

Out-of-Plane Integration of a Multimode Optical Fiber for Single Particle/Cell detection at Multiple Points on a Microfluidic Device with Applications to Particle/Cell Counting, Velocimetry, Size Discrimination and the Analysis of Single Cell Lysate Injections

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Microchip dimensions.

Two-layer PDMS/glass hybrid microfluidic device (50mm x 70mm) composed of 50 μ m thick bottom layer (fluidic channel manifold) and 5mm thick top layer (micropump manifold). All the microfluidic channels were 50 μ m wide and 18 μ m deep except the waste channels (where the micropumps were integrated; they were 100 μ m wide and 18 μ m deep). Thickness of the PDMS layer between fluidic channel and the micropump (vertical gap) was 32 μ m. All the micropumps were 20 μ m deep and total surface area was 200 μ m x 200 μ m.

Cell lysing as a function of cell size. Figure 5 shows consecutive image frames of the lysis of 4 individual Jurkat cells loaded with 6-CFDA. The images of the cells were taken with a CCD camera at a frame rate of 30 Hz. The first three images, t_1 to t_3 , show three cells approaching the intersection. In the fourth image (t_4), the first cell that seems smaller than the second one passed by the intersection without observable lysing, whereas second larger cell was completely lysed by the electric field (t_6 - t_7). In the next frames (t_8 - t_{12}), a part of the fluorescent lysate of the second cell is seen traveling into and down the separation channel electrophoretically. The cell debris and the residue part of lysate were transported into the waste channel. The process is observable for the remaining two cells. The third cell, as the smallest cell, escaped towards waste reservoir without lysing and the fourth cell is completely lysed but with a different fraction of the lysate being injected compared to the second cell. As illustrated in t_8 and t_{11} , lysate injection of the second cell into the separation channel is more than fourth cell. The cell images after passing the intersection (t_4 and t_8) are distorted because the exposure time of the CCD camera was long compared to these high cell velocities.

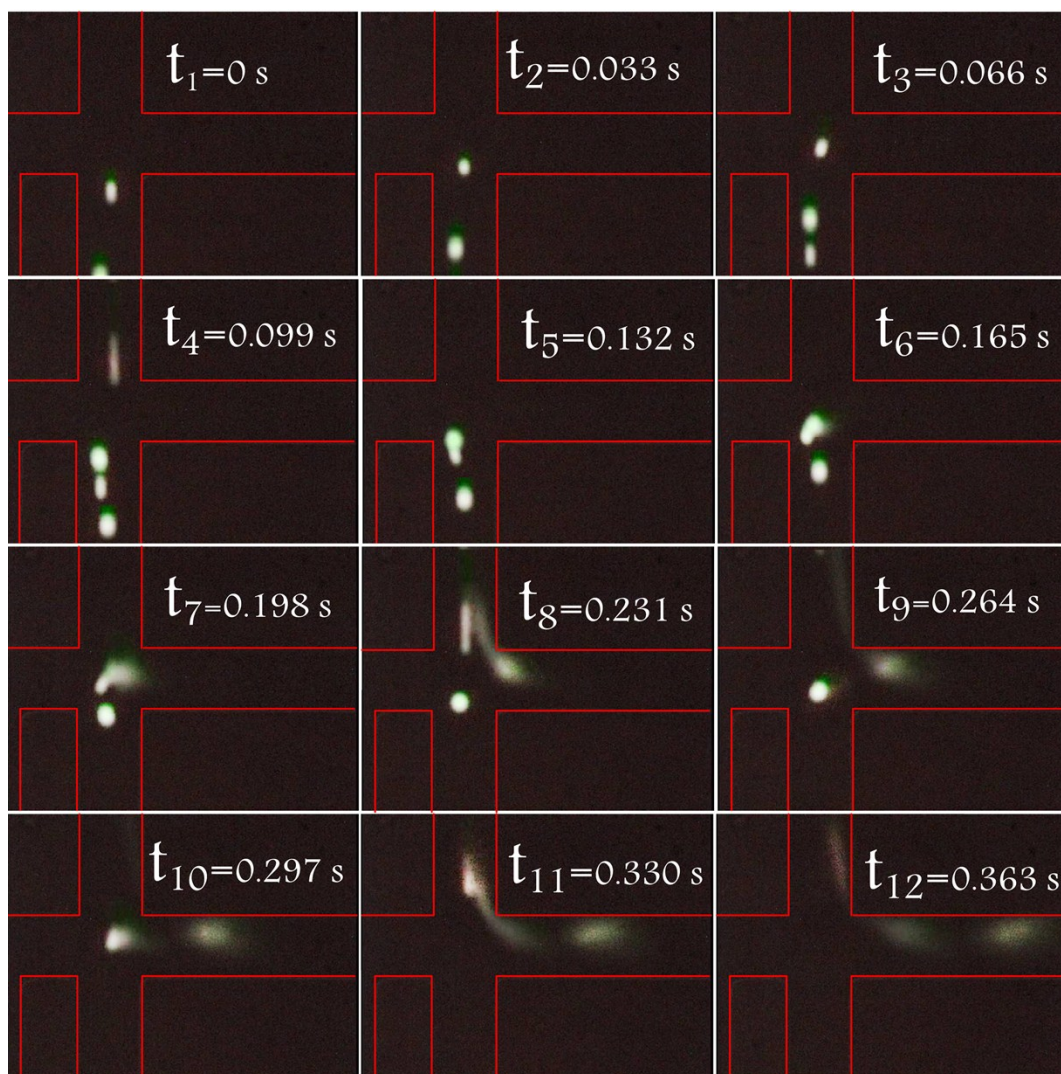


Figure S1: Images obtained from a video of four Jurkat cells lysing. The cells in frames t_1 - t_5 are hydrodynamically transported toward the lysis intersection. In frame t_6 , second cell at the intersection encounter an electric field that causes it to lyse. In frames t_7 - t_{12} , the cell lysate is electrophoretically transported down the separation channel while the cell debris is shunted to the waste channel.