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

Supplementary information

Laser-induced Microbubble as an *In Vivo* Valve for Optofluidic Manipulation in Living Mice's Microvessels

Meng Shao,[a] Changxu Li,[b] Chun Meng,[a] Rui Liu,[b] Panpan Yu,[a] Fengya Lu,[b] Zhensheng Zhong,[b] Xunbin Wei,*[bc] Jinhua Zhou,*[b] and Min-Cheng Zhong*[a]

[a] Anhui Province Key Laboratory of Measuring Theory and Precision Instrument, School of Instrument Science and Optoelectronics Engineering, Hefei University of Technology, Hefei 230009, China. *E-mail: zhongmch@hfut.edu.cn

[b] School of Biomedical Engineering, Anhui Medical University, Hefei, 230032, China. *E-mail: zhoujinhua@ahmu.edu.cn

[c] Biomedical Engineering Department and Cancer Hospital and Institute, Key Laboratory of Carcinogenesis and Translational Research, Peking University, 100081, Beijing, China. *E-mail: xwei@bjmu.edu.cn

S1 The assessment of the laser's biological safety

The laser power is set to 100 mW to irradiate individual mouse erythrocytes for evaluating laser-induced damage. As shown in **Fig. S1**, One second after activating the laser, the trapping force generated by the laser caused a change in the orientation of the erythrocyte. However, after continuous irradiation for 300s and subsequently turning off the laser, the erythrocytes are observed to recover their original shape, with minimal changes in cell morphology and size. The experimental results demonstrate that, at least within 5 minutes, the damage to cells caused by the 100mW laser is limited.

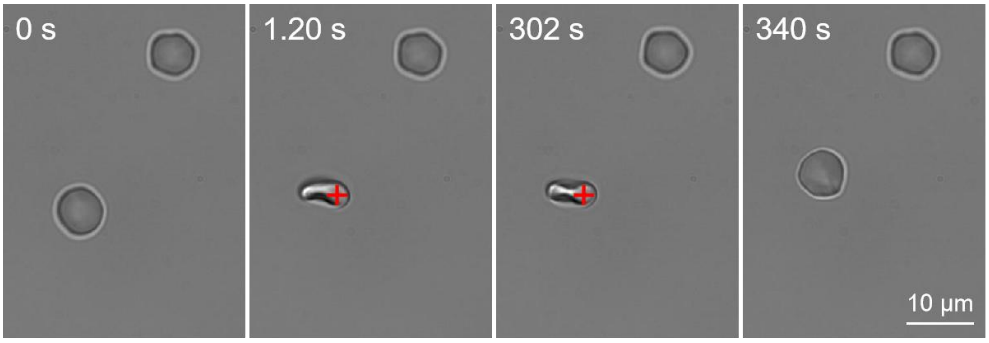

Fig. S1 Erythrocytes are irradiated with a laser at 100mW for 300s.

S2 Labeling of the laser spot position in Fig. 3(a)

To accurately demonstrate the functionality of microbubbles, Fig. 3(a) in the main text depicts cropped regions of interest, with the laser spot position extending beyond the cropped area. **Fig. S2** displays the laser spot position indicated in Fig. 3(a) under a wider field of view.

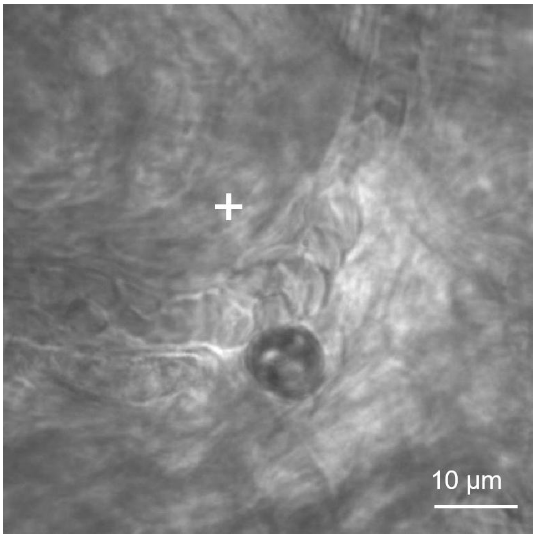

Fig. S2 Labeling of the laser spot position in Fig. 3(a). "+" represents the laser spot position.

S3 Labeling of the laser spot position in Fig. 3(d)

To accurately demonstrate the functionality of microbubbles, Fig. 3(d) in the main text depicts cropped regions of interest, with the laser spot position extending beyond the cropped area. **Fig. S3** displays the laser spot position indicated in Fig. 3(d) under a wider field of view.

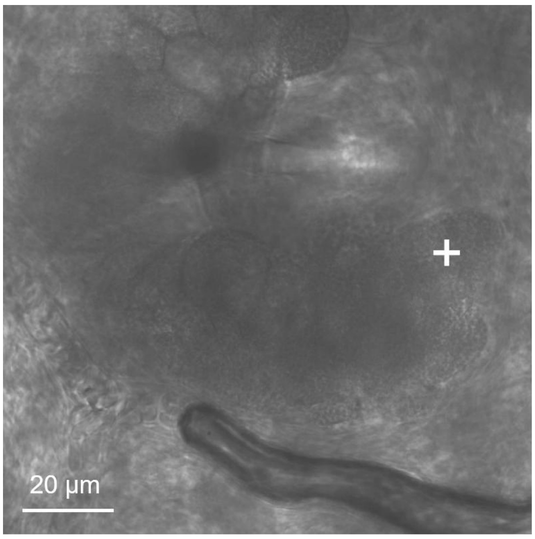

Fig. S3 Labeling of the laser spot position in Fig. 3(d). "+" represents the laser spot position.

S4 The relationship between reverse blood pumping and laser switching

As shown in **Fig. S4**.When the bubble reaches the target microvessel, the distance it pumps blood is labeled as D_p. Upon activating the laser, the microbubble gradually grows in the opposite direction of the original blood flow, propelling the blood. The relationship between pumping time and distance can be observed in Fig. S4(b). After deactivating the laser, the bubble quickly diminishes to zero. Subsequently, the blood flows in the original direction. Throughout this process, the speed at which the bubble pumps blood is directly correlated with the laser power. As the laser power increases, the growth rate of the bubble also increases. This is because higher laser power provides more energy, promoting bubble formation and expansion, thereby increasing the driving force on the blood flow. Conversely, reducing laser power slows down the growth rate of the bubble, and may even halt its growth.

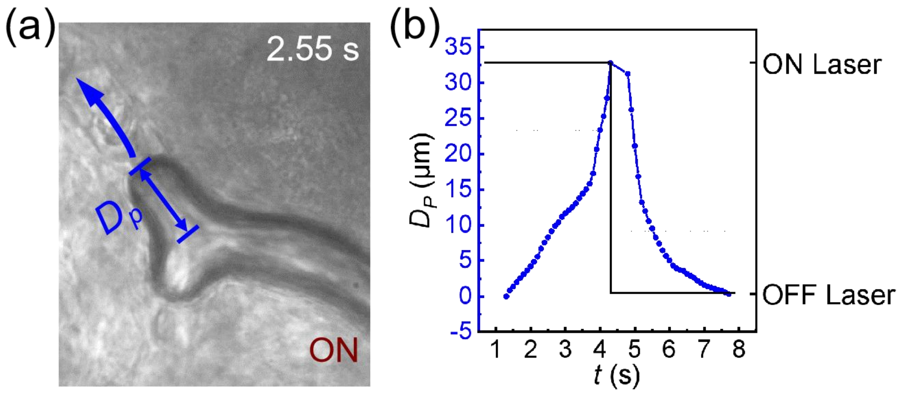

Fig. S4 After turning the laser on and off, the pumping of microbubbles on blood flow.

S5 Labeling of the laser spot position in Fig. 4(a)

To accurately demonstrate the functionality of microbubbles, Fig. 4(a) in the main text depicts cropped regions of interest, with the laser spot position extending beyond the cropped area. **Fig. S5** displays the laser spot position indicated in Fig. 4(a) under a wider field of view.

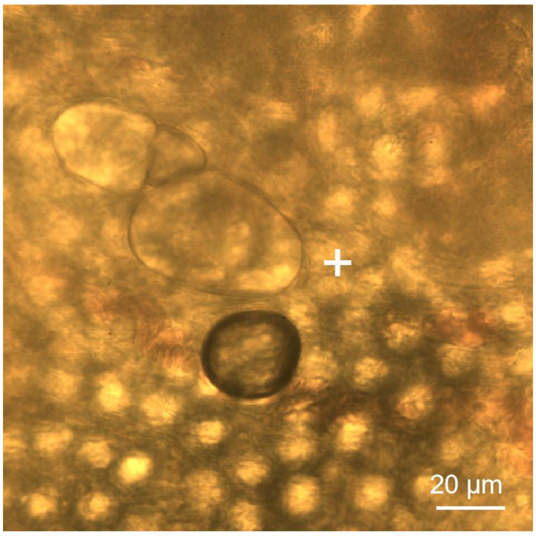

Fig. S5 Labeling of the laser spot position in Fig. 4(a). “+” represents the laser spot position.