Supplemental Information for: *Planar Membrane Devices with Integrated Electrodes for Studying Cellular Release*

Microscopic characterization of small molecule cross-over is demonstrated in the images below, where 500 μM fluorescein served as the small molecule and visual indicator and a 7 % hematocrit solution of RBCs served as the flowing cell line.

The experiments were first conducted with 5 μm pillar array height and different flow rates were investigated. Injections of either fluorescein or RBCs were made into the cell channel via a 4-port injector that was interfaced with the microchip by a fused-silica capillary.

The figures (S1 and S2) show the channel/membrane interface at different flow rates being applied to the cell channel and the collector channel. It can be noted from the micrographs that an increased small molecule cross-over is observed as the flow rate on the collector channel decreased while the flow rate on the cell channel is kept constant.

It is also shown in Figure S1 that with the 5 μm pillar array membrane, the pores created by the membrane are small enough so that RBCs (~7 μm in diameter) cannot cross-over into the collector channel. In Figure S2, with the 10 μm pillar array membrane, the pores are larger, allowing RBC cross-over at low flow rates being applied to the collector channel (0.05 μL/min).

For both pillar array heights (5 μm and 10 μm), an optimal flow rate of 3 μL/min for the cell channel and 0.5 μL/min for the collector channel were selected, due to these flow rates leading to significant small molecule cross-over but total exclusion of cells from the collector channel.

As shown in Figure S3, the flow from the collector channel does not cross-over into the cell channel (where it could possibly cause cell lysis) at the flow rates used in this study (3 μL/min to the cell channel and 0.5 μL/min to the collector channel. Only when the flow rate of the collector channel exceeds the flow rate applied to the cell channel does any cross-over back into the cell channel occur.

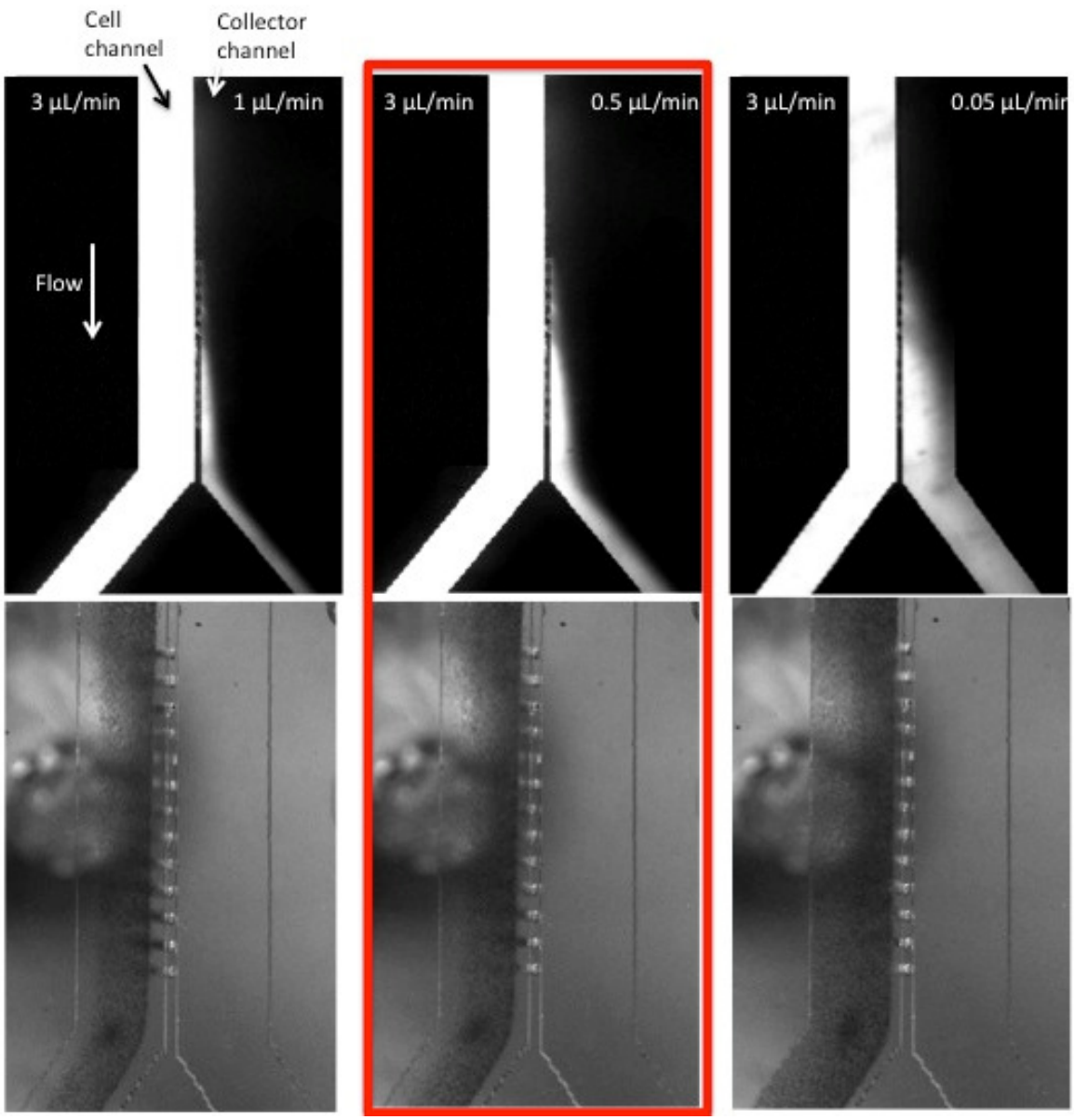

Figure S1. Flow profiles at the membrane/channel interface using a 5 µm pillar height, with the flow rate applied to the collector channel being varied. The flow rates selected as optimal in this study were 3.0 µL/min to the cell channel and 0.5 µL/min to the collector channel (denoted with red box).

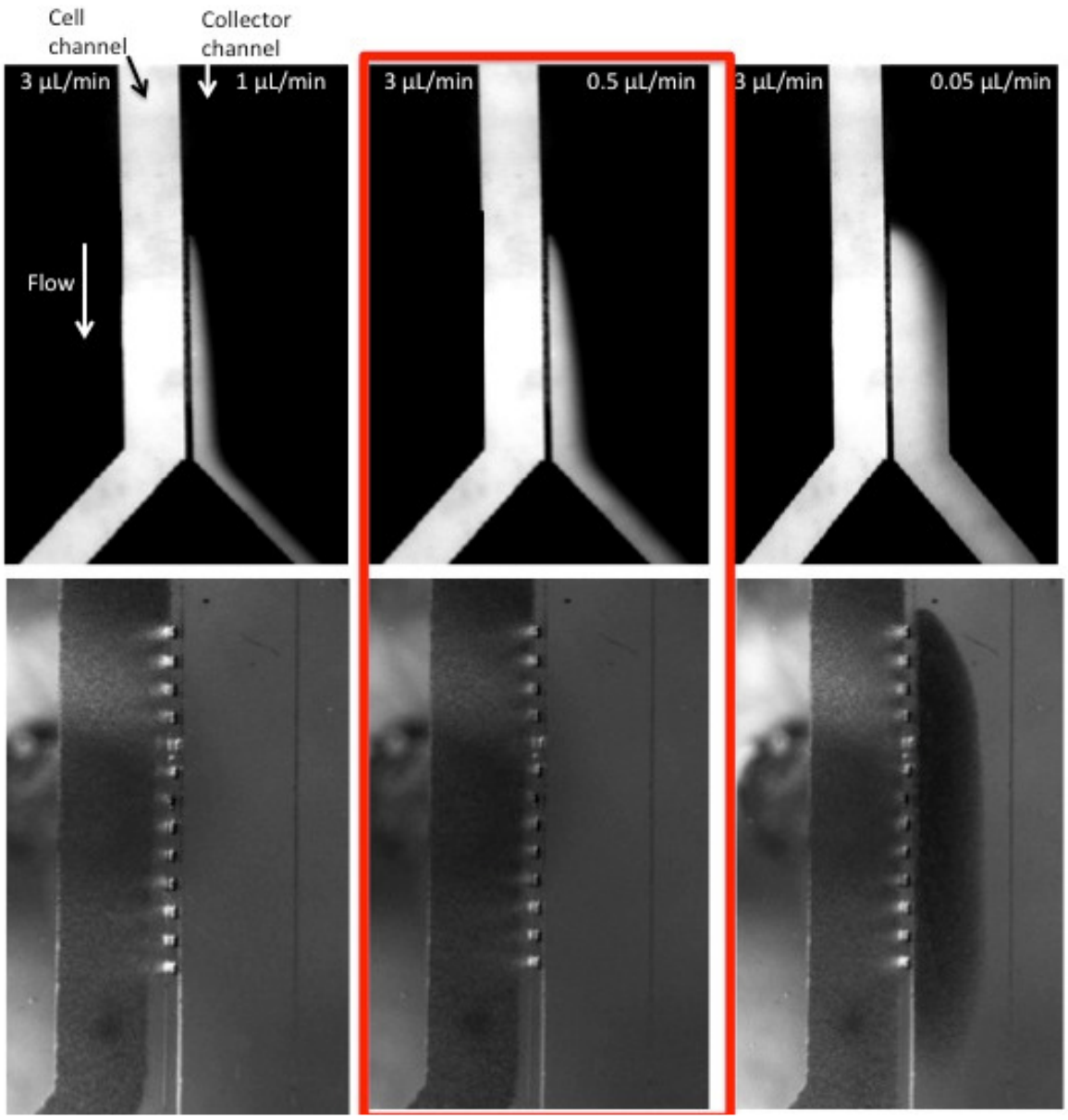

Figure S2. Flow profiles at the membrane/channel interface using a 10 µm pillar height, with the flow rate applied to the collector channel being varied. The flow rates selected as optimal in this study were 3.0 µL/min to the cell channel and 0.5 µL/min to the collector channel (denoted with red box).

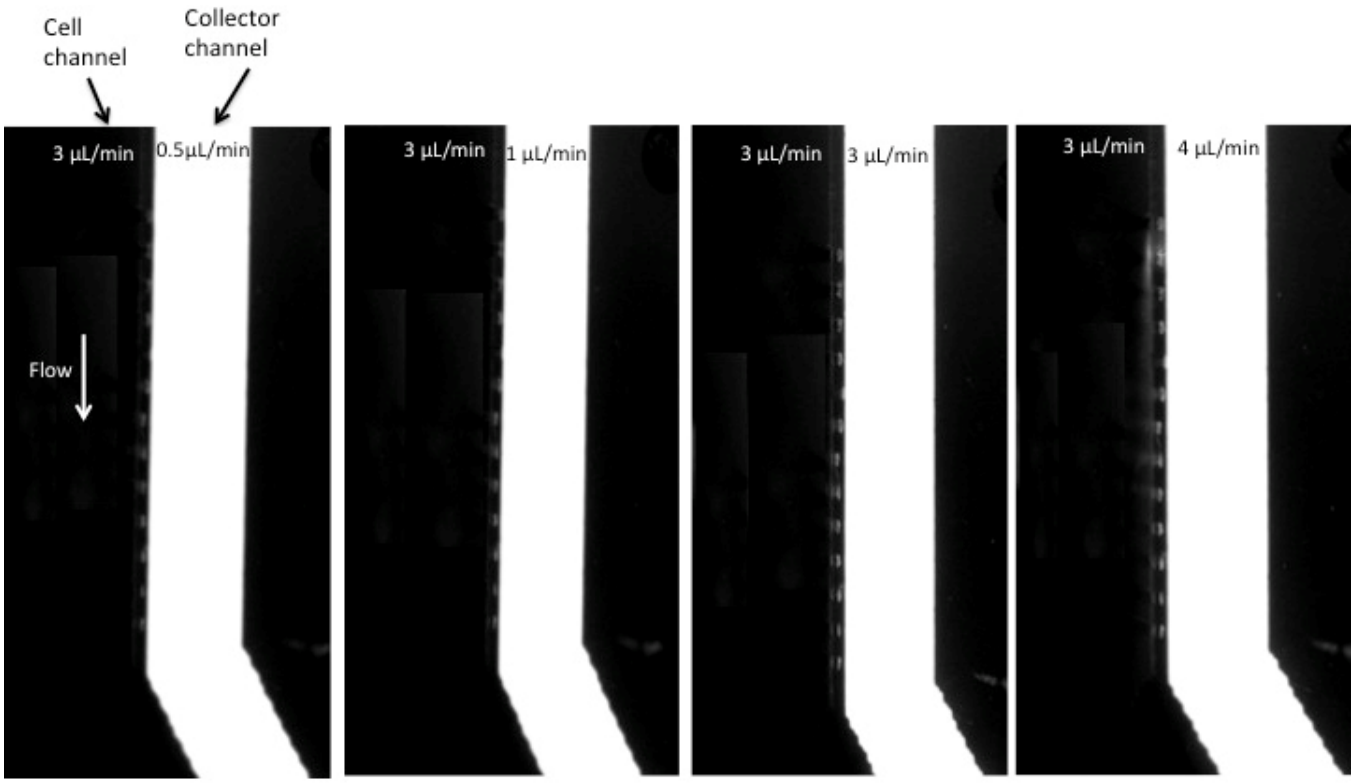

Figure S3. Flow profiles at the membrane/channel interface using a 5 µm pillar height. This study was used to show that no cross-over occurs from the collector channel to the cell channel until the collector channel flow rate exceeds the flow rate being applied to the cell channel. It should be noted that the sample injections were made on the collector side.