Electronic Supplementary Material (ESI) for Lab on a Chip.

Supplementary information

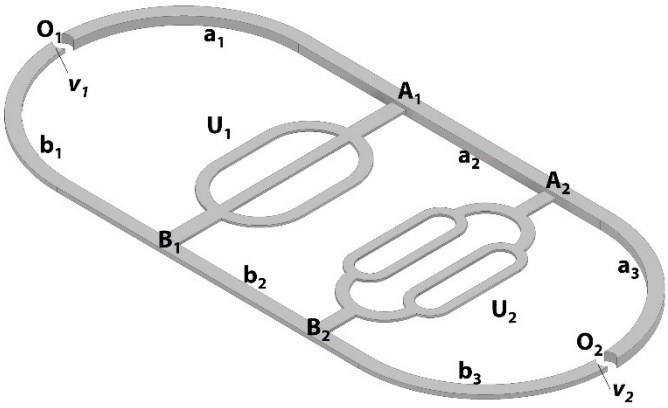

Figure S1. Fluid network of an example multi-channel, multi-unit UniChip. O_1 and O_2 are I/O ports; U_1 with 3 branches and U_2 with 4 branches are two unidirectional channel networks (UCNs); a_1, a_2, a_3, b_1, b_2, and b_3 are supporting channels. R_x is the hydraulic resistance of channel x. $\frac{R_{a_1}}{R_{b_1}} = \frac{R_{a_2}}{R_{b_2}} = \frac{R_{a_3}}{R_{b_3}}$ (by designing channel a_i and bi to have same length and width but different depth (i=1, 2, or 3)). v_1 and v_2 are one-way valves. v_1 only allows fluid in b_1 flows from B_1 to O_1; v_2 only allows fluid in b_3 flows from B_2 to O_2.

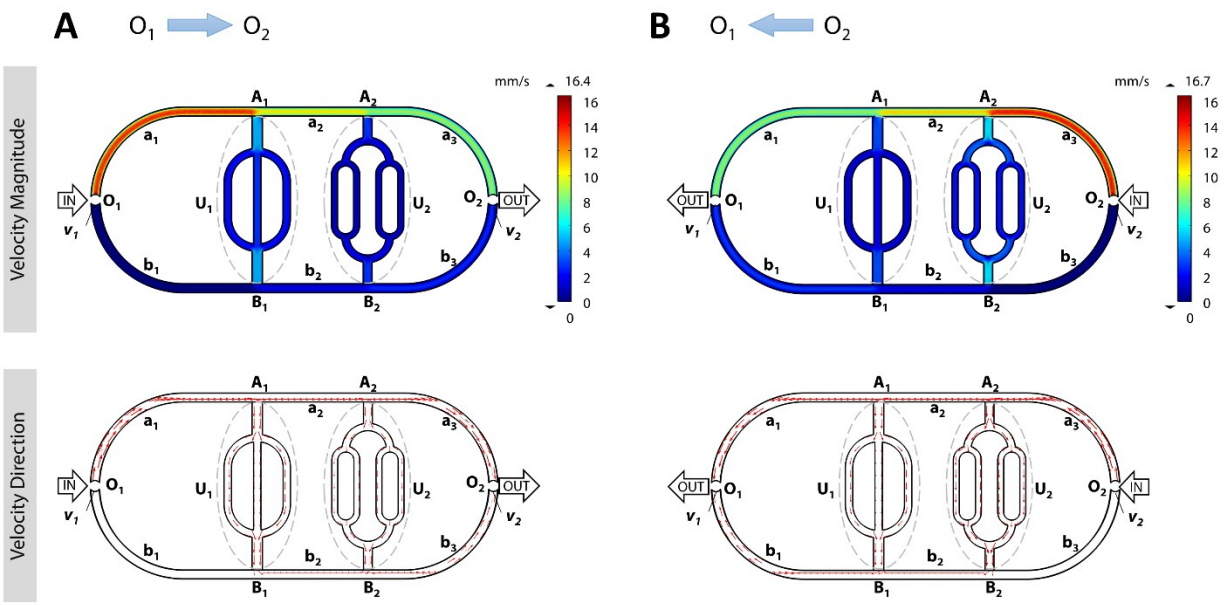

Figure S2. Simulated velocity field (magnitude and direction) of the example multi-channel, multi-unit UniChip (Figure 1) with reciprocating flow input: A) $O_1 \rightarrow O_2$; pressure was set to 30 pa for O_1 and 0 for O_2 for simulation; B) $O_2 \rightarrow O_1$; pressure was set to 30 pa for O_2 and 0 for O_1; In both cases, flow in U_1 is from A_1 to B_1, and flow in U_2 is from A_2 to B_2 (arrows)

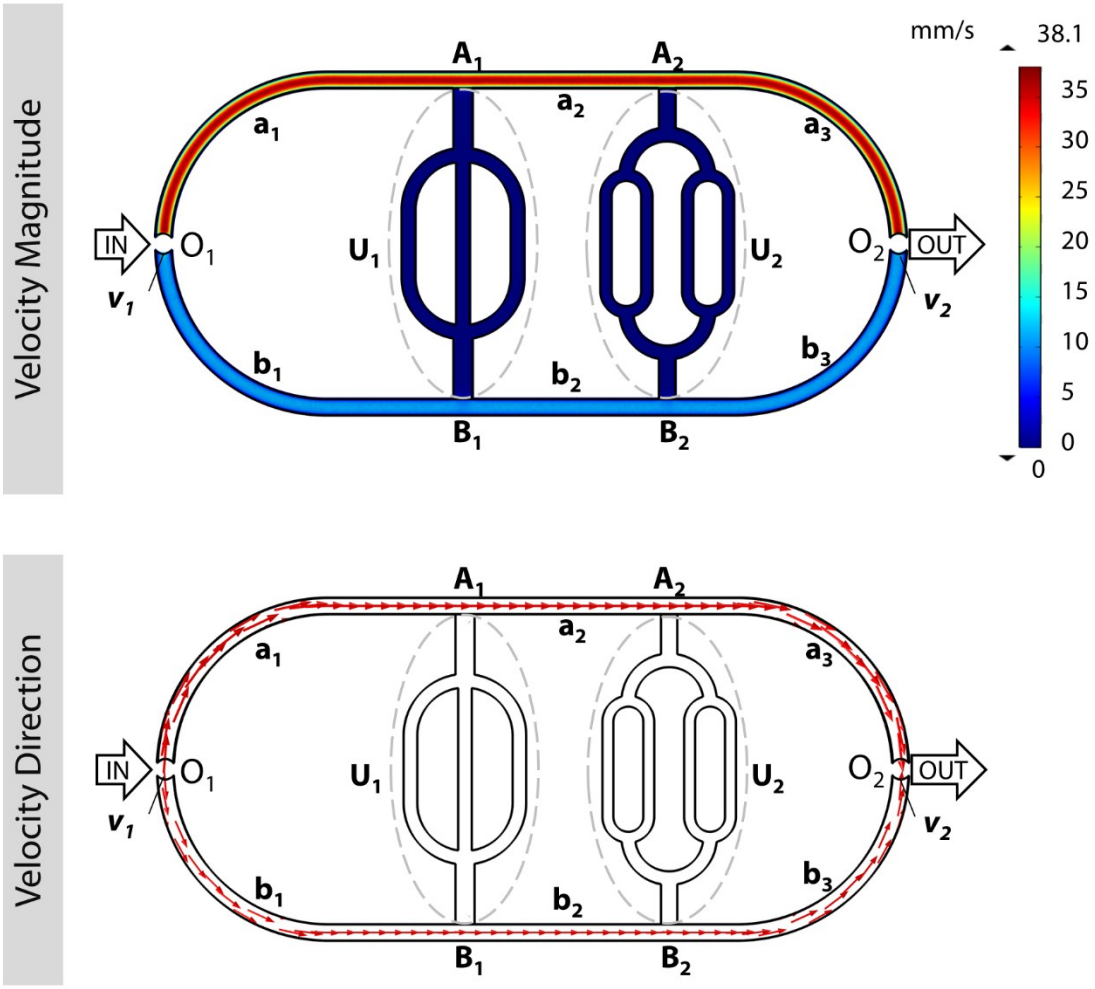

Figure S3. Operation of the backflow proof mechanism in the example multi-channel, multi-unit UniChip when valves fail to limit backflow. Simulated velocity field in the UniChip, when v_1 completely fails to limit backflow (from O_1→ B_1 through b_1). Fluid flows from O_1 to O_1 through a_1, a_2, and a_3, or through b_1, b_2, and b_3. Flows in U_1 and U_2 approach 0 without changing flow direction.