

Supporting information

High-throughput and label-free enrichment of malignant tumor cells and clusters from pleural and peritoneal effusions using inertial microfluidics

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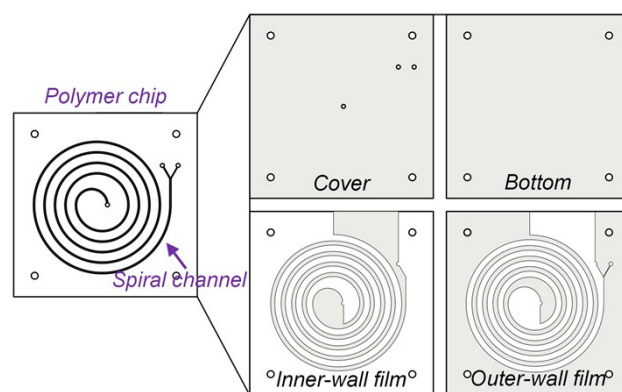


Figure S1. Detail patterns of the polymer microfluidic chip and each polymer film.

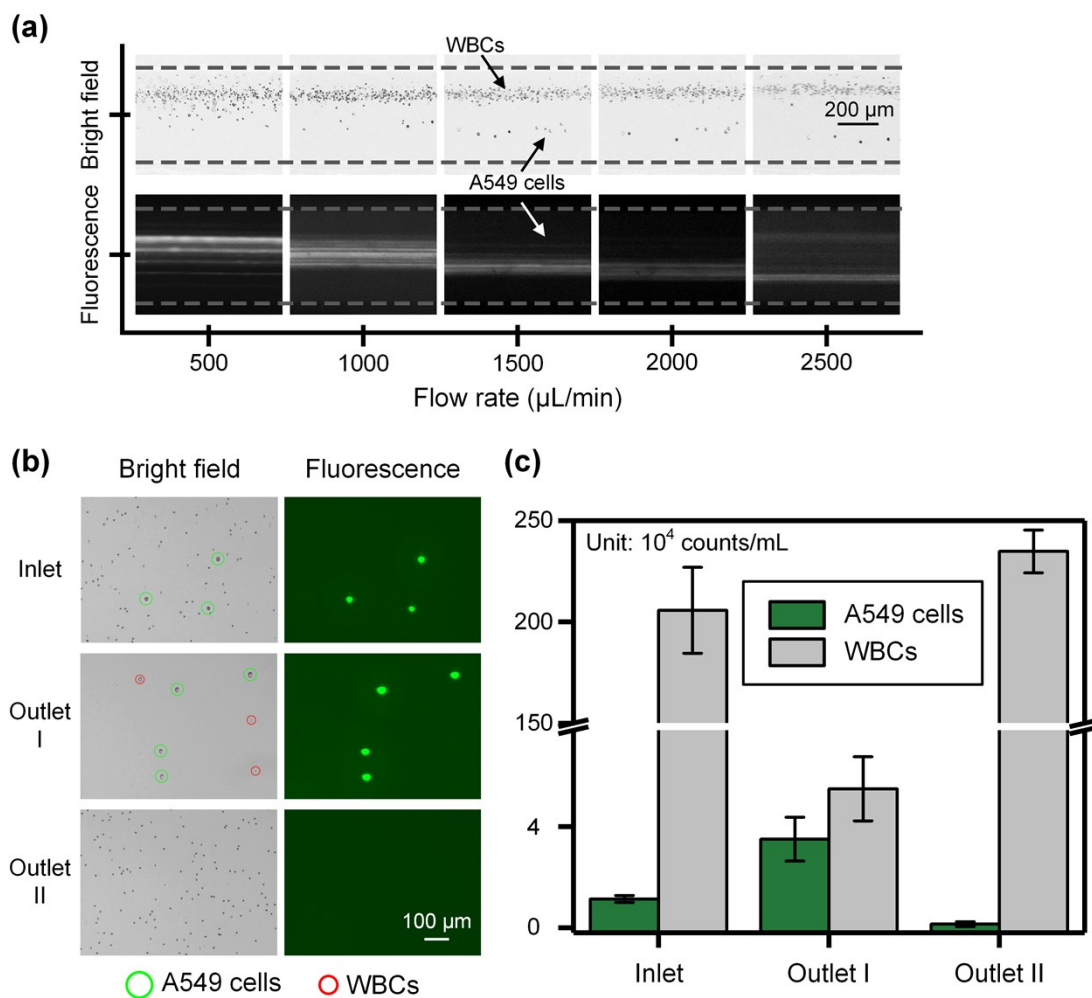


Figure S2. (a) Focusing maps illustrating the dynamic distributions of A549 cells and WBCs at the flow rates ranging from 500 to 2500 $\mu\text{L}/\text{min}$. (b) Microscopic images of cells recovered from two outlets. A549 cells were discolored with green fluorescence in order to distinguish from the unlabeled WBCs. (c) Quantitative analysis of the cell concentrations sampled from inlet and two outlets.

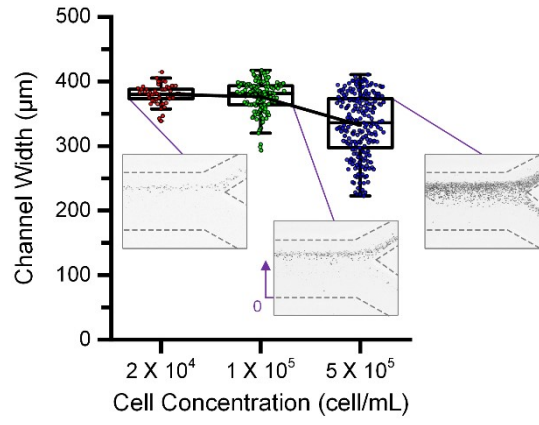


Figure S3. The distributions of white blood cells across the channel width under different cell concentrations ranging from 2×10^4 to 5×10^5 cells/mL.

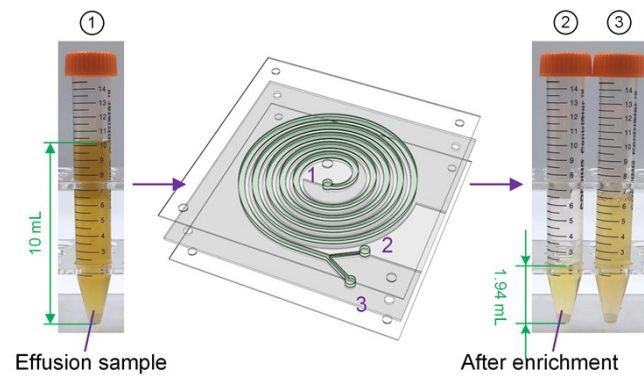


Figure S4. Photograph illustrating the actual sample volume of effusion after enrichment.

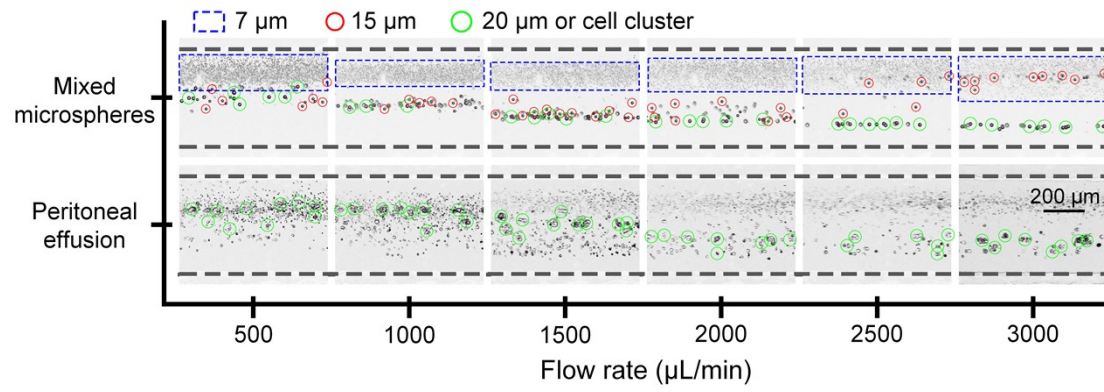


Figure S5. Focusing maps illustrating the dynamic distributions of mixed particles (7 μm , 15 μm , and 20 μm) and cell clusters at the flow rates ranging from 500 to 3000 $\mu\text{L}/\text{min}$.

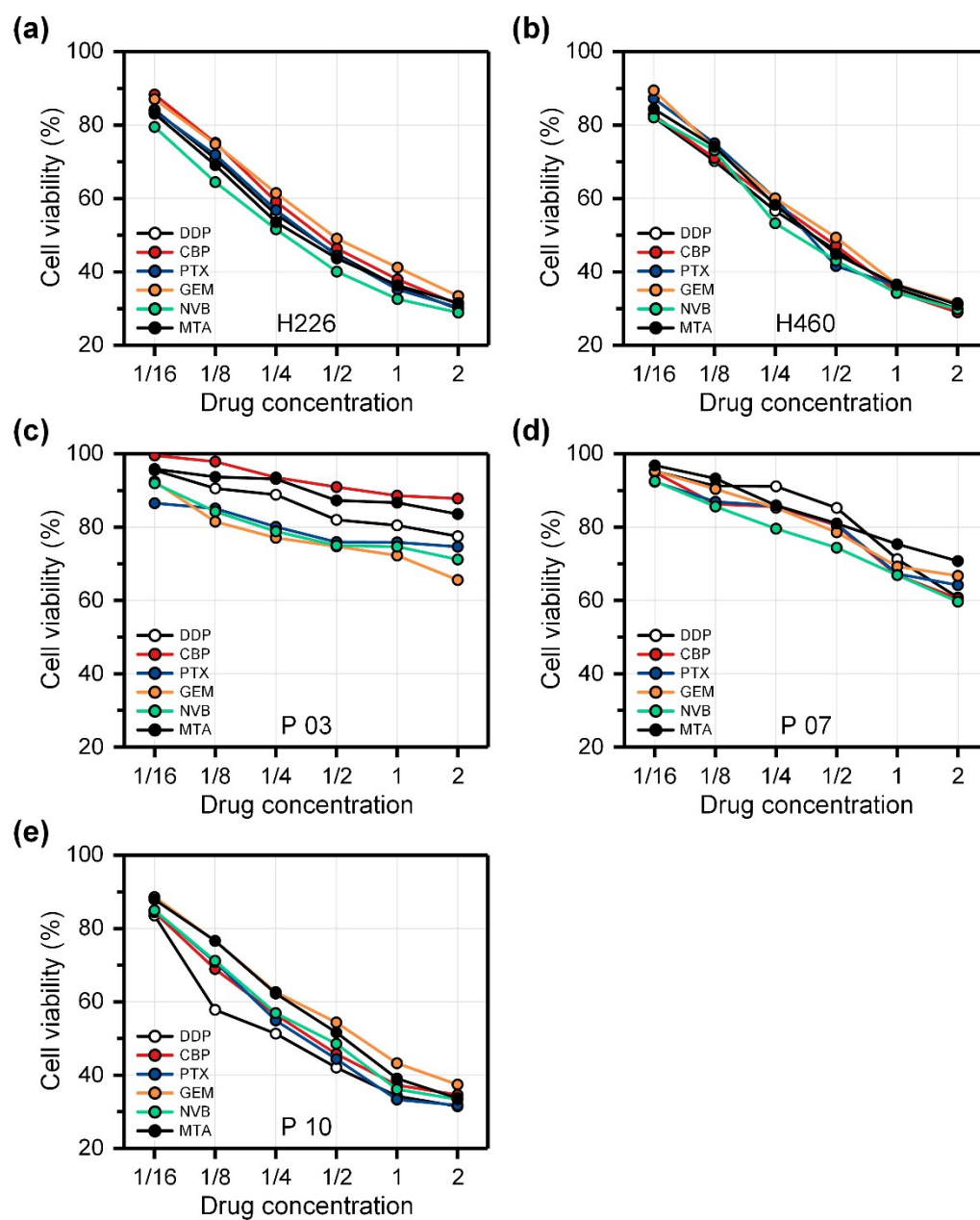


Figure S6. (a-e) Drug sensitivity test at the drug concentrations ranging from 1/16 to 2 times of the peak plasma concentration.

Table S1. Clinical and pathological data of patients.

No.	Age/ Sex	Disease	Stage	Treatment	Sample
1	75/M	Lung cancer	III	NA	Pleural effusion
2	40/F	Lung cancer	IV	NA	Pleural effusion
3	56/M	Lung cancer	IV	PTX	Pleural effusion
4	71/M	Lung cancer	IV	NA	Pleural effusion
5	54/M	Lung cancer	IV	DDP	Pleural effusion
6	NA/F	Lung cancer	IV	Bevacizumab	Pleural effusion
7	61/F	Lung cancer	IV	DDP	Pleural effusion
8	78/F	Lung cancer	IV	Osimertinib	Pleural effusion
9	62/M	Lung cancer	NA	NA	Pleural effusion
10	66/F	Lung cancer	III	NA	Pleural effusion
11	53/F	Breast cancer	III	Trastuzumab	Pleural effusion
12	76/F	Breast cancer	IV	Surgery	Pleural effusion
13	54/M	Colorectal cancer	NA	PTX	Peritoneal effusion
14	57/M	Colorectal cancer	IV	NA	Peritoneal effusion
15	65/M	Colorectal cancer	IV	NA	Peritoneal effusion
16	70/F	Colorectal cancer	NA	NA	Peritoneal effusion
17	68/M	Colorectal cancer	IV	Surgery	Peritoneal effusion
18	67/M	Colorectal cancer	III	NA	Peritoneal effusion
19	56/F	Colorectal cancer	NA	NA	Peritoneal effusion
20	NA/F	Ovarian cancer	NA	NA	Peritoneal effusion
21	60/F	Ovarian cancer	IV	PTX	Peritoneal effusion
22	74/F	Ovarian cancer	IV	PTX	Peritoneal effusion

Table S2. Summary of inertial microfluidics for tumor cell sorting.

Method	Throughput	Yield	Purity	Clinical Application	Fabrication
Slanted spiral microfluidics ¹	1.7 mL/min	>80%	400–680 WBCs/mL	Blood of breast and lung cancer patients	Micro-milling technique and PDMS casting
Dean-flow fractionation microfluidics ³	0.75 mL/min	NA	~750 WBCs/mL	Blood of breast and lung cancer patients	Standard photolithographic technique
Dean-flow fractionation microfluidics ¹¹	1.25 mL/min	~85%	~50%	MCF-7 cells from human blood	UV laser cutting
Slanted spiral microfluidics ¹²	1.7 mL/min	NA	NA	Particle focusing	3D printing
Slanted spiral microfluidics ²	1.7 mL/min	>85%	NA	urine of patients with prostate cancer	Micro-milling technique and PDMS casting
Spiral microfluidics with periodic expansion structures ⁵	0.75 mL/min	88.6-93.5%	25.6-35.2%	MCF-7, Hela, and A549 cells	Standard photolithographic technique
Dean-flow fractionation microfluidics ⁴	NA	90%	NA	Pleural effusion in patients with lung cancer	Micro-milling technique and PDMS casting
Slanted spiral microfluidics (current work)	2 mL/min (single cell)	~85%	>37%	Pleural effusion in patients with breast and lung cancer, peritoneal effusion in patients with colorectal and ovarian cancer	UV laser cutting and jigsaw puzzle method
	3 mL/min (cell cluster)				