

### Video 1 (Bubble formation)

ESI video 1 shows the chip filling process and bubble formation. Our microfluidic chip comprises hundreds of dead-ended bubble side channels on both sides of the DNA sample channel. Hydrophobic treatment of the PDMS structures enables simple and well-controlled formation of bubbles in the side channels. DNA solution is initially injected in the chip with an appropriate flow rate (300  $\text{nL s}^{-1}$ ) to ensure stable air bubble formation, resulting in multiple air-liquid interfaces adjacent to the DNA sample solution in the main channel (width 600  $\mu\text{m}$ ).

### Video 2 (Streaming flow)

ESI video 2 shows how fluorescent bacteria in the suspension enable to trace the streamlines of the induced flow patterns once the ultrasound is switched on (channel width 600  $\mu\text{m}$ ). The microstreaming flow patterns are nearly symmetrical with respect to the position of the bubbles and the axis of the main channel. Two vortices are generated by each protruding bubble with the center of rotations in the vicinity of the bubble/main channel wall intersection on either side. Closer inspection reveals slightly asymmetric flow patterns of the otherwise stable vortex array.

### Video 3 (Bubble oscillation)

ESI video 3 shows a high-speed bright field microscopy video (taken at 5000 frames per second) of two symmetrical microvortices generated by ultrasonic actuation of a trapped bubble (see also Fig. 3c). As pressure fluctuations in the air bubble lead to a volume change, acoustic streaming is generated by the rapid ultrasound-driven radial oscillation of the bubble interface. High shear forces occur in regions with locally fast streaming flow and correspondingly high velocity gradients. High acoustic streaming stress occurs, in particular tensile stress generated in the counterrotating flow patterns and shear stress in regions with high velocity gradients. Side channel width is 200  $\mu\text{m}$ . Ultrasound parameters are 60 W, 40 kHz. A suspension of bacteria has been used in this case for visualization the microstreaming flow patterns.