Electronic Supplementary Information ESI

Inkjet printing: An integrated and green chemical approach to microfluidic paper-based analytical devices

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Table of Contents

Reagents and materials

Octadecyl acrylate, 2,2-dimethoxy-2-phenylacetophenone, glycerin, 0.002 mol/L $KMnO_4$ and 35% H_2O_2 were purchased from Wako Pure Chemical Industries Ltd. (Osaka, Japan). 1,10-decanediol diacrylate, 170 U/mg horseradish peroxidase (HRP) and 3,3',5,5'-tetramethylbenzidine (TMB) were purchased from TCI (Tokyo, Japan). Citric acid, disodium hydrogen phosphate and 2-propanol were purchased from Kanto Chemical (Tokyo, Japan). Contact lens cleaning solution, One step®, was purchased from Abbott Medical Optics (Tokyo, Japan). Filter papers were purchased from Advantec (Tokyo, Japan). 2,2-Dimethoxy-2-phenylacetophenone (Irgacure 651) was used as photoinitiator.

H_2O_2 sensing ink

The hydrogen peroxide sensing ink was composed of 1.0 mL of 2.8 mg/L HRP in citrate-phosphate buffer (pH 7.0), 2.0 mL of 7.5 mM TMB in 2-propanol, and 1.0 g of glycerin to control the viscosity.

Evaluation of ink spreading with time passed between printing and UV curing

In order to evaluate the spreading of the ink with time, microfluidic channels (1.5 mm nominal channel width) were printed on the topside of type 5C filter paper and left for a given length of time before UV irradiation. The backside cover layer was fabricated according to the "standard procedure" with UV curing initialized 7 s after completed printing. The resulting channel width was measured by a digital microscope after applying 3 μL of dye solution (Fig. S-1).

Selectivity and influence of potentially interfering compounds on the H_2O_2 sensor

Lithium nitrate, calcium nitrate, zinc nitrate, ammonium nitrate, ascorbic acid and glucose were purchased from Wako Pure Chemical Industries Ltd. (Osaka, Japan). Sodium nitrate, aluminum nitrate, iron nitrate, magnesium nitrate, sodium chloride and sodium perchlorate were purchased from Kanto Chemical (Tokyo, Japan).

Fourteen different species potentially interfering with the H_2O_2 determination on the μPAD, were investigated for their effect on the colourimetric signal. To evaluate the

selectivity of the sensor, the ΔR signals induced by the application of 1.0 mM solutions (14 foreign species and hydrogen peroxide) were recorded. In addition, the colourimetric signals after the application of 0.5 mM H_2O_2 solutions in the presence of 1.0 mM of the 14 foreign species were evaluated (Figs. S-3, S-4).

Table S-1. Chemical composition of the UV curable ink.

Compound	Weight%	log P_{ow} [a]	Remarks
Octadecyl acrylate	59.5	9.45	m.p. 32 °C
1,10-Decanediol diacrylate	25.5	4.95	b.p. 181 °C (2.7 hPa)
Irgacure 651	15.0	3.62	m.p. 64-67 °C

[a]Calculated values extracted from SciFinder®

Table S-2. Specification of filter papers

Paper type	3	5A	5B	5C	6	7
Grammage (g/m^2)	113	97	108	118	103	87
Thickness (mm)	0.23	0.22	0.21	0.22	0.20	0.18
Flow time[a] (s)	130	60	195	570	300	200
Nominal particle retention size (μm)	5	7	4	1	3	4

[a] Flow time is the time in seconds required to filter 100 ml of distilled water at 20°C under the pressure supplied by a 10 cm water column through a 10 cm^2 section of filter paper (data as quoted by the manufacturer Advantec.)

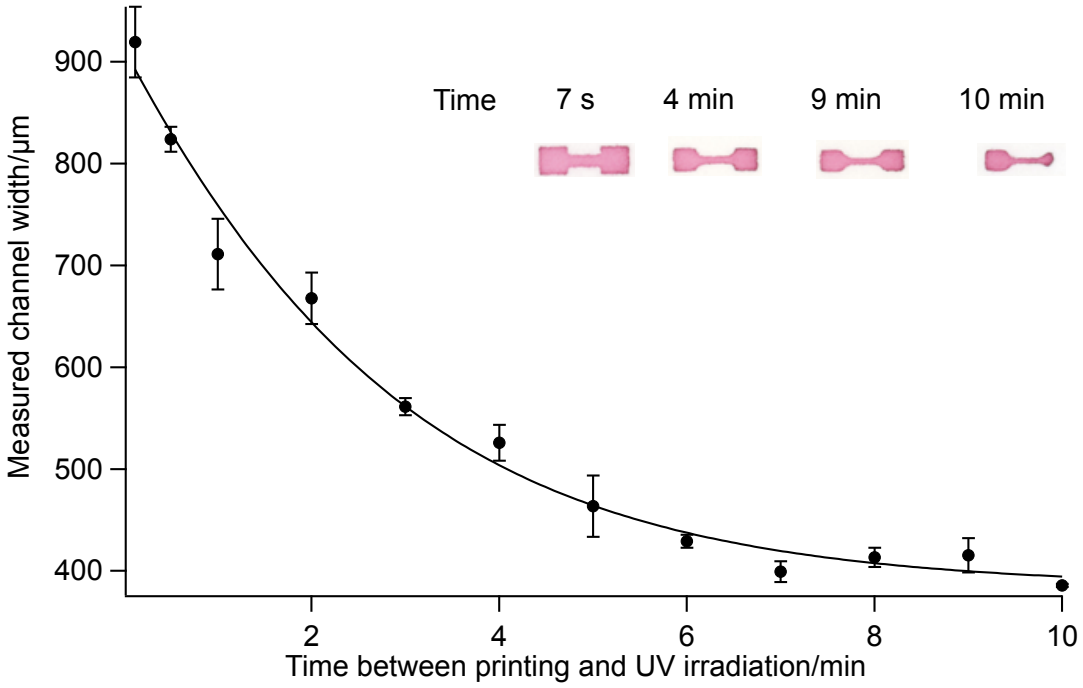

Figure S-1. Measurement of channel width in dependence of the time passed between printing and initializing UV curing (error bars: standard deviation for 3 patterns; the width of each single channel was measured at 6 positions and the mean value plotted as the channel width).

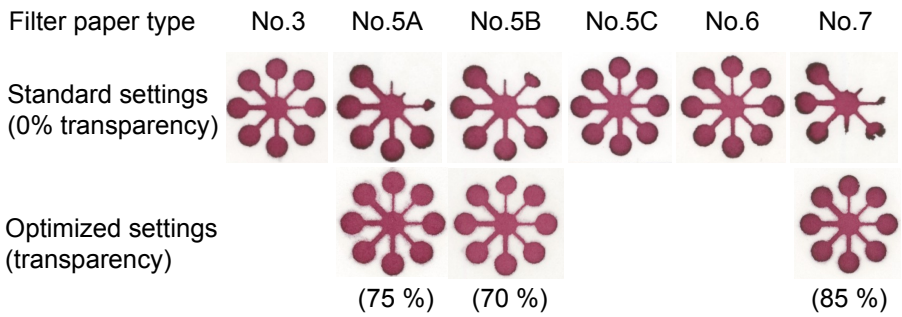

Figure S-2. Microfluidic structures printed on various types of filter papers. For details regarding the paper properties, refer to Table S-2; the transparency settings refer to the printing of the cover layer on the backside of the paper; the structure printed on the topside of the paper is identical to the one shown in Fig. 3 of the main text.

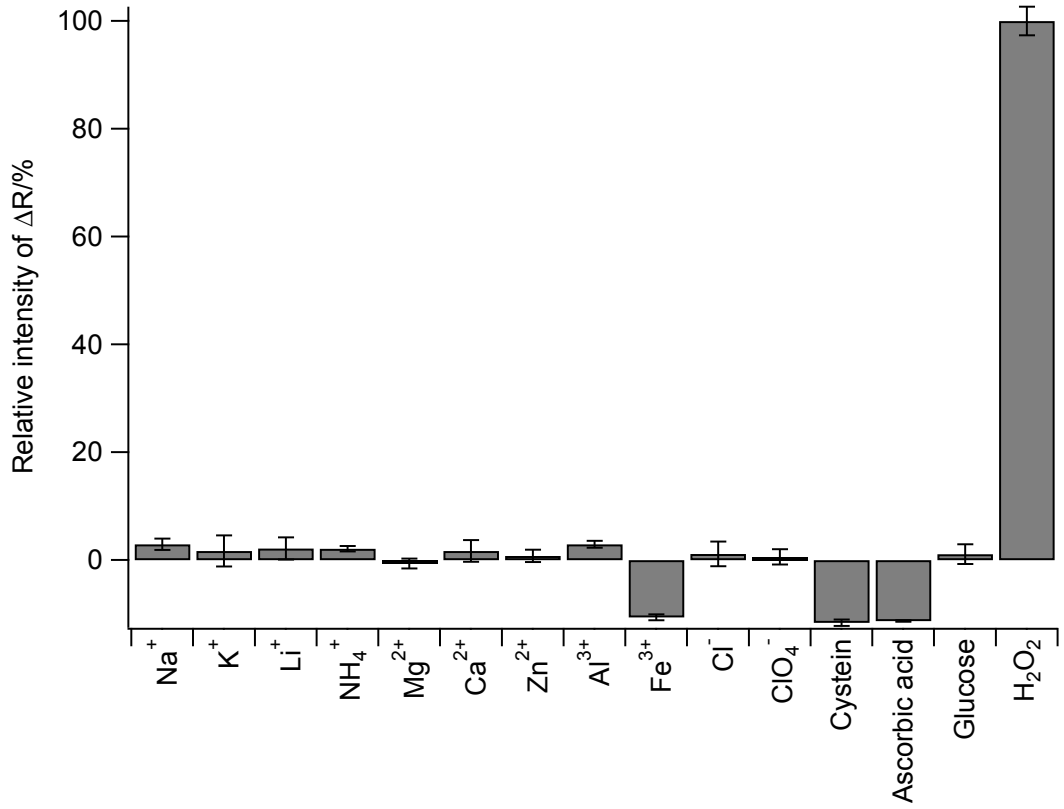

Figure S-3. Normalized colourimetric signal induced by the application of 1.0 mM solutions of various foreign species and H_2O_2 (error bars: n=5). All cations have been applied as nitrate salts.

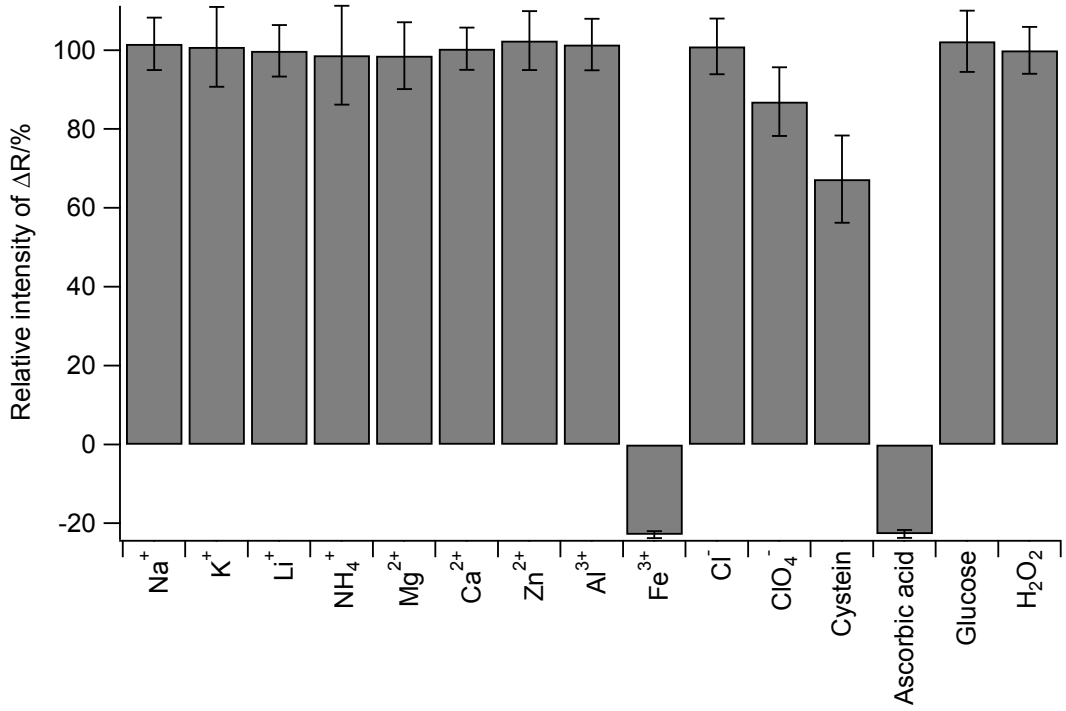

Figure S-4. Normalized colourimetric signal induced by the application of 0.5 mM H_2O_2 solution in the presence of 1.0 mM of various foreign species (error bars: n=5). All cations have been applied as nitrate salts.

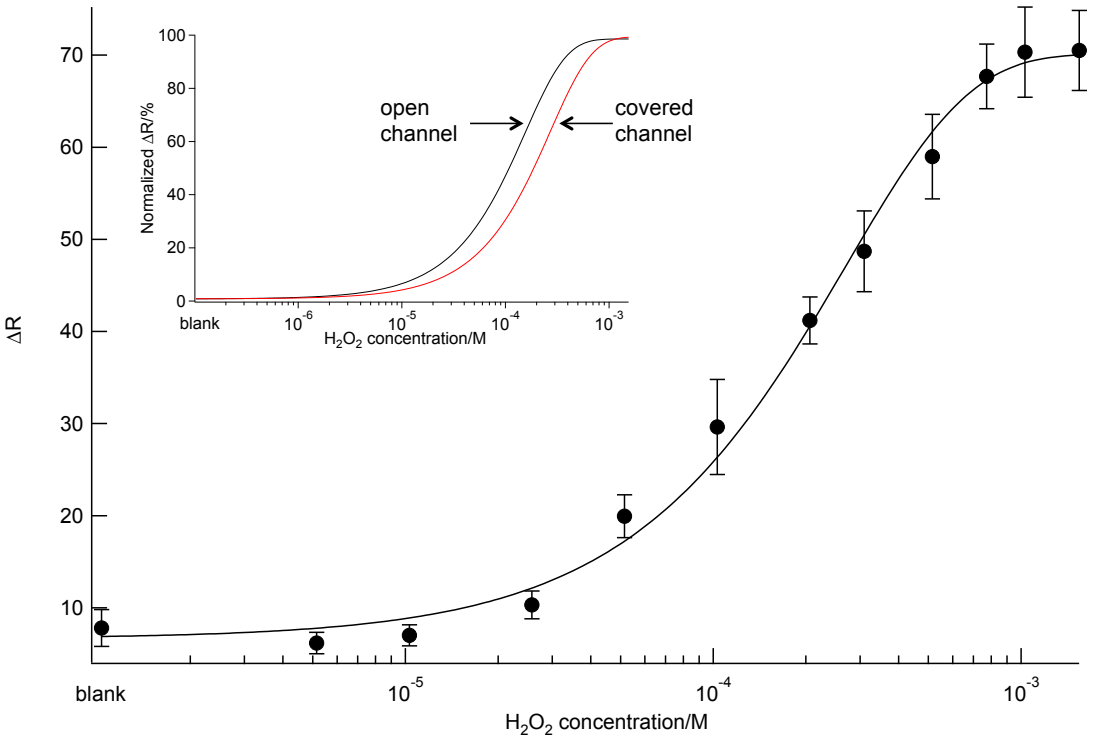

Figure S-5. "All-inkjet printed" H_2O_2 sensor with covered tunnel-like channels: the calibration curve was obtained by digital colour analysis using the RGB colour space (error bars: n=5). ΔR indicates the difference of the R-value between the sample inlet area and the signal detection area; the inset shows the shift of the calibration curve to higher concentrations in the case of using μPADs with covered channels (red line) compared to open channels (black line).