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Simultaneous DDPIV of the elastic wall and working fluid near the reflection sight of a valveless impedance pump[1] JOHN MEIER, DEREK RINDERKNECHT, MORTEZA GHARIB, California Institute of Technology — Predicting the pressure and flow behavior in microscale impedance pumps is crucial for implementing the pump into microfluidic devices. Studies by Hickerson and Gharib (J. Fluid Mech. 2006) and Avrahami and Gharib (J. Fluid Mech. 2008) highlight the role of wave dynamics, reflections, and resonance in valveless impedance pumps. In this study we investigate the pump performance and motion of the pump wall and working fluid in a 20mm x 10mm x 500μm planar impedance pump. Elastic membranes impregnated with tracer particles were fabricated in-house with varying mechanical properties. For the first time, using the 3-dimensional DPIV technique known as defocusing digital particle image velocimetry (DDPIV), we were able to simultaneously track the motions of the elastic pump wall and the fluid within the pump. We study the partial pulse reflection at the end of the pump where the elastic membrane is coupled to the rigid flow loop. The behavior of this reflection is critical in determining the performance characteristics of the pump and understanding how to design practical impedance pump devices for microfluidic applications.

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