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Twisted architecture for enhancement of passive micromixing in a wide range of Reynolds numbers

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Highlights

- Incorporating a novel twist microstructure in straight and serpentine micromixers.
- Establishing a numerical method to analyze the flow field within the micromixers.
- Fabricating 3D microstructure of micromixers by high-precision Micromilling method.
- Demonstrating high mixing efficiencies over a wide range of Re numbers.

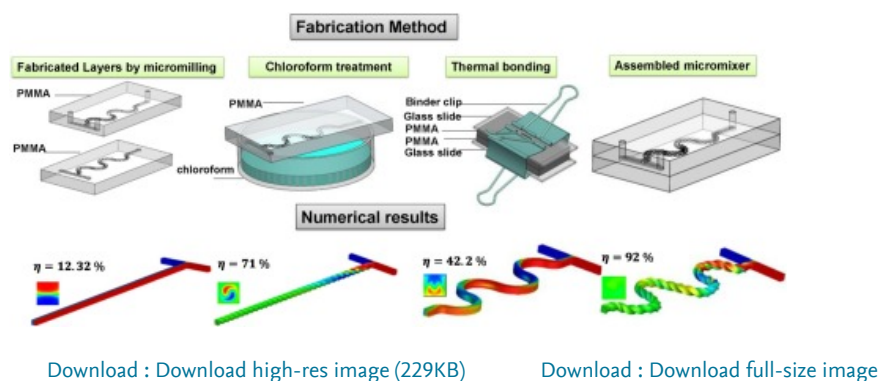
Abstract

Micromixers present essential roles in providing homogeneous mixtures in microfluidic systems. It is of critical importance to introduce strategies to increase the mixing efficiency of passive micromixers, capable of operating at high efficiency levels over a wide range of Reynolds (Re) numbers. To this end, a novel design of twisted microstructure for enhancing mixing performance in a wide range of Reynolds numbers was introduced. Incorporating this microstructure with straight and serpentine micromixers was numerically and experimentally investigated. Micromixers with twisted microstructures were

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fabricated in Poly(methyl methacrylate) (PMMA) using high-precision micromilling. The effects of Reynolds number, pitch number, and channel hydraulic diameter on mixing efficiency and pressure drop were analyzed. Results revealed that the twist architecture could increase mixing efficiency significantly with very low pressure drop of up to 0.89 kPa. The twisted serpentine micromixer could narrow the disparity of mixing efficiency from 87% (Re=10) to 98% (Re=400). High mixing efficiency could be achieved within a length of 4.8 mm in the twisted serpentine micromixer with a hydraulic diameter of 300 μm . Taken together, the twisted structure could be incorporated with various geometries to create compact and high efficiency micromixers for operation in a wide range of Re numbers.

Graphical abstract



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Keywords

Dean vortices; Micromilling; Microfluidics; Twisted structure; Passive micromixer

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