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

Shape-based separation of drug-treated *Escherichia coli* using viscoelastic microfluidics

Tianlong Zhang[1,2], Hangrui Liu[1], Kazunori Okano[2], Tao Tang[2], Kazuki Inoue[2], Yoichi Yamazaki[2], Hironari Kamikubo[2], Amy K Cain[4], Yo Tanaka[5], David Inglis[1], Yoichiroh Hosokawa[2], Yalikun Yaxiaer[2]*, Ming Li[1,3]*

1. School of Engineering, Macquarie University, Sydney 2122, NSW, Australia
2. Division of Materials Science, Graduate School of Science and Technology, Nara Institute of Science and Technology, 630-0192, Ikoma, Japan
3. Biomolecular Discovery Research Centre, Macquarie University, Sydney 2122, NSW, Australia
4. ARC Centre of Excellence in Synthetic Biology, School of Natural Sciences, Macquarie University, Sydney 2122, NSW, Australia
5. Center for Biosystems Dynamics Research, RIKEN, Osaka 565-0871, Japan

*Email: ming.li@mq.edu.au
yaxiaer@ms.naist.jp

Table S1. Dimensionless numbers at different PEO concentrations in the sheath. The flow rates of sheath (Q_{sh}) and sample (Q_s) are 8 μL/min and 2 μL/min, respectively.

PEO concentrations (c, ppm)	200	1000
Reynolds number (*Re*)	5.325	4.086
Weissenberg number (*Wi*)	3.276	9.324
Elasticity number (*El*)	0.615	2.282

Table S2. Dimensionless numbers of flow in the sheath at different flow rates when PEO concentration is 1000 ppm.

Q_{sh}:Q_s (μL/min) \ Dimensionless Numbers	Reynolds number (*Re*)	Weissenberg number (*Wi*)	Elasticity number (*El*)
9:1	4.086	9.324	2.282
16:4	8.171	18.649	2.282
8: 2	4.086	9.324	2.282
4:1	2.043	4.662	2.282
6:4	4.086	9.324	2.282

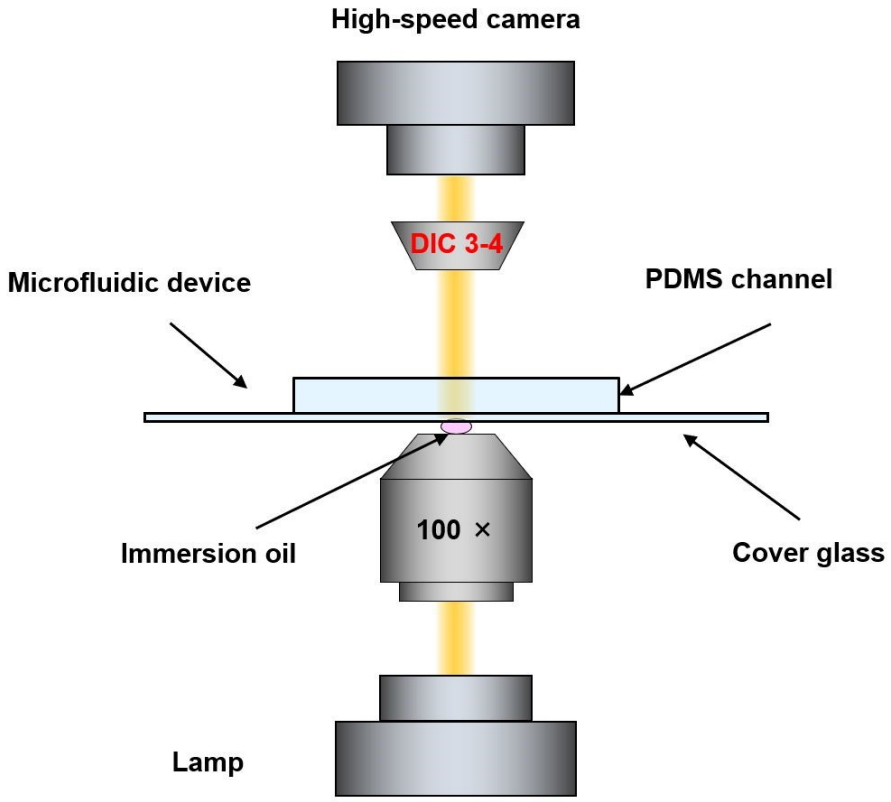

Figure S1. Schematic of the optical observation system.

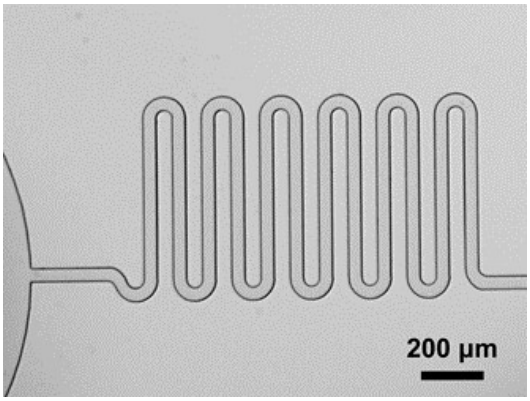

Figure S2. A microscopic image of a serpentine resistance channel, which is 40 μm in width, 50 μm in height and about 7.7 mm in length.

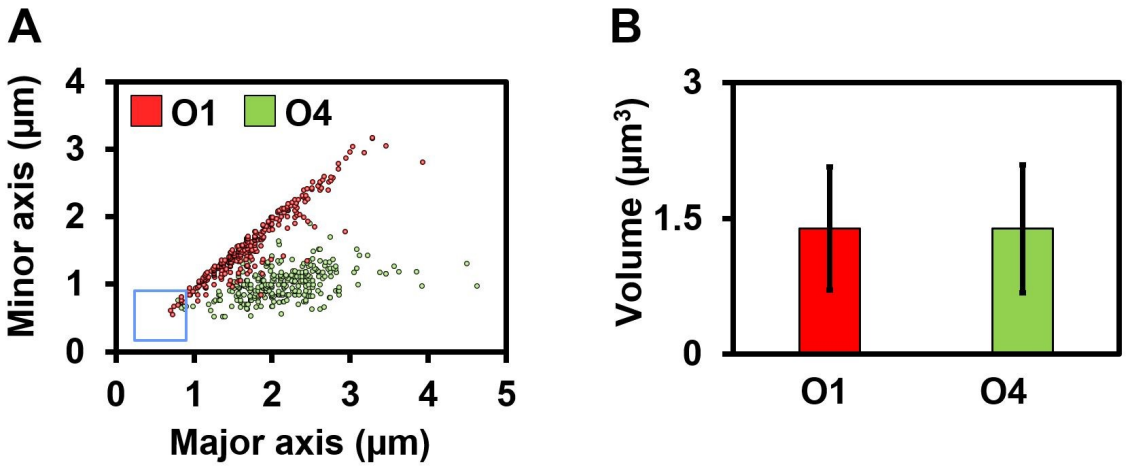

Figure S3. Analysis of drug-treated *E. coli* at the outlets O1 and O4. (A) Distributions of major and minor axis of *E. coli* at the outlets O1 and O4. The blue rectangle denotes *E. coli* with both major and minor axis less than 1 μm. (B) *E. coli* with the same volume after removing outliner cells at O1 and O4. N=300 for each condition.

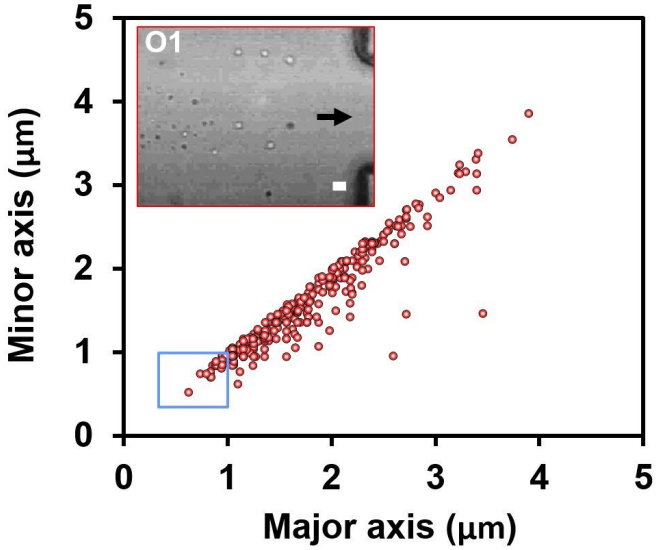

Figure S4. Distribution of the minor and major axis of *E. coli* flowing to the middle outlet O1. Sheath and sample solutions are injected at 9 and 1 μL/min, respectively. The PEO concentration is 1000 ppm. The blue rectangle denotes the nanoscale *E. coli*. The black arrow denotes *E. coli* flow direction. Scale bar is 5 μm. N = 300.

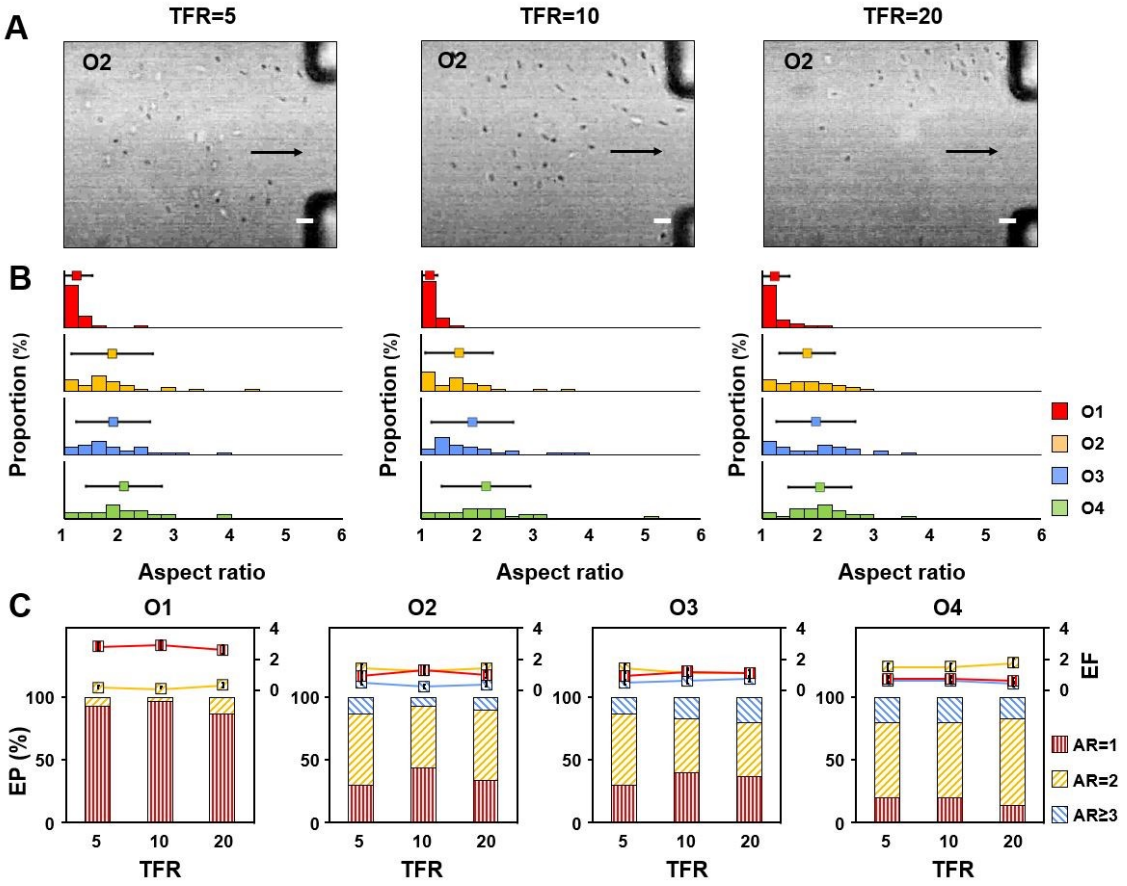

Figure S5. Shape-based separation of *E. coli* by viscoelastic microfluidics at different total flow rates (TFRs). The TFR are 5, 10 and 20 μL/min. The sheath-to-sample ratio is fixed at 4 and PEO concentration is 1000 ppm. (A) Experimental images *E. coli* at the outlet O2 at three different TFRs: (left) 5, (middle) 10 and (right) 20. Black arrows denote the flow direction. (B) Distributions of AR of *E. coli* at different outlets. (C) Enrichment factor (EF) and extraction purity (EP) of three groups of *E. coli* with different ARs in different TFR conditions at outlets. N=30 for each condition.