

Geometrical Optimization of Helical Flow in Grooved Micromixers

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Supplementary Information: Comparison of helical flow characterization methods

Previous characterization methods to quantify the extent of helical flow over patterned grooves have included, among other measures, the maximum shear flow $(v_x/v_y)_{\max}$, typically evaluated near the top of the channel.^{1, 2} Although $(v_x/v_y)_{\max}$ may be readily calculated from experiment or simulation, there are certain geometries with notably different helical flow magnitudes that yield the same value of $(v_x/v_y)_{\max}$. Figure C1 displays the normalized transverse flow magnitude η as a function of $(v_x/v_y)_{\max}$ for several hundred SGM geometries discussed in this article. For devices that exhibit low magnitudes of helical flow, η is roughly proportional to $(v_x/v_y)_{\max}$. However, as the magnitude of helical flow increases, there exist many cases where the same value of $(v_x/v_y)_{\max}$ leads to different flow behavior. For example, there are more than 5 SGM geometries considered in this study that possess the same value of $(v_x/v_y)_{\max} = 0.235$, however, these same devices demonstrate a range of

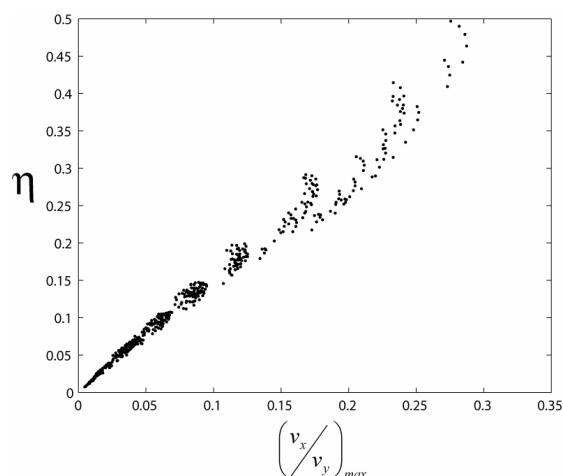


Figure C1. Values of η (calculated via equation 2) vs. values of $(v_x/v_y)_{\max}$ for the range of SGM geometries discussed in the manuscript

calculated η values in the range $0.32 \leq \eta \leq 0.42$. This effect is further highlighted in figure C2, which shows (v_x/v_y) values along the normalized height of two SGMs. Both devices exhibit the same $(v_x/v_y)_{\max}$ value, located at the top of the SGM. Moreover, the (v_x/v_y) profile of the two SGMs are very similar near the top of the micro-channel, however, the (v_x/v_y) profile of the two SGMs changes drastically near the bottom of the channel, that is, near the grooves. The discrepancy between the profiles of the two SGMs is further highlighted in figure C2(b), which displays the y -averaged normalized x -velocity profile of the same two mixers shown in figure C2(a). It is clear that the magnitude of helical flow is greater in one case (shown in the red data).

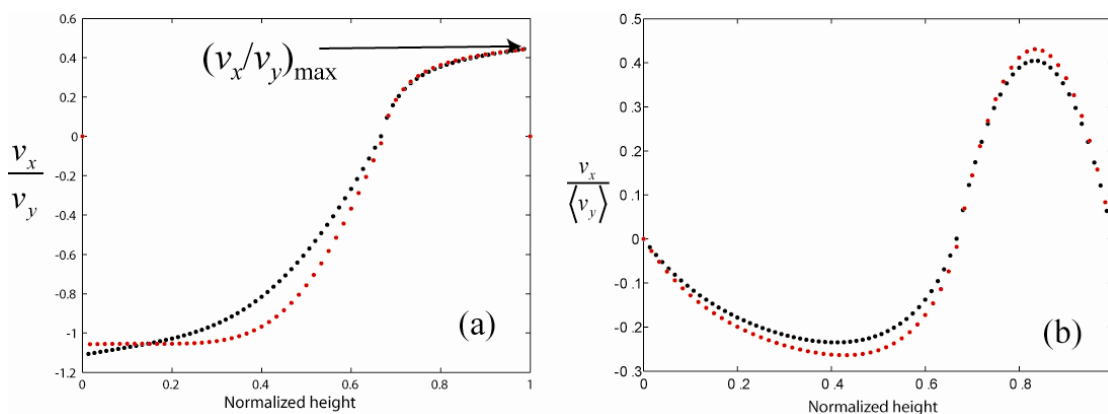


Figure C2. (a) (v_x/v_y) vs. the normalized height for two SGMS exhibiting the same value of $(v_x/v_y)_{\max}$. (b) Normalized y -averaged x -velocity profile vs. normalized height for the same SGMS shown in (a).

1. A. D. Stroock, S. K. Dertinger, G. M. Whitesides and A. Ajdari, *Analytical Chemistry*, 2002, **74**, 5306-5312.
2. F. Schonfeld and S. Hardt, *Aiche Journal*, 2004, **50**, 771-778.