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NUMERICAL ANALYSIS ON TWO-PHASE VORTEX AT MICROFLUIDIC Y-JUNCTIONS

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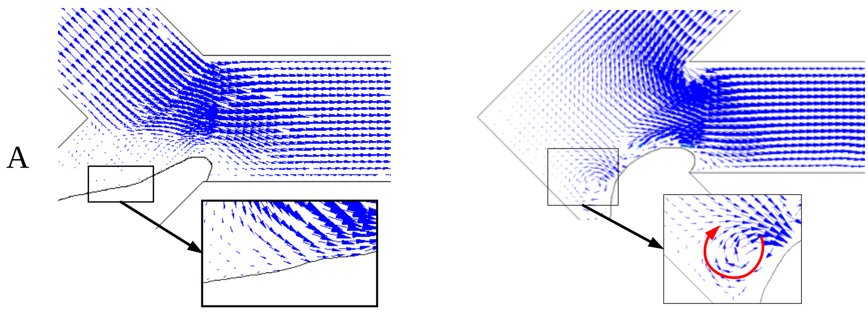
Lab on a chip can make biological or chemical laboratories scaling to a square centimetre chip [1]. Microfluidic chips in biomedical multiphase flow research areas have a wide range of applications, such as chemical synthesis, bio-pharmaceuticals, drug screening, as well as the emulsion technology in the food and cosmetic industries, etc. According to the different microchannel geometry, it can be designed and modified to various usages of micro-components [2-4]. While more analysis concentrated in the two-phase mixing flow pattern in Y-junctions microchannels, analysis of the droplet formation process and mechanism did not get a wide accepted result.
It is found that the Y-angle of the microfluidic Y-junctions, capillary number of continuous phase have a great influence on the two-phase vortex, as shown in Fig.1 and Fig.2, by making use of numerical simulation on two-phase vortex at microfluidic Y-junctions based on the two-phase flow interface tracking method. But the channel depth is not the main factors result in the vortex. The vortex in continuous phase enhances its transmission effect and influences the interface of dispersed phase. At the same time the dispersed phase interface is forced to reduce its stability, thereby the length of dispersed droplet is dragged by continuous phase liquid becomes shorter. So the vortex will result in the differed generation cycle and size of the droplet further.

(a) α=90˚ (b) α= -90˚



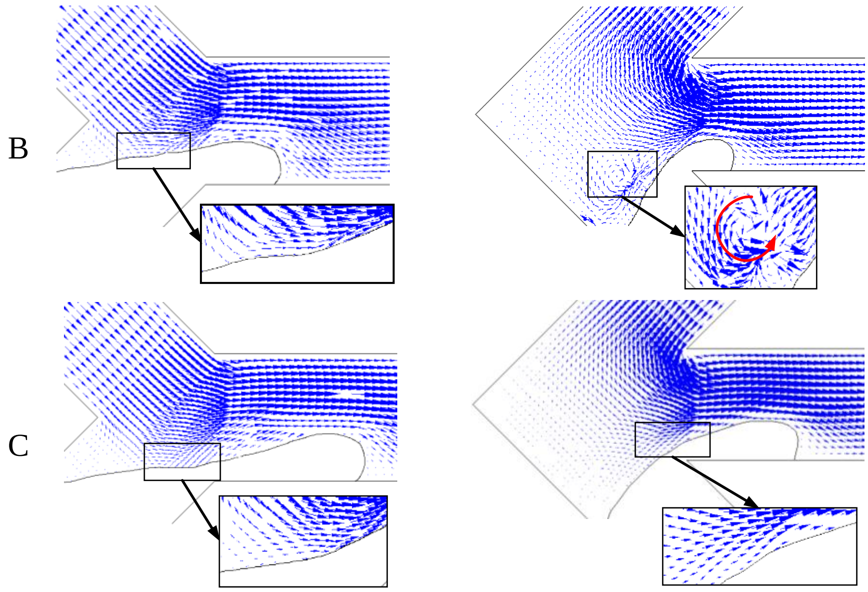


Fig.1 Numerical simulation results of droplet formation processes of Y-junctions and Anti-Y-junctions microchannles (Ca_d=0.0013， Ca_c=0.027)

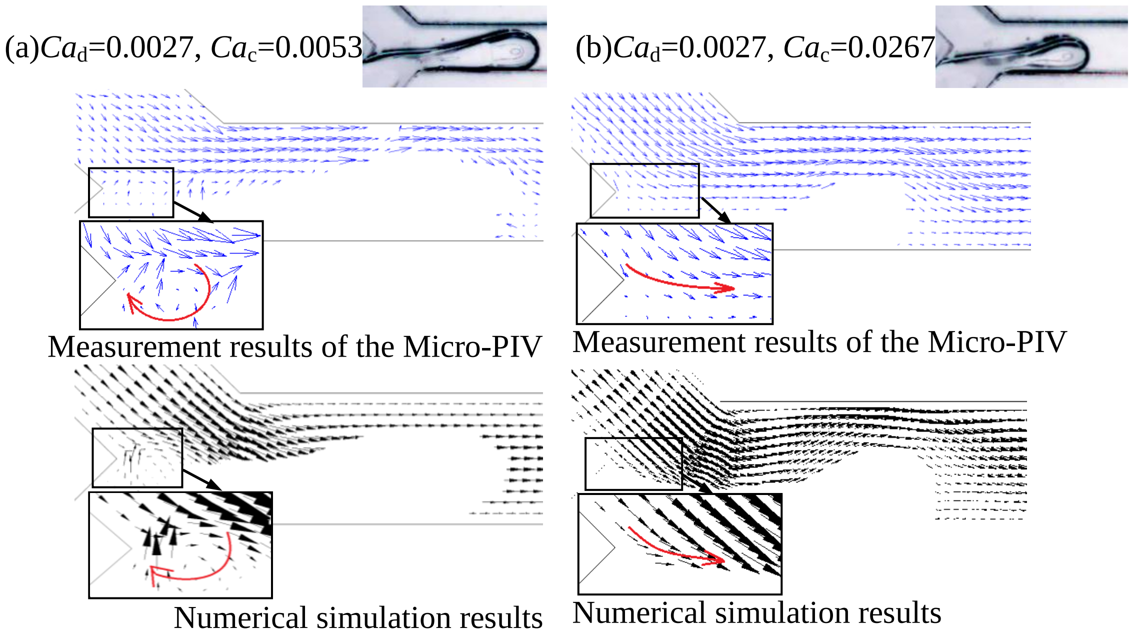


Fig.2 The in-plane velocities in the continuous phase before the droplet break-up (α=90˚)

REFERENCES

[1] Wang P, Chen B, Numerical simulation of micro-droplet breakup in T-shaped micro-fluidic chip, *Journal of Chemical Industry and Engineering (China)*, Vol. **63**, pp. 999-1003, 2012.

[2] Tarchichi N, Chollet F, Manceau JF. New regime of droplet generation in a T-shape microfluidic junction. *Microfluidics and Nanofluidics*, Vol. **14**, pp. 45-51, 2013.

[3] Glawdel T, Elbuken C, Ren CL. Droplet formation in microfluidic T-junction generators operating in the transitional regime: I. Experimental Observations. *Physical Review E*, Vol. **85(1)**, pp. 016322, 2012.