

Supplementary Information

Development of On-Chip Sample Injection system with a 6-Port Valve Incorporated in a Microchip

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Supplementary figures

Fig. S1. Photograph and illustration of the μ FIA system.

Fig. S2. Optical spectra used for designing the fluorescence detection device.

Fig. S3. The principle of flow injection-based hydrogen peroxide assay.

Fig. S4. Photograph of valves and PDMS plates for evaluating relationship of valve diameter and hole diameter in PDMS.

Fig. S5. Schematic of the μ FIA system with the commercial injector.

A CAD file of the 6-port valve.

A CAD file of the valve stopper.

A movie demonstrating the principle of sample injection with the 6-port valve.

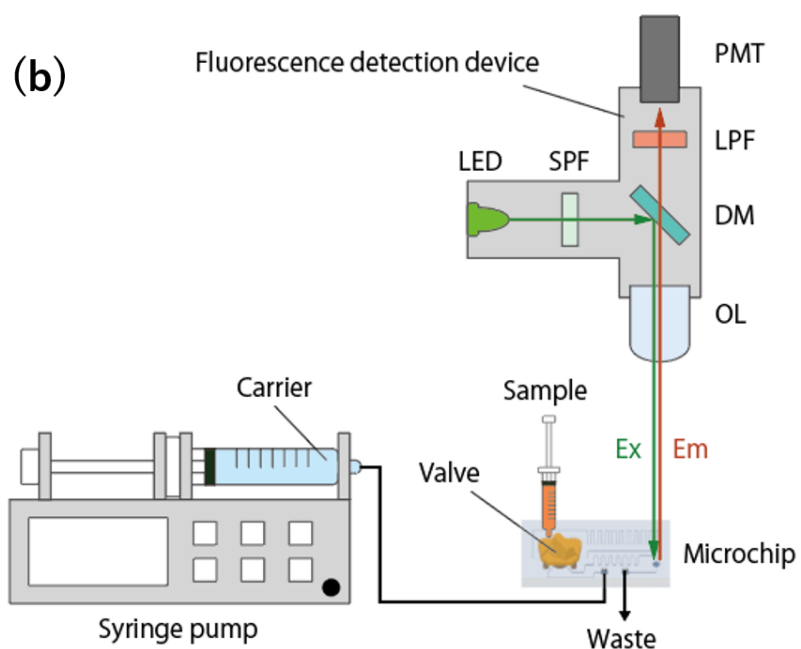
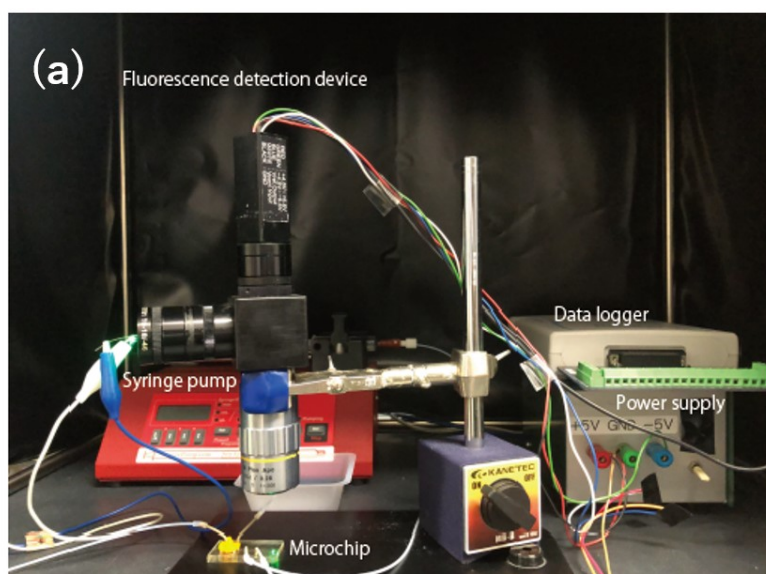


Fig. S1 Photograph and illustration of the μ FIA system. (a) Photograph of the whole μ FIA system. (b) Schematic Illustration of the μ FIA system. The abbreviations in the figure are as follows; PMT: photomultiplier, SPF: short-pass filter, LPF: long-pass filter, DM: dichroic mirror, OL: objective lens, Ex: excitation light, Em: emission.

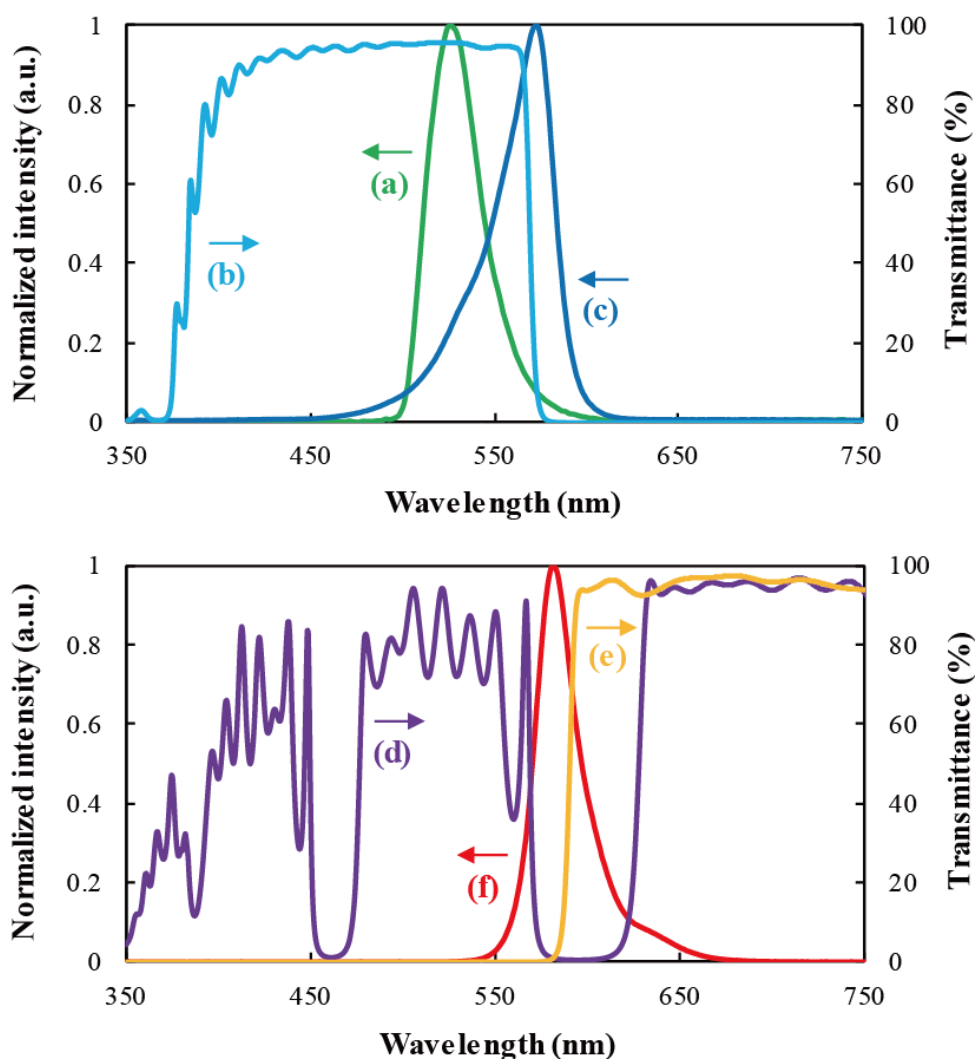


Fig. S2 Optical spectra used for designing the fluorescence detection device. The directions of arrows above the symbols indicate which vertical axis corresponds to the associated spectrum. (a) Emission spectrum of the high-brightness green LED. The peak emission wavelength and the full width half maximum (fwhm) are 527 nm and 35 nm, respectively. (b) Transmission spectrum of the short-pass filter. The cut-on wavelength is 569 nm. (c) Excitation spectrum for resorufin (maximum peak wavelength of 573 nm). (d) Transmission spectrum of the dichroic mirror. (e) Transmission spectrum of the long-pass filter with a cut-off wavelength of 591 nm. (f) Fluorescence spectrum of resorufin (maximum peak wavelength of 582 nm). Emission spectrum of LED was measured with a palm-sized spectrometer (Colorcompass MF, AT-system, Shizuoka, Japan). Transmission spectra were obtained with a UV-visible spectrophotometer (UV-1800, Shimadzu Corp., Kyoto, Japan). Optical spectra for resorufin were measured with a Fluorescence spectrophotometer (RF-5300PC, Shimadzu Corp., Kyoto, Japan).

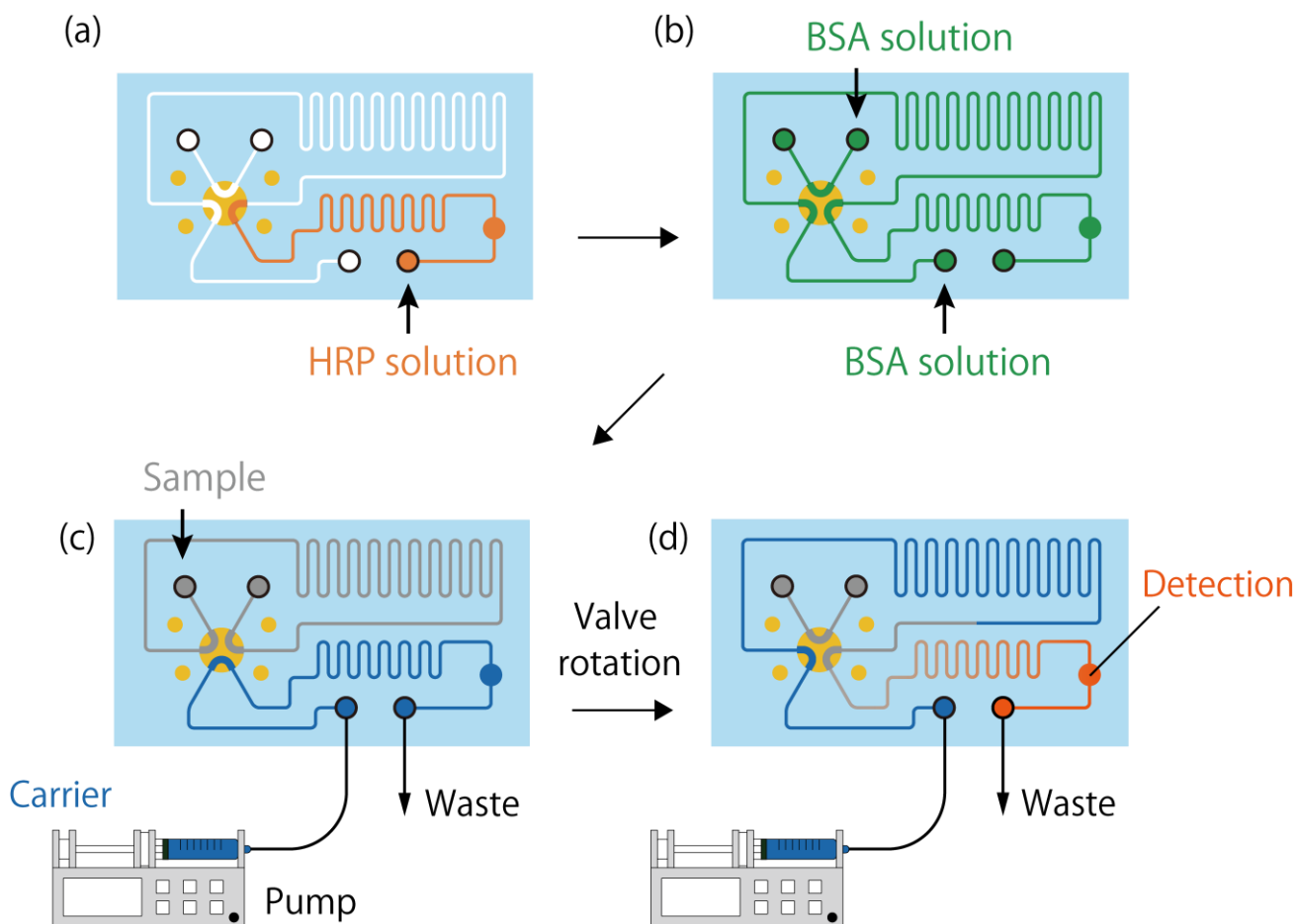


Fig. S3 Principle of flow injection-based hydrogen peroxide assay. The blocking treatment of the 6-port valve was carried out in advance. (a) A 10 ng/mL HRP solution was used to fill the microchannel between the valve and Outlet 1 for 1 h at room temperature, thereby immobilizing HRP on the inner wall of microchannel. (b) A 1% (w/v) BSA solution was used to fill all of the microchannels and the blocking treatment was performed for 30 min at room temperature. (c) A syringe pump was used to flow the carrier solution and the sample solution was loaded in sample channel. (d) The valve was rotated by 60° and the sample solution was injected into the microchannel. Time-dependent changes in fluorescence responses were monitored at the detection chamber.

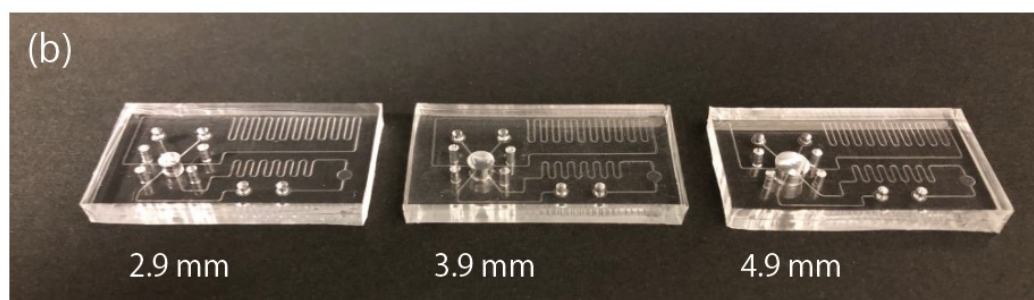


Fig. S4 Photograph of valves and PDMS plates for evaluating relationship of valve diameter and hole diameter in PDMS. (a) Photograph of valves with different diameter. (b) Photograph of PDMS plate with through hole with different diameter.

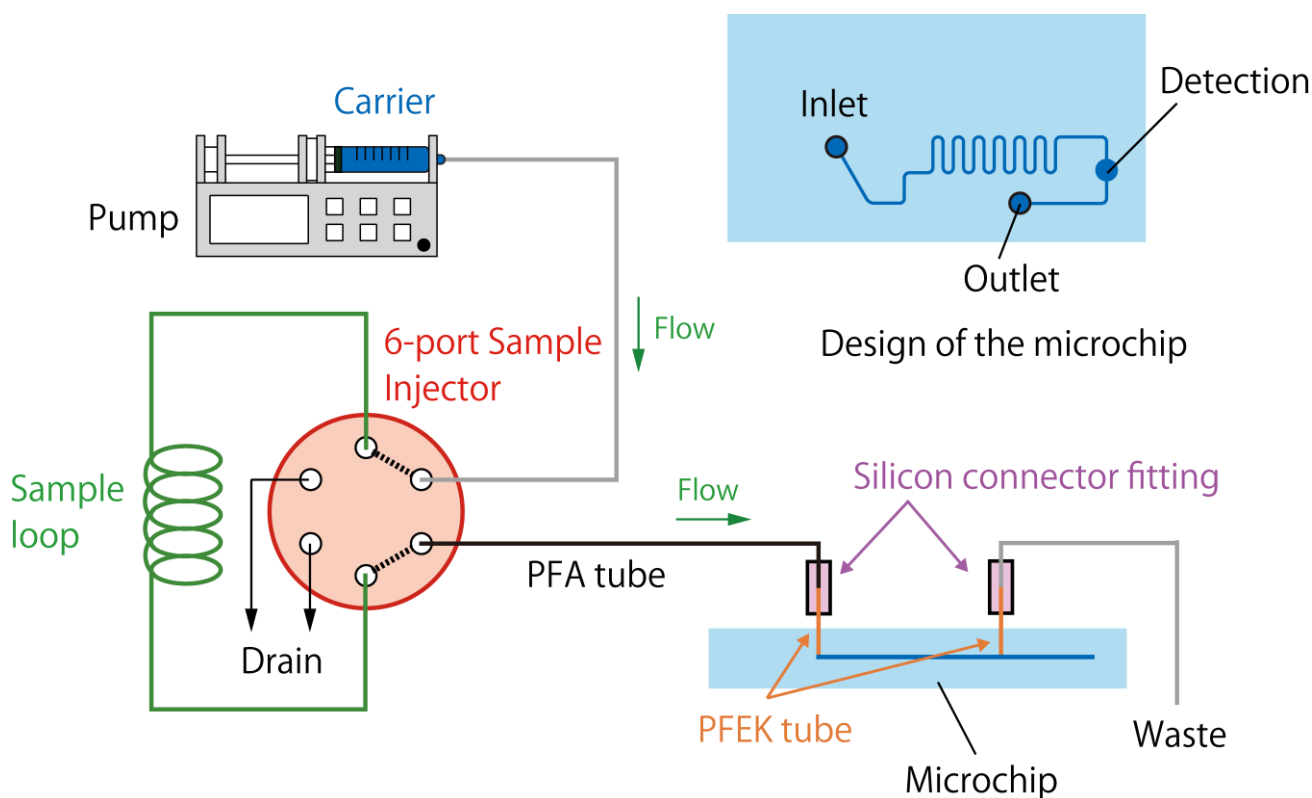


Fig. S5 Schematic of the μ FIA system with the commercial injector. Resorufin solutions were used as samples and injected with a commercial 6-port sample injector (VI-12, FLOM Corp., Tokyo, Japan). The injector was connected via a PFA tube (I.D. 0.25 mm, O.D. 1/16", Length: 60 cm). The open end of the PFA tube was connected to a PEEK tube (I.D. 0.25 mm, O.D. 1/16", Length: 4 cm) with a silicon connector fitting. The other end of the PEEK tube was directly inserted into an inlet on the microchip. The PEEK tube was fixed with sufficient strength by virtue of the PDMS flexibility. The volume of the sample loop was set to 6.4 μ L. Resorufin in the samples was measured under similar conditions to the measurement with the on-chip injection system. Green arrows indicate the flow direction of the carrier and sample solutions.

A CAD file of the 6-port valve.

A CAD file of the valve stopper.

A movie demonstrating the principle of sample injection with the 6-port valve. The movie is played at double speed.