MICROSCALE BACKGROUND ORIENTED SCHLIEREN FOR FLOW VISUALIZATION IN A MICROFLUIDIC OSCILLATOR

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ABSTRACT: In this study, we employ the microscale Background-Oriented Schlieren (μBOS) to facilitate measurement of inhomogeneities in a microfluidic oscillator. Mixing of dilute aqueous methanol and water in a microfluidic oscillator leads to gradient of refractive index. When random-dot pattern is placed in the background of the test volume, light deflection causes particle shifts in the acquired image. Using cross correlation of particle image velocimetry (PIV) analysis to compare the distorted image with the original background, we are able to reveal the displacements of dots that are proportional to gradients of refractive index presented in the microfluidic oscillator. Once the relation between concentration and refractive index is known, we can quantify the inhomogeneities in the microfluidic oscillator according to the vector field of displacement. From our μBOS experiment, Fig. 1(a) and Fig. 1 (b) show the vector field and magnitude of the displacement in the microfluidic oscillator. For comparison, conventional micro-schlieren image and fluorescence image are present in Fig. 1(c) [1] and Fig. 1 (d) [2]. From Fig. 1 (a) and Fig. 1 (b), we find large magnitude of displacement near the concave surface, indicating that part of the high-concentration fluid is entrained by the dominant vortex. This entrainment promotes the transverse mass transport and enhances the mixing process on both sides behind the obstacle. Hence, μBOS is able to provide detailed information of microscale mass transport and offer a valuable insight into the mixing phenomena that other methods fail to deliver.

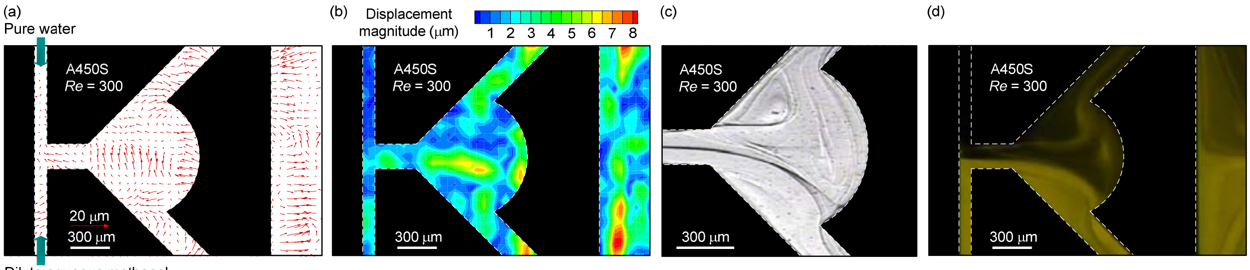

Fig. 1 Mixing of dilute aqueous methanol and water in a microfluidic oscillator, (a) displacement vectors (μBOS), (b) magnitude of the displacement (μBOS), (c) flow structure recorded by micro-schlieren technique [1], (d) fluorescence image [2]

References

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