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CFD analysis of microfluidic droplet formation in non–Newtonian liquid

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Abstract

A three-dimensional, volume-of-fluid (VOF) based CFD model is presented to investigate droplet formation in a microfluidic T-junction. Genesis of Newtonian droplets in non-Newtonian liquid is numerically studied and characterized in three different regimes, viz., squeezing, dripping and jetting. Various influencing factors such as, continuous and dispersed phase flow rates, interfacial tension, and non-Newtonian rheological parameters are analyzed to understand droplet formation mechanism. Droplet shape is reported by defining a deformation index. Near spherical droplets are realized in dripping and jetting regimes. However, plug shaped droplets are observed in squeezing regime. It is found that rheological parameters have significant effect on the droplet length, volume, and its formation regime. The formation frequency increases with increasing effective viscosity however, the droplet volume decreases. This work effectively provides the fundamental insights into microfluidic droplet formation characteristics in non-Newtonian liquids.

Keywords: Non-Newtonian liquid, Droplet, T–junction microchannel,

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