Particle based simulation of rarefied gas mixing in a T-shape micromixer

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ABSTRACT

In many micro-fluidic devices, for instance micro-reactors, micro-turbines, micromixers, micro-pumps etc., mixing of gases governs the efficiency of the system. The gas flow in these micro-devices is usually simulated by means of the direct simulation monte carlo (DSMC) method since the assumption of continuum breaks down on such a small scale.

However, the work done so far in simulation of gas mixing in micromixers is either based on the 2D-DSMC because of computational expence or on simplified CFD method. None of these approaches takes into account real particle scale dynamics to simulate the process of gas mixing. Therefore, this work tries to fill this gap by presenting the results of the 3D-DSMC simulation of gas mixing (N_2 and CO) in a T-shape micromixer (Fig. 1).

The mixing process is studied with respect to the several operating parameters such as wall characteristics, gas temperature, gas velocity etc. The effects of these parameters show interesting discrepancies in results as compared to 2D-DSMC and CFD simulation results. For instance, the predicted mixing length by 3D-DSMC is larger then the previous 2D-DSMC results [1] and far less then the CFD simulation predictions [2]. Moreover, since the gas mixing is simulated in 3-dimensions, the presented results are expected to be quite helpful in optimizing the gas mixing process in a real T-shape micro-channel.

Keywords – DSMC, Mixing, T-shape, Micromixer

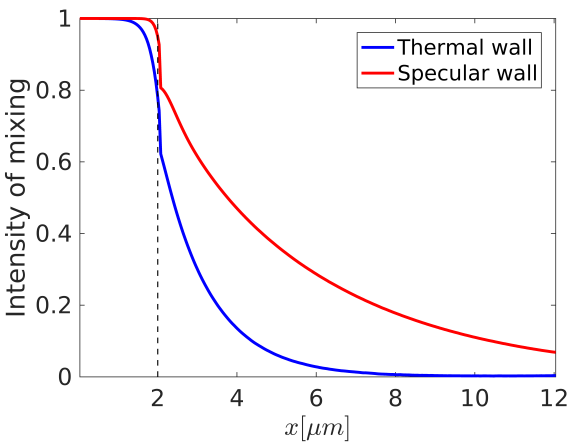

Figure 1: Effect of wall characteristics in DSMC simulation of a T-shape micromixer.

References

[1] M. Le and L. Hassan, DSMC simulation of gas mixing in T-shape micromixer, *Appl. Therm. Eng.* **27** 2370–2377 (2007).

[2] D. Gobby, P. Angeli and A. Gavriilidis, Mixing characteristics of T-type microfluidic mixers, *J. of Micromech. and Microeng.* **11** 126–132 (2001).