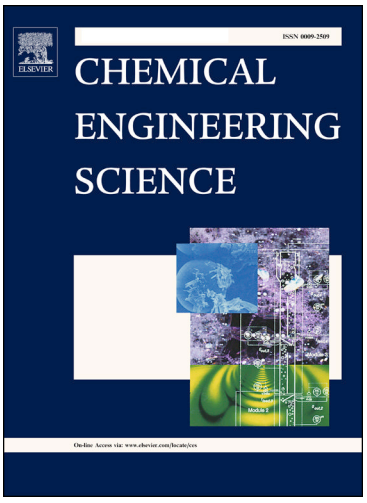

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Turbulence generation after a monolith in automotive catalytic converters

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Abstract

This work reports theoretical studies of flow behaviour in a monolith outlet zone for different Reynolds numbers covering laminar and transitional/turbulent flow regimes. Monolith type substrate is the core part of the automotive catalytic converter. Due to computational limitations, most numerical models of the converter represent the monolith as a continuum, averaging the effect of the solid and the open space on the flow. This strategy is useful to study the macro-structure of the flow, however, it does not capture the exact behaviour of an actual honeycomb type structure, especially at its entrance and exit. In this work, which is a continuation of the publication by Cornejo et al. [1], a series of 3D LES and RANS simulations are performed using different discrete channel geometry to study and quantify the velocity fluctuations of flow leaving a monolith. The results show that above a certain Reynolds number the instability of the flow after the monolith is significant, leading to turbulence generation. The velocity fluctuations are mainly explained by the flow past the outlet of the monolith, and their magnitude is related to the Reynolds number based on the thickness of the walls between channels. An expression for this critical Reynolds number has been designed and verified against numerical simulations. Parametric studies are carried out to illustrate the influence of the Reynolds number on the appearance of flow fluctuations at the outlet zone of the monolith.

Keywords: Catalytic converter, monolith, channels, LES, turbulence, transition

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