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*Abstract*

# Droplet Formation in a Cross-Junction Microfluidic Channel with Non-Newtonian Dispersed Phase †

**Maryam Fatehifar *, Alistair Revell and Masoud Jabbari**

Department of Mechanical, Aerospace and Civil Engineering, The University of Manchester, Manchester M13 9PL, UK; alistair.revell@manchester.ac.uk (A.R.); m.jabbari@manchester.ac.uk (M.J.)

* Correspondence: maryam.fatehifar@postgrad.manchester.ac.uk

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**Abstract:** Microfluidics enables generating series of isolated droplets for high-throughput screening. As many biological/chemical solutions are of shear thinning non-Newtonian nature, we studied non-Newtonian droplet generation to improve the reliability of simulation results in real-life assays. We considered non-Newtonian power-law behaviour for Xanthan gum aqueous solution as the dispersed phase, and Newtonian canola oil as the continuous phase. Simulations were performed in OpenFOAM, using the inter foam solver and volume of fluid (VOF) method. A cross-junction geometry with each inlet and outlet channel height (H) and width (W) equal to 50 micrometers with slight contractions in the conjunctions was used to gain a better monodispersity. Following validation of the numerical setup, we conducted a series of tests to provide novel insight into this configuration. With a capillary number, of 0.01, dispersed phase to continuous phase flow-rate ratio of 0.05, and contact angle of 160°, simulations revealed that, by increasing the Xanthan gum concentration (0, 800, 1500, 2500 ppm) or, in other words, decreasing the n-flow behaviour index from 1 to 0.491, 0.389, and 0.302 in power-law model, (a) breakup of the dispersed phase thread occurred at 0.0365, 0.0430, 0.0440, and 0.0450 s; (b) the dimensionless width of the thread at the main channel entrance increased from 0 to 0.066, 0.096, and 0.16; and (c) the dimensionless droplet diameter decreased from 0.76 to 0.72, 0.68, and 0.67, respectively. Our next plan is to study effect of shear-thinning behaviour on droplet generation in different Ca and flow-rate ratios.

**Keywords:** simulation; droplet microfluidics; non-Newtonian fluid; volume of fluid

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