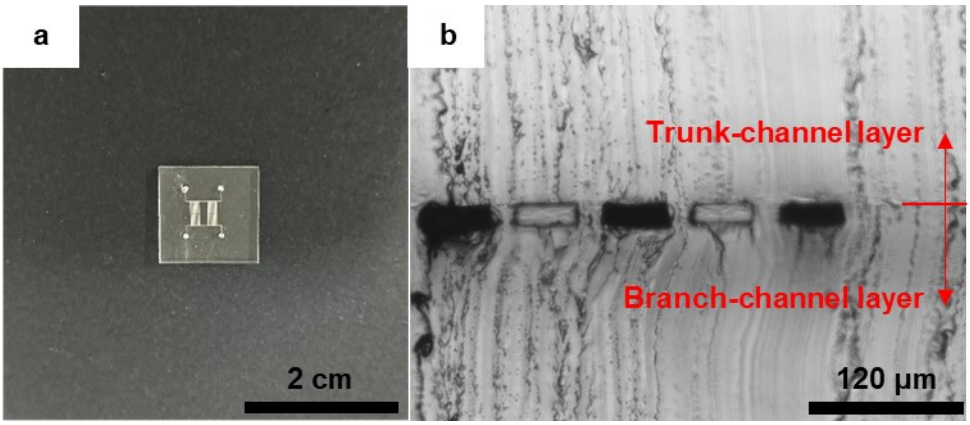
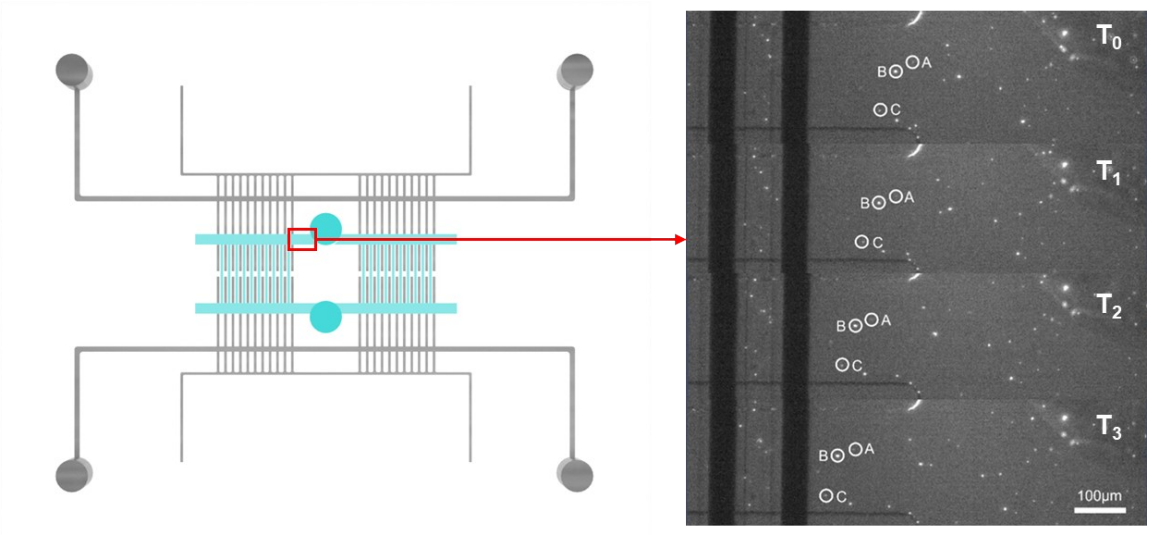
Electronic Supplementary Material (ESI) for Lab on a Chip.

Supplementary Information

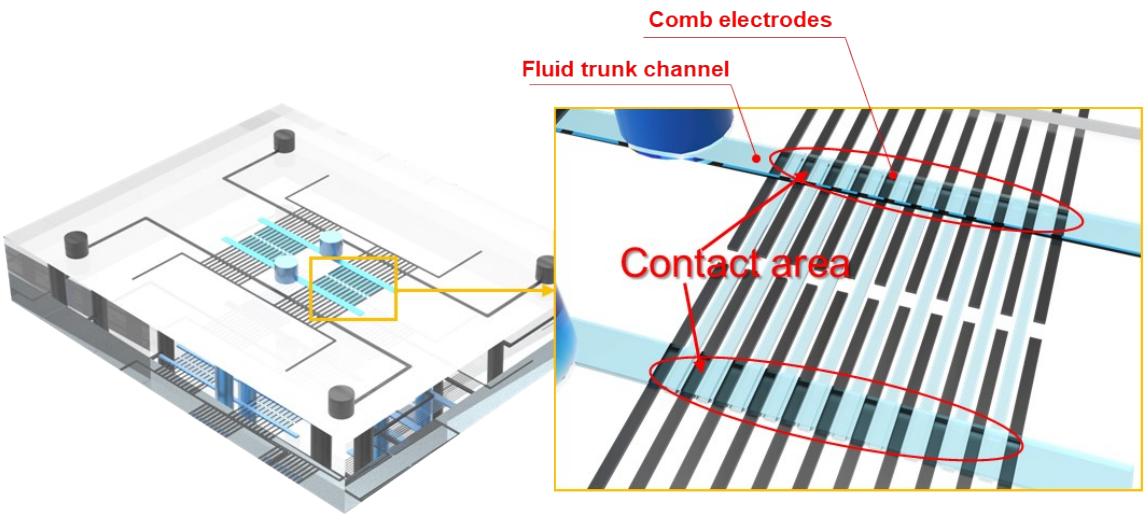
1.1 Supplementary Figures



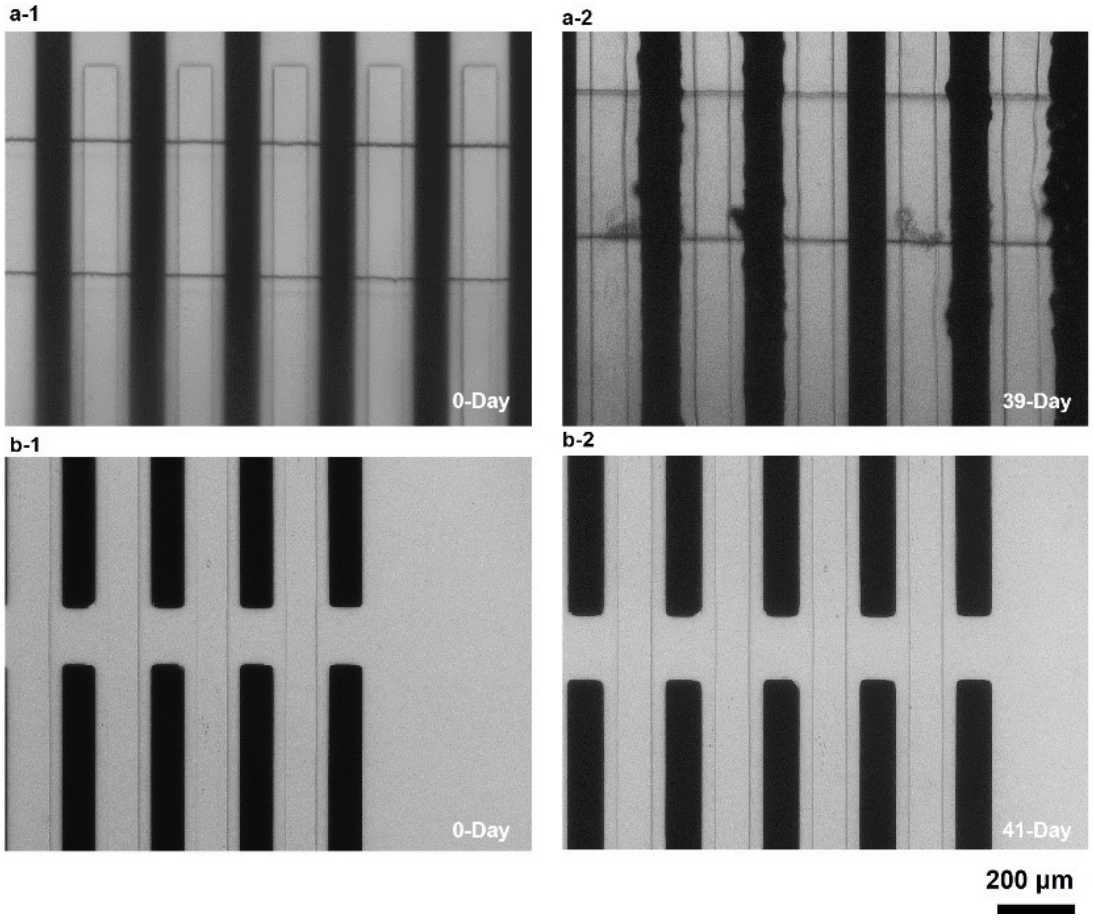
Supplementary Figure 1. a) Physical picture of liquid metal resting on the channel. b) Partial side view of the electrodes after bonding with PDMS.



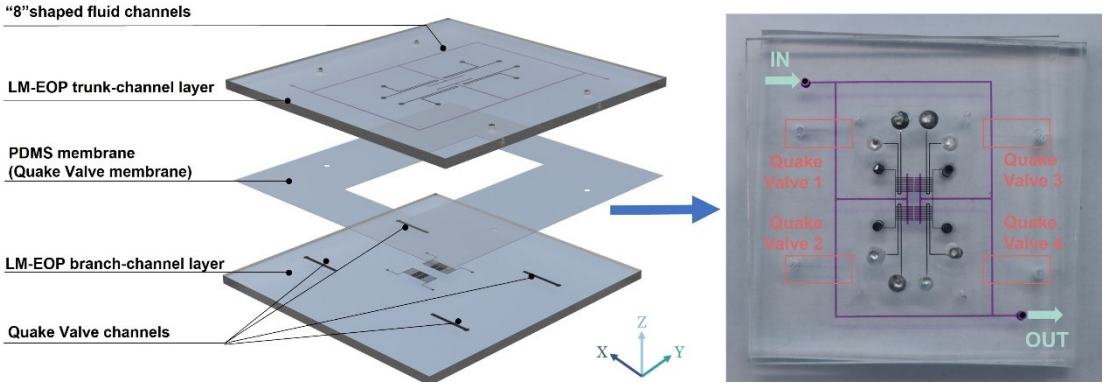
Supplementary Figure 2. Observation area and statistical method of the LM-EOP flow rate.



Supplementary Figure 3. Schematic representation of the electrode contact position with the fluid.



Supplementary Figure 4. Microscope image of corrosion of bismuth-based electrode. a) Water sealed storage only. b) Water sealed storage with 0.5V voltage for cathodic protection.



Supplementary Figure 5. The schematic diagram of the pump-valve integrated structure, consisting of three layers. The top layer is the LM-EOP trunk-channel layer with "8" shaped fluid channels and four Quake valve inlets. The PDMS membrane in the middle layer provides the valve membrane, and the skeletonized part realizes the contact between the upper and lower layers. The lower layer is the LM-EOP branch-layer containing Quake valve channels.

1.2 Supplementary Equation Derivation

The relationship between the parameters (w_2 and w_3) and the v_{EOF} can be expressed by the following fitted equation:

$$v_{EOF} = -\frac{\varepsilon\xi}{\eta}\left(0.6382\frac{U}{w_2} + 0.0622\frac{U}{w_3} - 517.4463\right) \#(4)$$

For a more intuitive description of the relationship between v_{EOF}, $\frac{U}{w_2}$, and $\frac{U}{w_3}$, a parameter β is defined as:

$$\beta = 0.6382 + 0.0622 = 0.7004$$

Therefore, $\frac{v_{EOF}}{\beta}$ can be expressed as:

$$\frac{v_{EOF}}{\beta} = -\frac{\varepsilon\xi}{\eta}\left(0.91\frac{U}{w_2} + 0.09\frac{U}{w_3} - 738.7868\right)$$

Furthermore, the relationship between v_{EOF}, $\frac{U}{w_2}$, and $\frac{U}{w_3}$, can be described as：

$$v_{EOF} \propto \left(0.91\frac{U}{w_2} + 0.09\frac{U}{w_3} - 738.7868\right) \#(5)$$