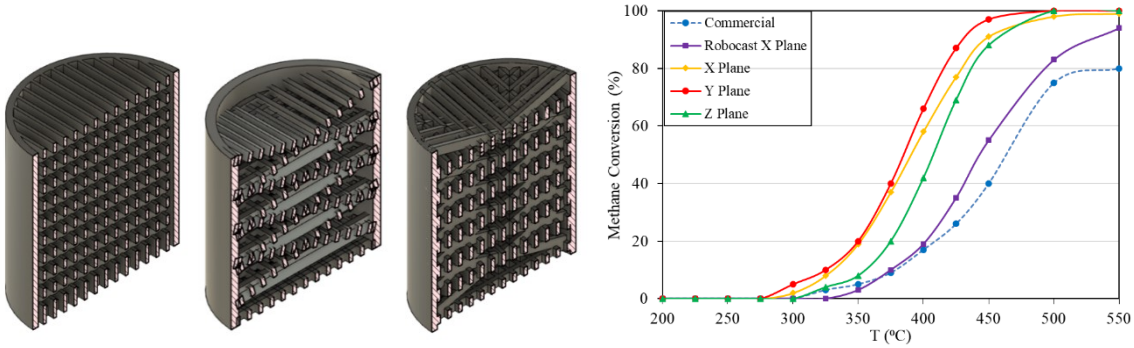

Fig. 1. (left) CAD images showing variation in X-, Y- and Z-planes; (right) methane oxidation catalyst activity; 5% CH_4:10% O_2:85% He; total flow 100 ml/min.

[1] S. Hajimirzaee, A.M. Doyle, Fuel, 274, 117848 (2020).

[2] S. Hajimirzaee, D. Shaw, P. Howard and A.M. Doyle, Chem. Eng. Sci., 231, 116287 (2020).