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

Supplemental information

Generating Digital Drug Cocktails via Optical Manipulation of Drug-containing Particles and Photo-Patterning of Hydrogels

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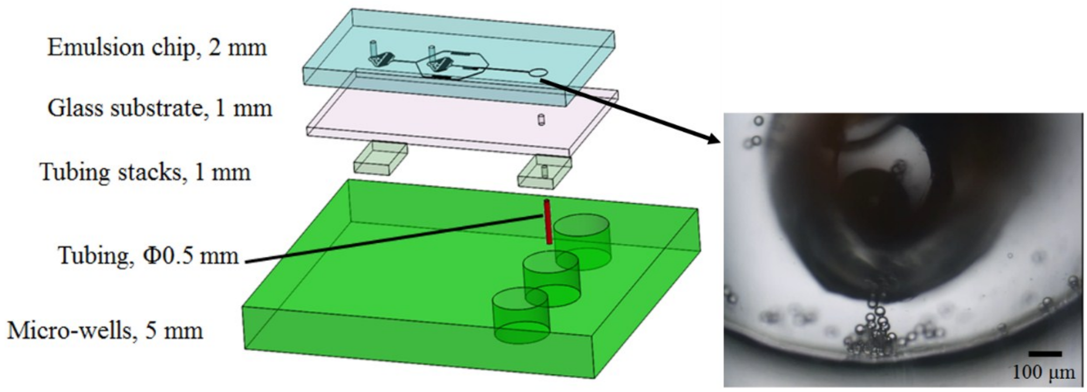
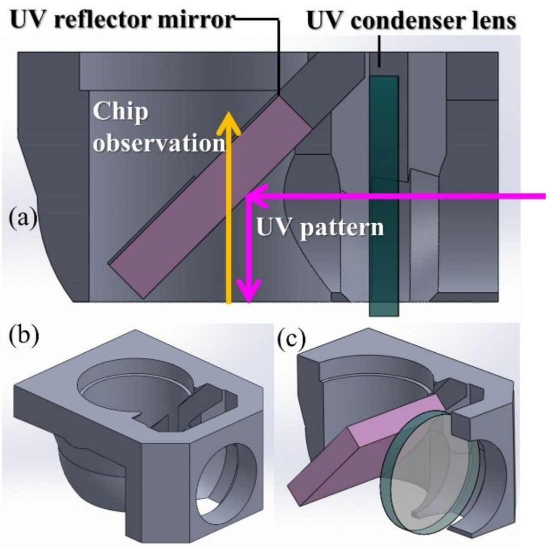
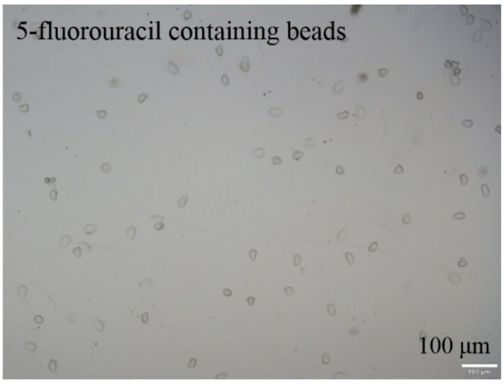


A B

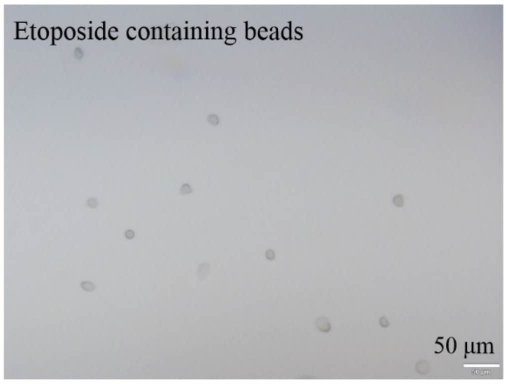
Supplementary figure 1. (A) Exploded view of an emulsion droplet chip and a micro-well chip. There was a micro-tube (red) connecting these two chips. (B) Drug-containing droplets were generated hydrodynamically, and 1 M of calcium chloride solution was injected into the micro-well for 30 min to solidify the drug-containing alginate particles.



Supplementary figure 2. A beam splitting device composed of an UV reflector mirror was placed at an inclination angle of 45^0 while aligned with a 20x UV light condenser lens.



A



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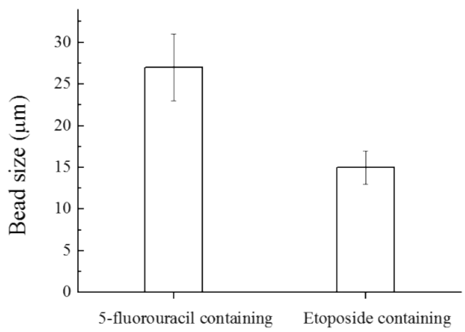
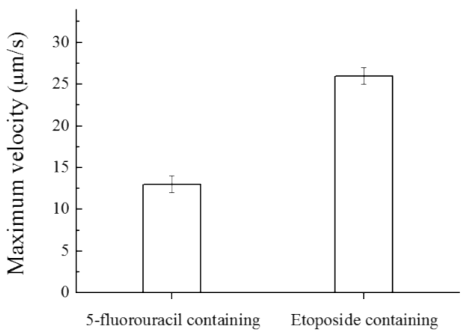
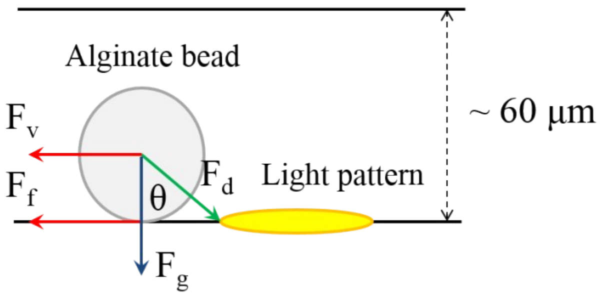


C



D

Supplementary figure 3. Solidified alginate particles containing 5-fluorouracil (A; diameter=27 ± 4 µm) and etoposide (B; diameter=15 ± 2 µm) (n=50). (C-D) The corresponding maximum velocities while exposed to ODEP forces were measured to be 13 ± 1 µm/s and 26 ± 1 µm/s, respectively. Error bars represent standard deviation (n=10).



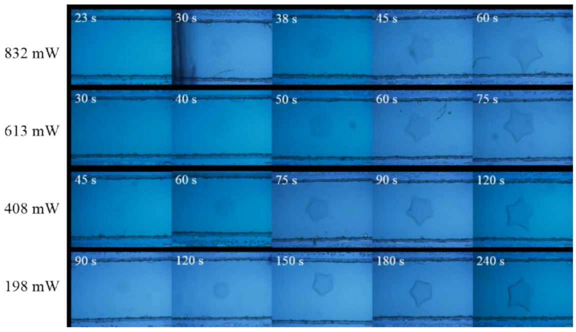
F_d (dielectrophoresis force) = $2\pi r^3 \varepsilon_m R_e(f_{CM})\nabla E^2$

F_v (viscous force) = $6\pi r \mu v$

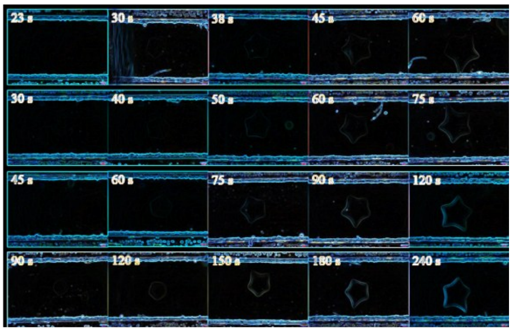
F_f (friction) = $\mu F_N = \mu (\cos(\theta) F_d + F_g)$

F_g (gravity) = $4\pi r^3 d g / 3$

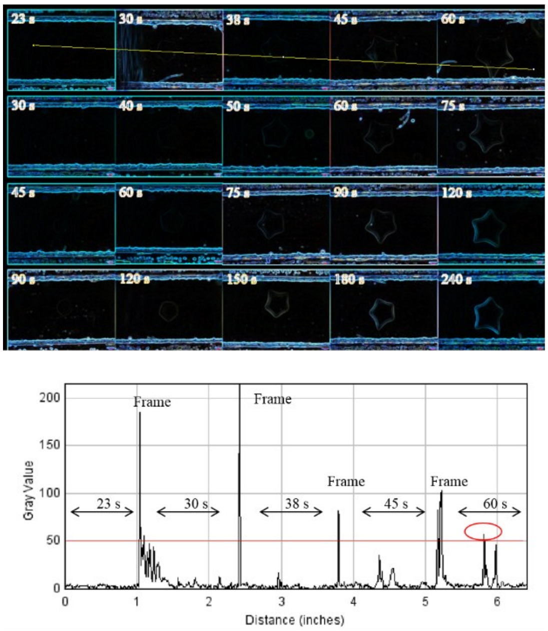
Supplementary figure 4. The analysis of forces acting on the alginate particles. In a steady state, the horizontal component of the ODEP force was balanced by 1) a viscous force against the relative movement of a particle in the fluid and 2) friction, which was calculated from the net effect of gravity acting on the particle and the perpendicular component of the ODEP force.


832 mW
613 mW
408 mW
198 mW
23 s
30 s
38 s
45 s
60 s
30 s
40 s
50 s
60 s
75 s
45 s
60 s
75 s
90 s
120 s
90 s
120 s
150 s
180 s
240 s

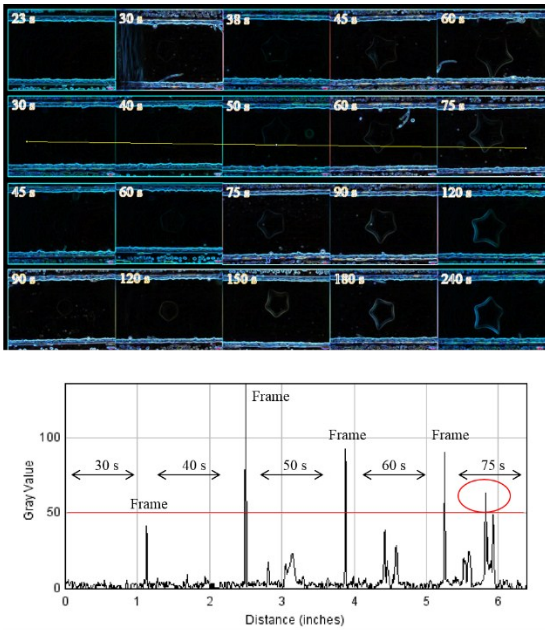
A



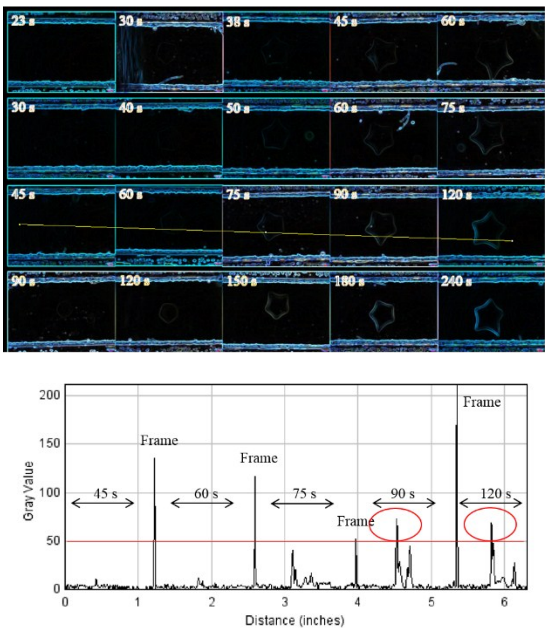
B


Gray Value
Distance (inches)
Frame
Frame
Frame
Frame
23 s
30 s
38 s
45 s
60 s

C


Gray Value
Distance (inches)
Frame
Frame
Frame
Frame
30 s
40 s
50 s
60 s
75 s

D


Gray Value
Distance (inches)
Frame
Frame
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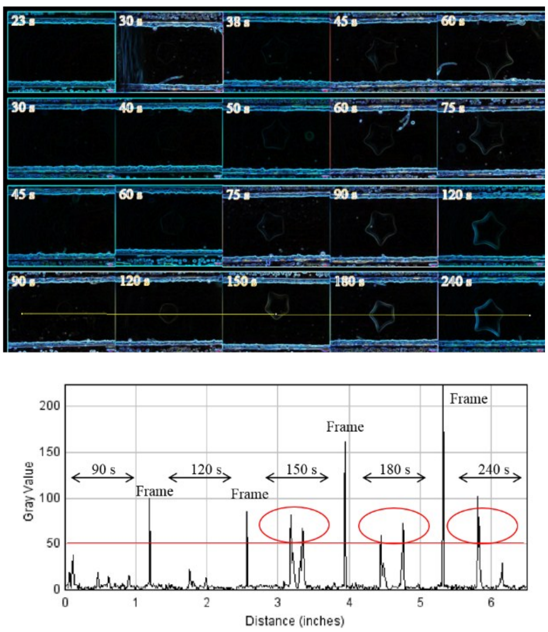
45 s
60 s
75 s
90 s
120 s

E


Gray Value
Distance (inches)
Frame
Frame
Frame
Frame
90 s
120 s
150 s
180 s
240 s

F

Supplementary figure 5. The image analysis by ImageJ to define the “clear pattern.” (A) Patterns in Figure 6 were presented for better image analysis. (B) A process function, “find edges” in ImageJ was used to identify the edges of UV light patterns. (C) A line across five images exposed at an UV light intensity of 832 mW was drawn and then another function, “plot profile” in ImageJ was used to display the intensities of pixels along the line. According to the plot profiles, the patterns with grey values of the edge higher than 50 were defined as “clear patterns.” (D-F) The same process was performed for images while exposed at UV light intensities of 613, 408, 198 mW, respectively.

Supplementary table 1. Four cases with exposure times of 60, 75, 90, and 150 s, respectively, were required to form clear patterns at light intensities of 832, 613, 408 and 198 mW, respectively.

832 mW	Exposure time (s)	23	30	38	45	60
	Gray value of edge	N/A	12.76	17.23	35.74	57.71
613 mW	Exposure time (s)	30	40	50	60	75
	Gray value of edge	N/A	9.63	23.47	39.32	63.33
408 mW	Exposure time (s)	45	60	75	90	120
	Gray value of edge	10.823	12.14	41.06	73.56	68.88
198 mW	Exposure time (s)	90	120	150	180	240
	Gray value of edge	19.3	22.75	82.27	73.23	101.74