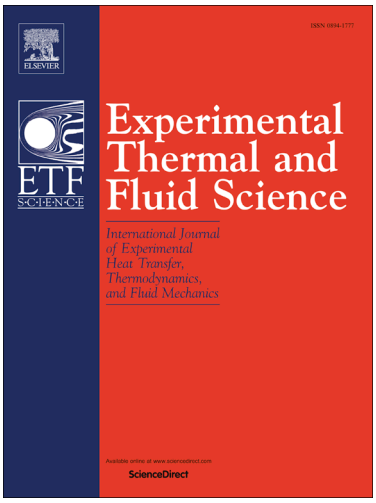

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Mixing in planar spiral microchannel

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Abstract

The mixing characteristics in spiral microhannels are studied experimentally and numerically in this work. Effect of cross section aspect ratio (α = 0.3-1.2) on mixing characteristic is studied both qualitatively and quantitatively using top as well as side view details. The study is carried out for a wide range of Reynolds number (1-468) and Dean number (0.1-75). The pathline behaviour and species fraction are tracked to understand the effect of Reynolds number and aspect ratio on mixing. It is observed that spiral microchannel with higher aspect ratio results in better mixing as compared to smaller aspect ratio microchannel. An optimal Reynolds number at which the mixing efficiency is maximized is observed from the experimental data. It is observed that the fluid is trapped within the vortex core at higher Reynolds number, leading to a reduction in mixing efficiency and appearance of a maxima. Frequent twisting of pathlines is further identified to affect mixing and leads to a dependence of mixing on aspect ratio. The analysis presented in this work is of significance in the design of spiral microchannel based microreactors.

Keywords: Dean vortices, aspect ratio, pathline, micromixer, species transport

1. Introduction

Mixing of two or more fluids is a basic requirement in any chemical or biochemical process. With the advancement of Lab-on-chip devices for chemical and biochemical applications, there is a growing need for realizing mixing at microscale. In this direction, various types of passive as well as active designs for micromixers have been proposed by different research groups. However, passive type of micromixers are more promising because of their self-sustaining flow behavior and compatibility with µTAS (Micro Total Analysis systems) since they do not require external power. Design of almost all passive micromixers is broadly based on the techniques of