

Flow Field, Heat Transfer and Mixing in Segmented Plug Flow in Microchannels

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Abstract

Multiphase microfluidics offers a great number of opportunities in different applications ranging from analytical chemistry, chemical engineering, pharmaceutical and biomedical sciences, to life science. To understand the flow fields within liquid plugs in microchannels, theoretical models are presented. These models offer conveniences for subsequent analyses because transport phenomena can be analyzed directly with the known flow fields.

Different applications are demonstrated with the proposed models, such as the heat transfer in plugs and the chaotic mixing in plugs moving in meandering microchannels. The analyses of heat transfer showed that the heat transfer process can be significantly enhanced by the recirculating vortices as compared to the single phase flow. The study of chaotic mixing showed that rapid chaotic mixing can be achieved in plugs moving in meandering microchannels.