Kinematic mixing and heat transfer enhancement in chaotic split-and-recombine heat exchangers/reactors

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Résumé en anglais	Small system dimensions, low fluid velocity and high viscosity are all factors that hinder the production of turbulence. Enhancing mixing and heat transfer under these conditions, while keeping sufficient residence times and moderate pressure drops, constitutes a real challenge. Adapted to low-Reynolds flow regimes, Split-And-Recombine (SAR) static mixer and heat exchanger configurations are designed to exploit flow energy to produce chaotic advection and promote diffusion at the molecular level. The present work explores the hydrodynamic and thermal character of the SAR flow and compares, through CFD simulations, two such geometries namely SAR-1 and SAR-2, with two other reference configurations: a square three-dimensional continuous flow geometry (3D-Flow) and a plain square channel. Efficient convective heat transfer is achieved in deeply laminar creeping flow. Relative enhancements up to 1700% can be achieved compared to plain square channel flow, with a moderate increase in the pressure drop that does not exceed 17% for the SAR-2 configuration showing the better performance.
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