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Figure S1. The distribution of the fluorescently labeled higher-density sample flow over the t-junction transducer for increasing volume flows (i-iv) and total volume flows ranging from 4.25-85.0 #L min-1. The left column of images (transducer off) shows the laminar flows with evident decrease in diffusion between the sample and sheath liquids for higher flow velocities. The right column (transducer on) shows a decline in the mixing efficiency with higher flow velocities as seen from the less broadened sample fluorescence profile.

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Figure S2. The evident effect of on-chip mixing was demonstrated with celllysis in the device. A sample flow of vital K12 E. coli cells with sheath flows of lysing reagent was studied. (a) When the transducer is off, no mixing occurs apart from diffusion. The PI containing fluid generates a diffuse fluorescence in the middle flow. Apart form some cells at the fluid interface that are in contact with the lysing fluid, no dead cells are detected (observed as white lines in the image). Bright dots originate from impurities sticking to the channel walls. (b) When the transducer is activated, the fluids mix and the cells are chemically lysed (observed as white lines in the image) upon extended interaction with the lysing reagent. The redistribution of the PI containing lysing reagent due to mixing is observed as a diffuse fluorescent signal. Images were taken with x200 magnification and the system had a total volume flow of 3.4 #L min-1 (0.8 mm s-1).



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Figure S3. The fluorescence peak broadening as a function of driving frequency for (a) the t-junction transducer and (b) the mid-channel transducer.

Movie S4. The movie shows the mixing process for the mid-channel transducer in realtime. The fluorescent sample flow is the fluid of lower density (DI water with Rhodamine B) compared to the sheath fluids (17 % glycerol in DI water), i.e. the fluids have a density difference of 4.5 %.