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Microfluidic Chip with Double-Sided Herringbone Microstructures for Enhanced Capture of Rare Tumor Cells

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Supplementary Tables

Table S1. The geometrical parameters and corresponding actual sizes of the single-sided herringbone chips.

μ	0.25	0.375	0.5	0.625	0.75
Width of groove: μW_T (μm)	50	75	100	125	150
Spacing between grooves: $(1-\mu) W_T$ (μm)	150	125	100	75	50
Groove periodicity: W_T (μm)	200				
λ	0.3	0.4	0.5	0.6	0.7
Height of groove: λH (μm)	30	40	50	60	70
Height of microchannel: (1-λ)H (μm)	70	60	50	40	30
Total height: H (μm)	100				

Table S2. Percentages of contacting streamlines (C. S.) and contacting points (C. P.) with different geometrical parameters (width of herringbone groove / interval between herringbone grooves / depth of herringbone groove / height of microchannel) and different inlet flow rates. The flow direction is forward flow. Geometrical designs leading to >90% contacting streamlines are shown in the table.

	75/125/50/50		100/100/50/50		125/75/50/50		150/50/50/50	
	C. S. (%)	C. P. (%)	C. S. (%)	C. P. (%)	C. S. (%)	C. P. (%)	C. S. (%)	C. P. (%)
1 mL/h	--	--	96	9.75	98	6.88	99	4.93
2 mL/h	--	--	96	10.11	96	7.83	99	4.99
3 mL/h	--	--	96	12.3	95	5.76	99	4.66
4 mL/h	--	--	95	11.37	97	6.21	96	3.62
5 mL/h	--	--	90	6.85	96	3.79	96	2.26
	75/125/60/40		100/100/60/40		125/75/60/40		150/50/60/40	
	C. S. (%)	C. P. (%)	C. S. (%)	C. P. (%)	C. S. (%)	C. P. (%)	C. S. (%)	C. P. (%)
1 mL/h	98	23.97	100	18.67	100	8.86	100	4.82
2 mL/h	98	22.29	100	17.07	100	8.08	100	5.05
3 mL/h	98	21.92	100	9.72	100	9.82	100	4.02
4 mL/h	97	21.07	98	11.9	100	6.61	100	3.3
5 mL/h	92	17.09	91	3.26	99	2.5	97	2.59
	75/125/70/30		100/100/70/30		125/75/70/30		150/50/70/30	
	C. S. (%)	C. P. (%)	C. S. (%)	C. P. (%)	C. S. (%)	C. P. (%)	C. S. (%)	C. P. (%)
1 mL/h	100	22.13	100	13.09	100	6.05	100	8.44
2 mL/h	100	17.12	100	5.72	100	4.32	100	6.32
3 mL/h	100	16.39	99	6.41	100	1.35	100	4.43
4 mL/h	94	11.36	95	0.92	90	0.67	100	3.24
5 mL/h	--	--	--	--	--	--	100	3.69

Table S3. Percentages of contacting streamlines (C. S.) and contacting points (C. P.) with different geometrical parameters (width of herringbone groove / interval between herringbone grooves / depth of herringbone groove / height of microchannel) and different inlet flow rates. The flow direction is reverse flow. Geometrical designs leading to >90% contacting streamlines are shown in the table.

	75/125/50/50		100/100/50/50		125/75/50/50		150/50/50/50	
	C. S. (%)	C. P. (%)	C. S. (%)	C. P. (%)	C. S. (%)	C. P. (%)	C. S. (%)	C. P. (%)
1 mL/h	--	--	94	8.04	95	10.22	91	5.17
2 mL/h	--	--	92	8.9	93	9.54	92	7.91
3 mL/h	--	--	100	4.91	95	11.36	91	6.73
4 mL/h	--	--	92	6.32	92	8.88	90	5.59
5 mL/h	--	--	92	4.87	--	--	--	--
	75/125/60/40		100/100/60/40		125/75/60/40		150/50/60/40	
	C. S. (%)	C. P. (%)	C. S. (%)	C. P. (%)	C. S. (%)	C. P. (%)	C. S. (%)	C. P. (%)
1 mL/h	97	31.42	99	12.61	100	17.04	100	7.28
2 mL/h	97	34.19	99	11.49	100	11.22	100	6.7
3 mL/h	97	28.02	100	13.15	100	8.06	100	8.5
4 mL/h	96	23.52	97	11.17	100	7.48	99	4.84
5 mL/h	90	23.25	95	13.14	95	6.67	98	3.45
	75/125/70/30		100/100/70/30		125/75/70/30		150/50/70/30	
	C. S. (%)	C. P. (%)	C. S. (%)	C. P. (%)	C. S. (%)	C. P. (%)	C. S. (%)	C. P. (%)
1 mL/h	100	38.56	100	11.28	100	16.05	100	16.61
2 mL/h	100	34.35	100	14.38	100	9.98	100	10.14
3 mL/h	99	17.79	100	9.47	100	14.41	100	12.63
4 mL/h	98	14.17	94	2.38	98	7.45	100	12.55
5 mL/h	--	--	--	--	91	2.62	95	8.81

Table S4. Primers used in this study for targeting oncogenic driver mutations. All primers were synthesized by Life Technologies.

Name	Sequence
EGFR-18F	TGGAGAAGCTCCCAACCAA
EGFR-18R	TTCCCAAACACTCAGTGAAACA
EGFR-19F	GTGGCACCATCTCACAATT
EGFR-19R	ATGCTCCAGGCTCACCAAG
EGFR-20F	CTTTATCCAATGTGCTCCTC
EGFR-20R	TCTCCCTTCCCTGATTACCT
EGFR-21F	TTCGCCAGCCATAAGTCCT
EGFR-21R	TCATTCACTGTCCCAGCAAG

Supplementary Figures

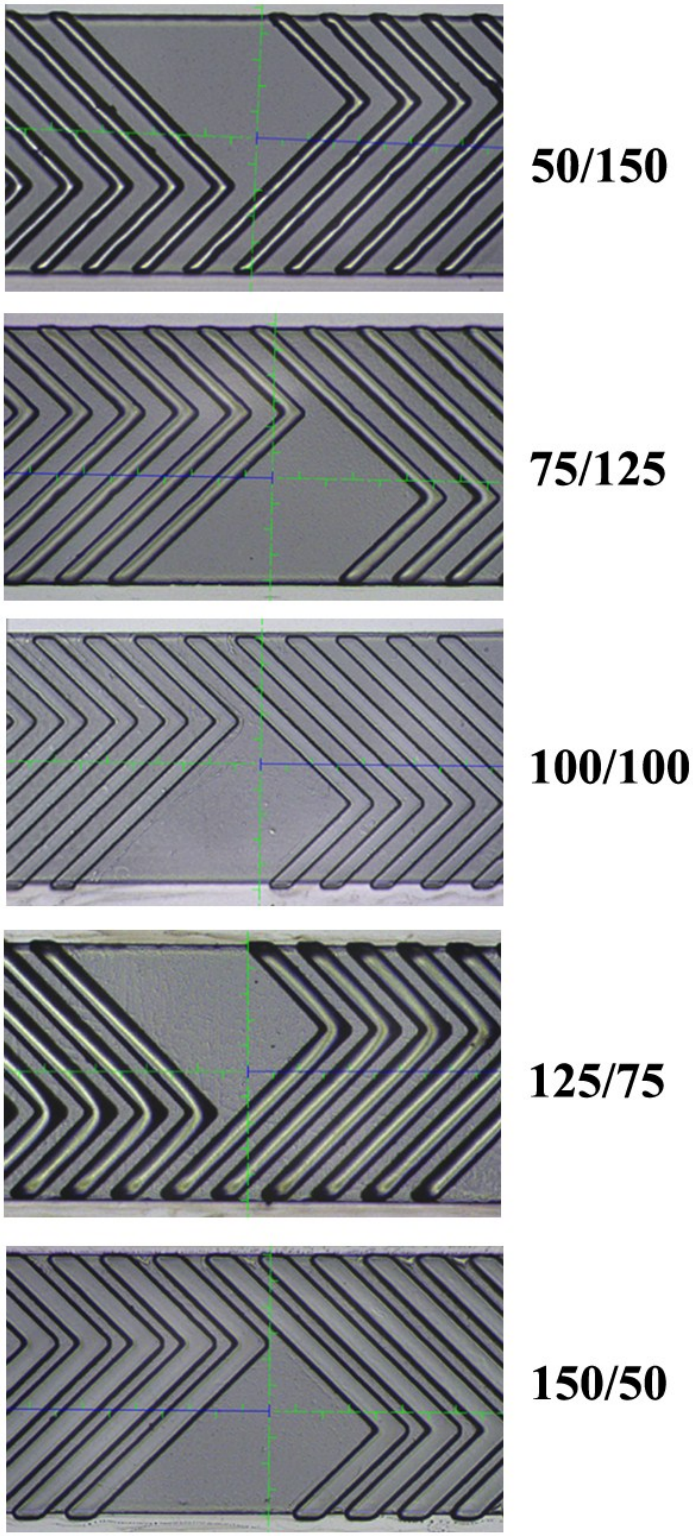

Figure S1. The microscopic figures of photoresist templates of single-sided herringbone chips with different herringbone groove width.

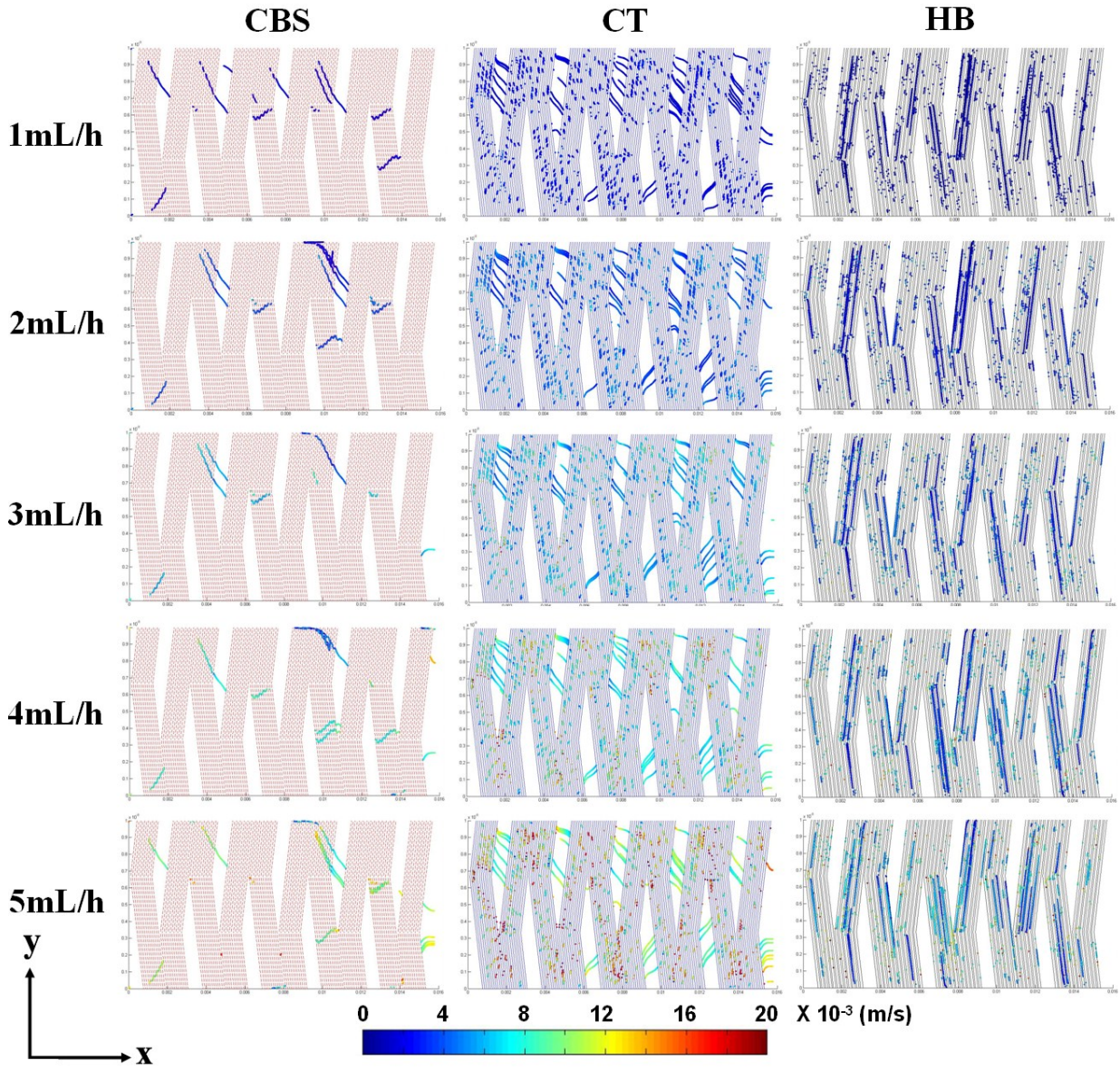

Figure S2. Simulated surface contact as a function of the inlet flow rate under forward flow, broken down by contact location (CBS: channel bottom and sides; CT: channel top; HB: herringbone groove top and sides). The herringbone groove width, interval between herringbone grooves, herringbone groove depth and channel height are fixed at 125 μm, 75 μm, 50 μm and 50 μm (μ=0.625, λ =0.5), respectively. The color bar is shown with the unit of m/s.

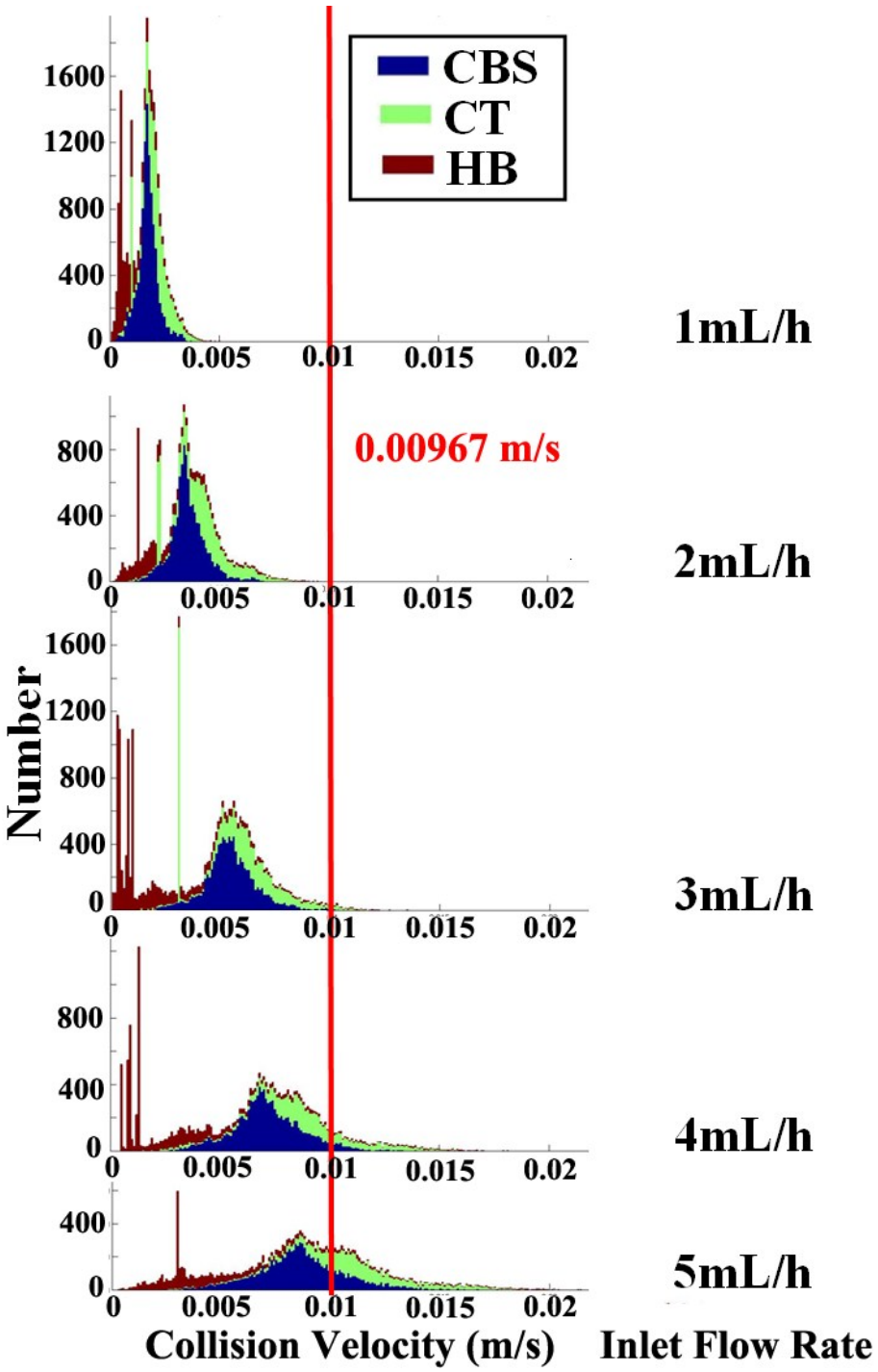

Figure S3. Distributions of contact velocity under different inlet flow rates and contact locations (CBS: channel bottom and sides; CT: channel top; HB: herringbone groove top and sides). The herringbone groove width, interval between herringbone grooves, herringbone groove depth and channel height are fixed at 125 μm, 75 μm, 50 μm and 50 μm (μ=0.625, λ =0.5), respectively. The flow direction is reverse flow (see Figure 1A).

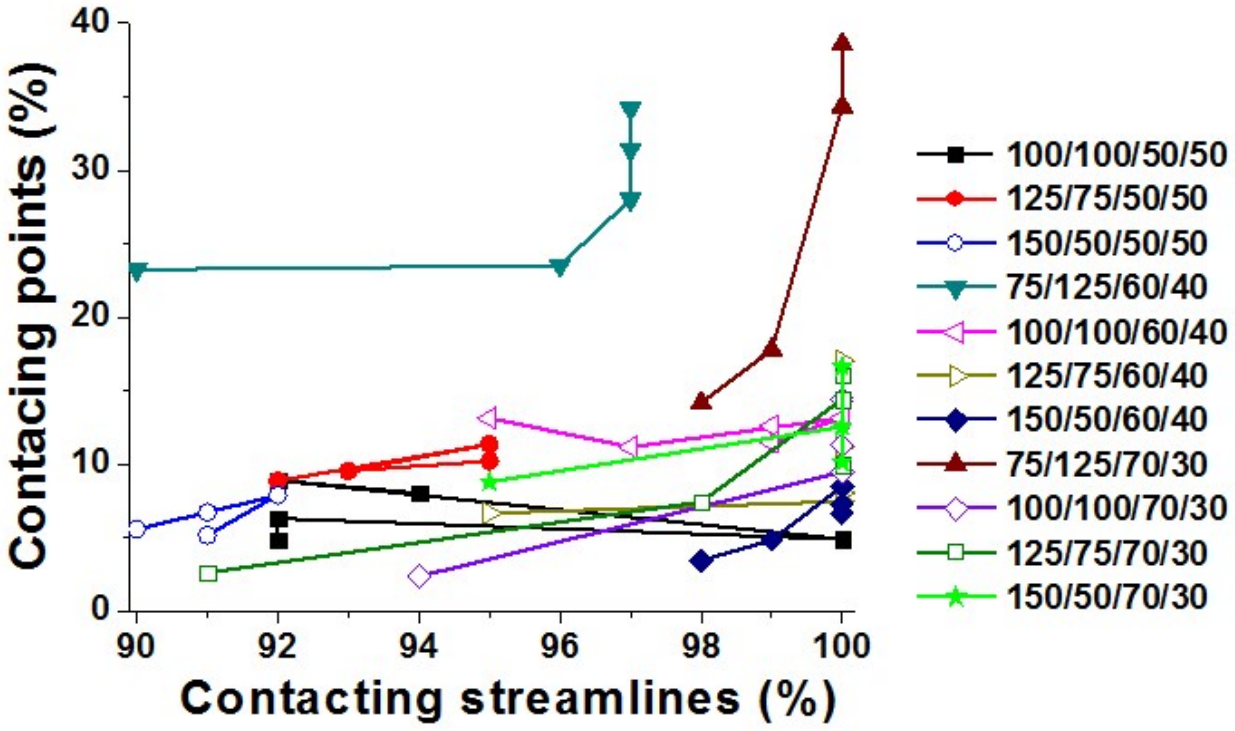

Figure S4. Percentages of contacting streamlines and points with different geometrical parameters (width of herringbone groove / interval between herringbone grooves / depth of herringbone groove / height of microchannel) and different inlet flow rates (1~5 mL/h). The flow direction is reverse flow.

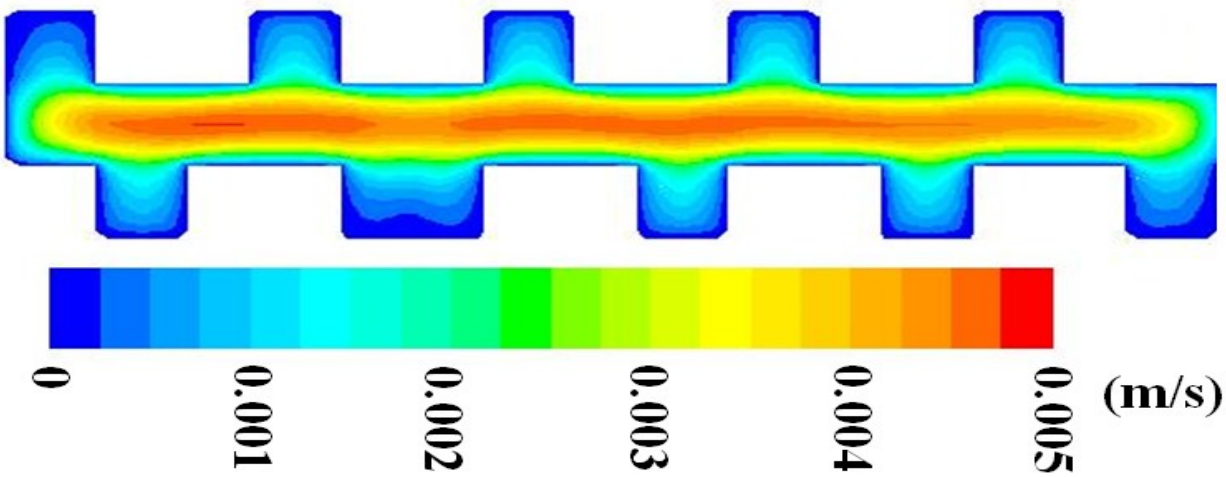

Figure S5. Velocity profile in the double-sided herringbone chip shown in Figure 4C