# Electronic supplementary information:

**Fig. S1** Photograph of the multilayer microchip.

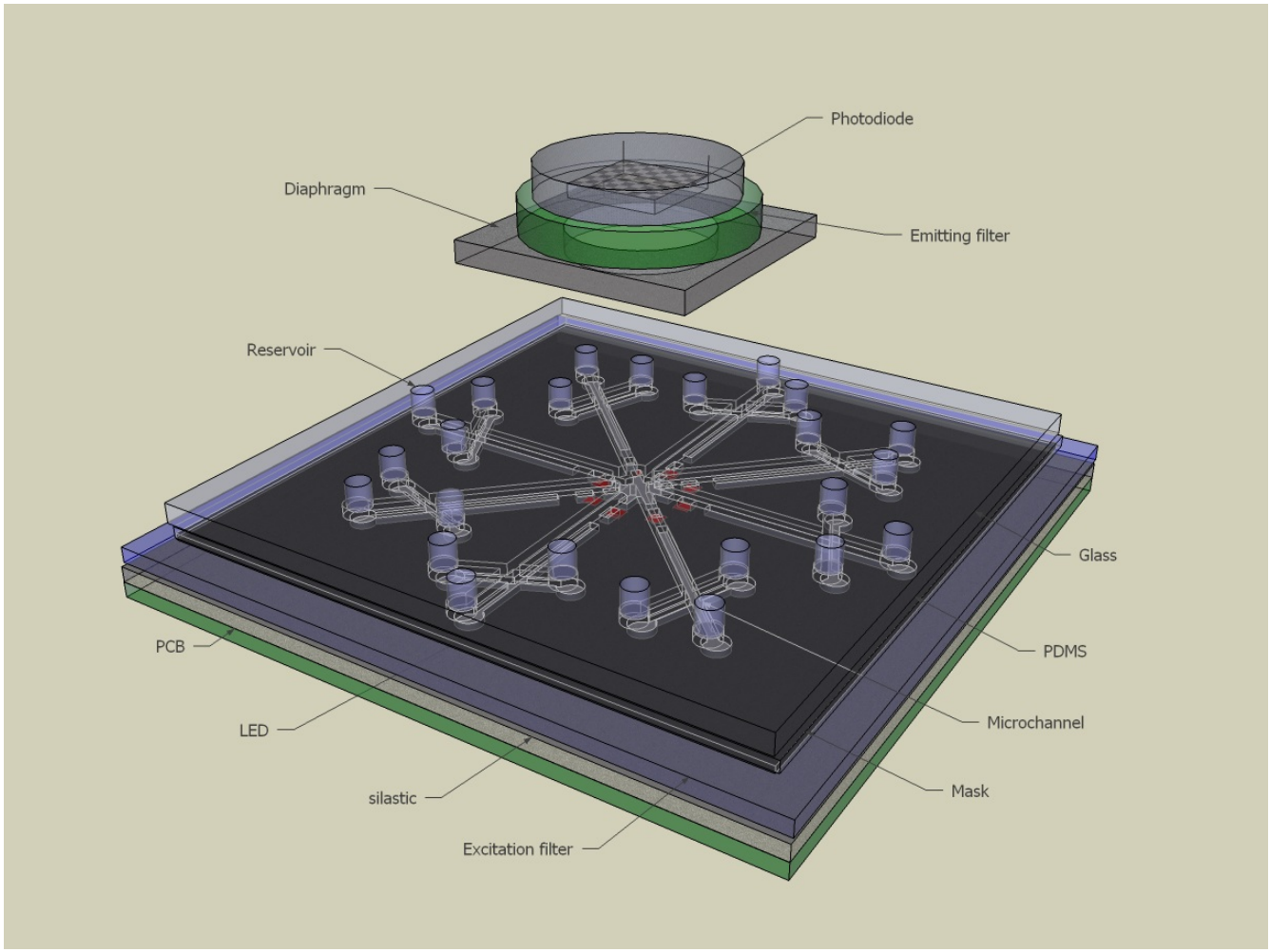



**Fig. S2** A schematic diagram of the detection system with detailed information of the chip.

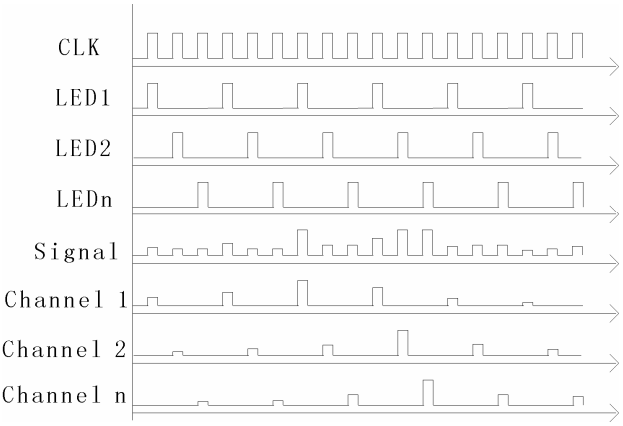



**Fig. S3** A diagram of the clock-time scheduling of the detection system.

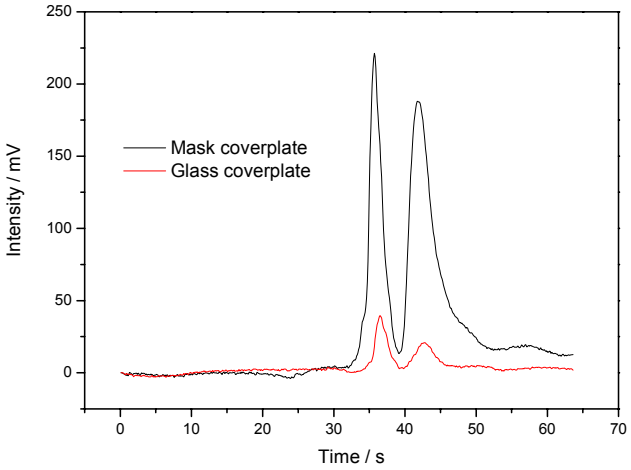



**Fig. S4** Electropherograms of 20 μM FITC labeled Arg in one channel of the 8-lane CAE chip with different distance between the channel and the light source. Injection field strength was 250 V $cm^{-1}$; separation field strength was 300 V $cm^{-1}$. The peak of FITC-Arg was at about 35 s and the peak of FITC was at about 42 s. The photomask coverplate configuration achieved a higher S/ N (62) of FITC-Arg than that of the glass coverplate configuration (10), with a 0.5 mm and 3.5 mm distance respectively.

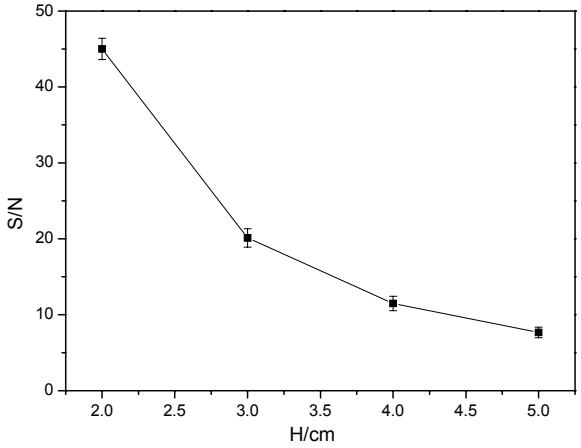



**Fig. S5** S/ N of 10 μM FITC-Arg with different distance of the detector from the chip.

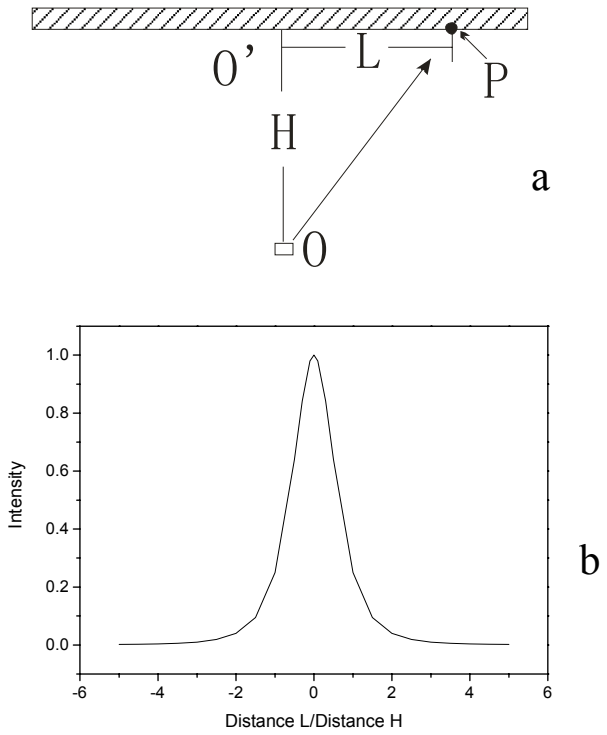



**Fig. S6.** a. A schematic diagram of the simulation model of the LED excitation intensity in the microchannel. b. Simulation result of the excitation intensity in the microchannel.

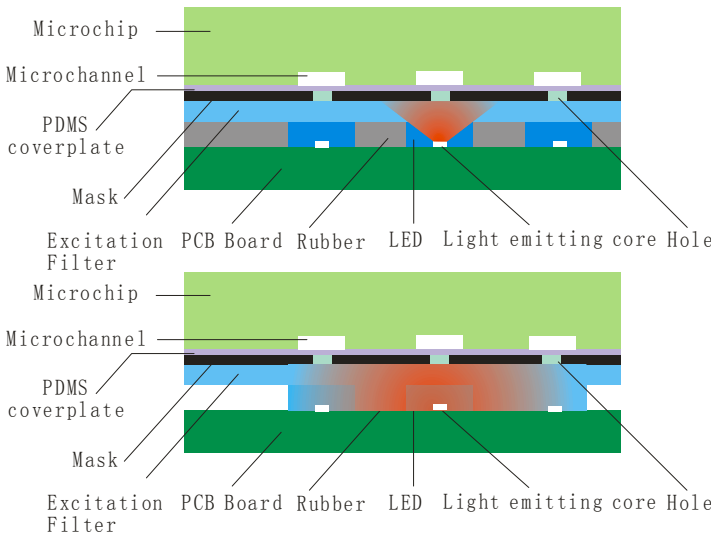
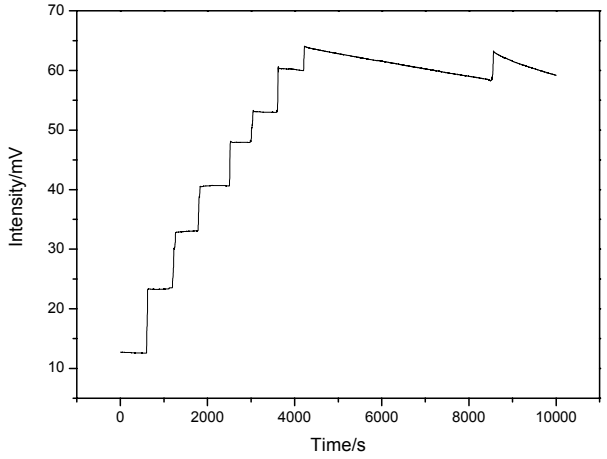
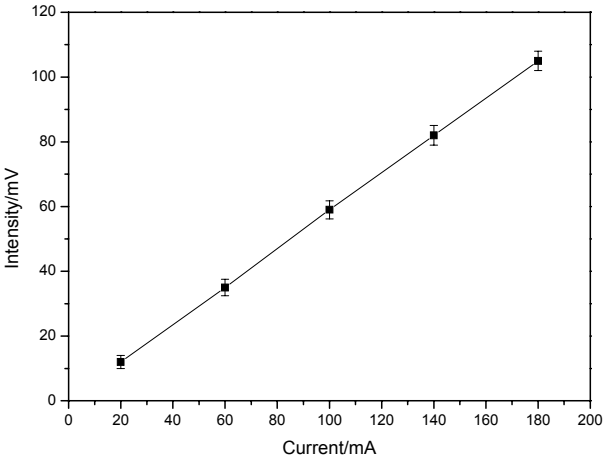



**Fig. S7** Cross-talk effect of the systems with (a) and without (b) silastic diaphragms. Since the filter has angle–based capability, the long wavelength part of the light in big angle will be cut off, so holophotal effect in the microchannel can be ignored.




a




b

**Fig. S8** Stability test of a LED by continuous current and pulsed current driving. a. A low speed A/D card (N2000, Zhida, Zhejiang, China) was used during the constant current driving, and the sampling rate was 10 Hz. As output of the power supply increased every 5 min from 10 mA to 60 mA, the excitation intensity skipped upwards accordingly. When the driving current was as high as 80 mA, signal sharply declined which indicated irreversible damage occurred. b. A LED was driven by an increased pulse current from 20 mA to 180 mA.

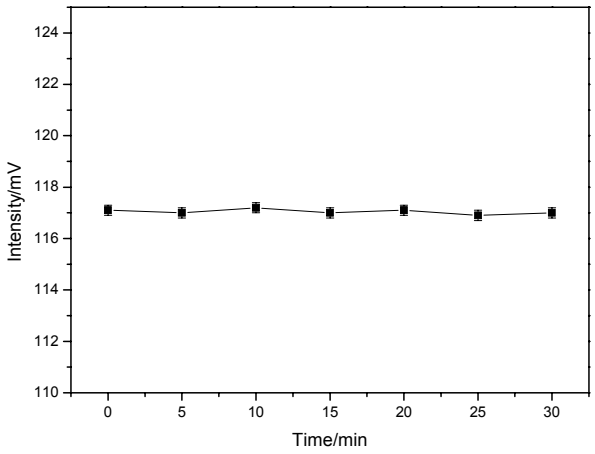
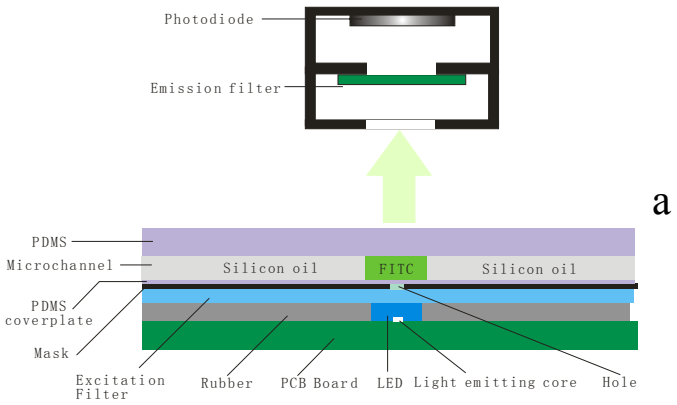
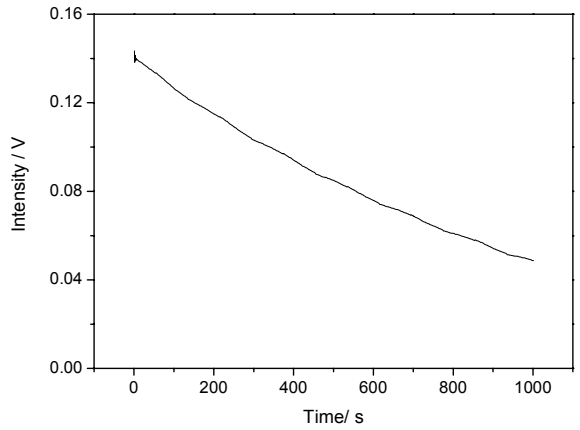


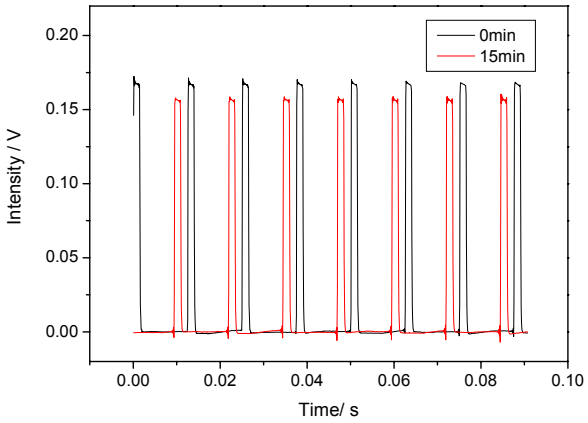

**Fig. S9** Stability test of a LED by 200 mA pulsed current driving.




a




b




c

**Fig. S10** Test of the photobleaching effect by continuously and pulsedly driving the LED. a. A schematic diagram of the system for photobleaching effect measurement. 10 nL of 2 μM FITC was airproofed in a droplet in a microchip and a 480 nm emission LED was used as light source. b. The continuously driven LED led to a 64% decrease of the fluorescence intensity in 1000 s. c. The 1: 7 (on: off) duty cycle pulse driven LED caused an 8.8% decrease in fluorescence intensity in 900 s.

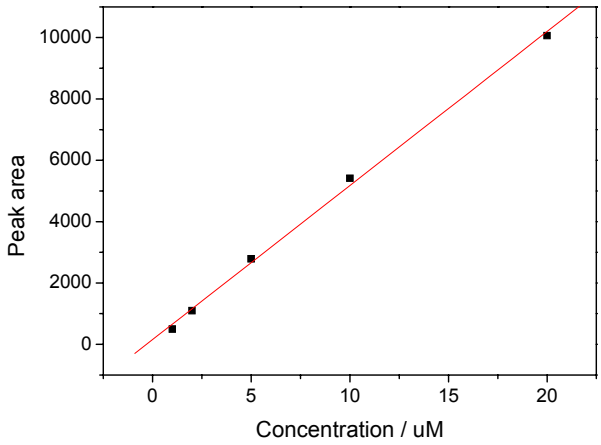



**Fig. S11** Peak areas of FITC-Arg with the concentration of 1 μM, 2 μM, 5 μM, 10 μM and 20 μM. The coefficient of correlation (r) achieved in the standard curve was 0.9990.

**Reagents and sample preparation**

Fluorescein isothiocyanate (FITC) was purchased from Sigma-Aldrich (St. Louis, MO, USA). L-Arginine was obtained from Kangda Amino Acid Works (Shanghai, China).

The FITC-labeled amino acid stock solution with a concentration of 2.5 mM was prepared by mixing 25.0 mL of L-Arginine stock solution (10 mM in water) with 10.0 mL FITC solution (40 mM in acetone) and 65.0 mL 10 mM sodium tetraborate buffer. The reaction was carried out at 20 ℃ for 12 h in dark. Working sample solutions were prepared daily by diluting FITC-amino acid stock solutions with 5 mM borate buffer.

**Sample Loading**

Each day before use, the microchip was rinsed with 10 mM sodium hydrate followed by water for 5 min and 10 min respectively. Before each performance, it was rinsed with CE buffer (10 mM borax in water) for several minutes. Then the sample (S) reservoir (Fig. 1c) was filled with 4 μL sample solution, while 4 μL CE buffer were added into each of the other reservoirs.