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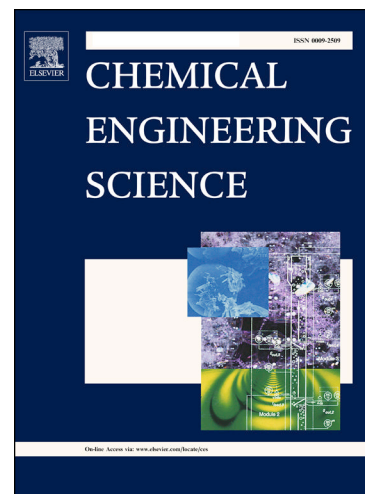
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# Three-dimensional simulation of droplet dynamics in planar contraction microchannel

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## Abstract

In droplet-based microfluidic systems, microchannel design plays a primary role in transport and manipulation of liquid droplets. The objective of this paper is to investigate dynamics of a droplet in planar contraction microchannel via three-dimensional numerical simulation and theoretical analysis. In particular, this study characterizes three regimes of the droplet dynamics, namely, trap, squeeze and breakup, depending on capillary number ( $Ca$ ) and contraction ratio ( $C$ ). In addition, theoretical models have been proposed to describe transitions from one to another regime as a function of  $Ca$  and  $C$ . For the transition from trap to squeeze, the critical capillary number ( $Ca_{lc}$ ) was found to follow  $Ca_{lc} = a(C^M - 1)$ , whereas the critical capillary number ( $Ca_{llc}$ ) of transition from squeeze to breakup corresponds to  $Ca_{llc} = c_1 C^{-1}$ . Furthermore, details of the droplet dynamics along

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