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Asymmetrical microbubble streaming in a confined geometry J.-C. TSAI, DAVID HANSEN, SASCHA HILGENFELDT, Northwestern University — Ultrasound-driven oscillating microbubbles situated on a substrate induce steady streaming flows that show great potential in cellular-scale force actuation for bioengineering or in microfluidic applications [1-3]. We have demonstrated for a streaming flow of azimuthal symmetry around a single bubble that the presence of a second wall opposite to the substrate does not compromise the flow speed but instead enhances the circulation efficiency. Additionally, we show here that a continuous spectrum of flow patterns ranging from localized vortex circulations to transport-dominated directional flows can be created by breaking the symmetry either passively (by changing the subtrate topology) or actively (by imposing a large-scale flow field). The spatial confinement provides a dominant lengthscale that simplifies the flow patterns and enhances the transport efficiency. Asymmetrical microbubble streaming, with its capability to fine-tune the relative strength between the circulation and forward transport, offers a continuously adjustable tool for microfluidic applications that demand the simultaneous optimization of mixing rate and transport efficiency. Ref: [1] P. Marmottant and S. Hilgenfeldt, Nature 423, 153 (2003). [2] P. Marmottant and S. Hilgenfeldt, Proc. Natl. Acad. Science USA, 101, 9523 (2004). [3] P. Marmottant, J.-P. Raven, H. Gardeniers, J. G. Bomer, and S. Hilgenfeldt, J. Fluid Mech., vol.568, 109 (2006).

J.-C. Tsai
Dept. of Engg. Science and Applied Math & Dept. of Mech-E, Northwestern University

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