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Cell-encapsulating droplet formation in a flow-focusing configuration MOHAMMAD NOORANIDOOST, Department of Mechanical and Aerospace Engineering, University of Central Florida, Orlando, Florida 32816, USA, MAJID HAGHSHENAS, Department of Mechanical and Aerospace Engineering, University of Central Florida, METIN MURADOGLU, Department of Mechanical Engineering, Ko University, RANGANATHAN KUMAR, Department of Mechanical and Aerospace Engineering, University of Central Florida — Cell encapsulation in a flow-focusing microchannel is computationally studied using a three- phase front-tracking method. A series of cells with predefined size and frequency are encapsulated by the disperse phase forming compound droplets suspended in an outer fluid. Compound droplet formations are examined for a wide range of parameters including cell size, viscosity ratio ($\beta = \mu_{\text{out}}/\mu_{\text{in}}$) and capillary number of the continuous (Ca_{out}) and disperse (Ca_{in}) phases. An extensive simulation on Ca_{out} and Ca_{in} for different viscosity ratios (β =0.5,1,2 and 4) reveals a region in which a uniform compound droplet production is most likely to occur. Depending on the fluid and flow parameters, compound droplets can consist of one or multiple cells, while for some cases no cells are found in a compound droplet. For a fixed Ca_{out} and Ca_{in} in the favorable region, effects of viscosity ratio and cell size are studied to control cell encapsulation dynamics. It is found that decreasing viscosity of the outer phase results in higher rate of cell encapsulation, while decreasing cell size adversely impacts compound droplet generation.

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