Supplementary Information

Experimental

Materials and Regents

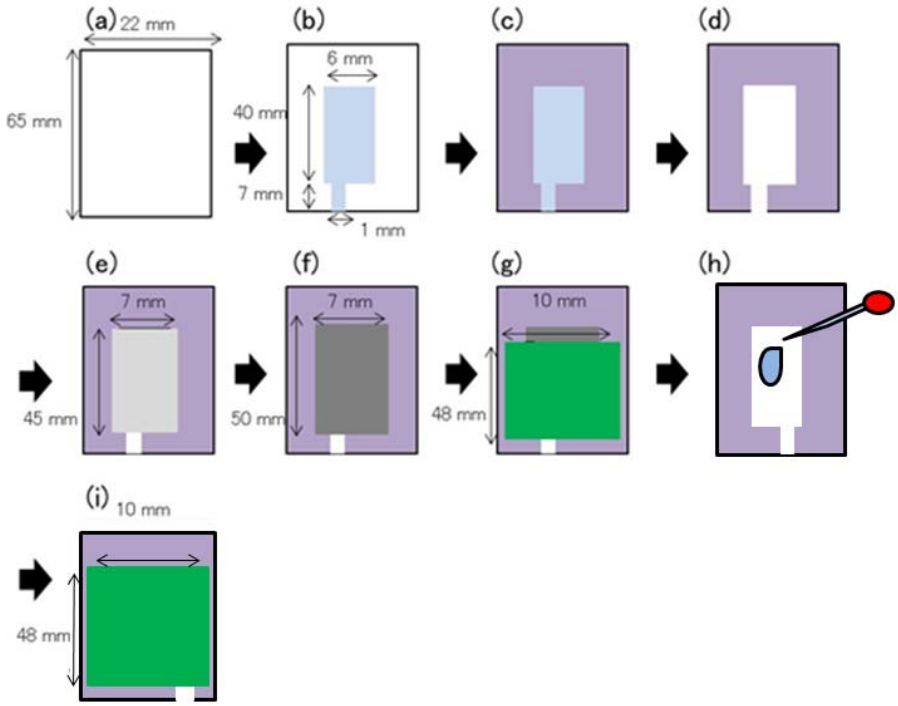
The Ag ink (ECM-100 AF5000) and resist ink (TF-200 FRI) used were purchased from TAIYO INK MFG. CO., LTD. (Japan). A piece of filter paper (Munktell M-1, Germany) was used as the substrate. The water-repellent ink used (Fluorosurf FC-3030C-30) was purchased from Fluoro Technology Co. (Japan). The other reagents used were purchased from Wako Pure Chemical Industries (Japan).

Equipment for screen-printing

We used an LS-150TV screen printer (New Long Seimitsu Kogyo, Japan) to fabricate the reference electrode. Screen-pattern films designed using a CAD soft were ordered from Mitani Micronics (Japan). The Ag and Ag/AgCl pattern films were made of polyester mesh films (120 μm in thickness). The resist film used was a metal-masked film (120 μm in thickness). An ultrasonic homogenizer (UH-150, STM, Japan) was used to prepare the Ag/AgCl ink. Finally, we used an NR-2000 data logger (Keyence, Japan) to measure the open-circuit potentials.

Processes for fabricating the water-repellent layer and the synthesized reference electrode

Figure S1 shows the process for fabricating the synthesized paper-based reference electrode. First, a piece of filter paper was cut into dimensions of 22 × 65 mm (a). Next, masking tape was put on the filter paper (b). The dimensions of the pattern formed using the masking tape is shown in Fig. S1. A layer of the water-repellent ink was then coated on the masked substrate and dried for 1 day (c). After the ink had dried, the masking tape was removed (d). A layer of the Ag/AgCl ink was printed on one side of the water-repellent-treated paper substrate (e). Next, a Ag conducting layer was formed by printing a layer of the Ag ink (f). The layers of the Ag and Ag/AgCl inks were cured at 120 °C for 20 min. Then, a layer of the resist ink was printed and cured at 100 °C for 20 min (g). Next, 0.5 mL of a saturated KCl solution, which consisted of 246 mg of KCl in 1 mL of ultrapure water, was dropped on the opposite side of the water-repellent-treated paper substrate three times (h). Finally, a layer of the resist ink was printed and dried at 120 °C for 20 min (i).



SI Figure 1 *Schematic showing the process for fabricating the synthesized Ag/AgCl reference electrode.*

SI Table 1

Comparison of the performance of the synthesized reference electrode and those of the solid-state Ag/AgCl reference electrodes reported in the literature

Fabrication technique	Liquid junction	Electrolyte layer	Test solution	Set-up time (min)	Stability (h)	Ref.
Screen-printing (Reference electrode synthesized in the current study)	Paper	Saturated KCl in paper substrate	0.1 M Na_2SO_4 solution	<1	75	This work
Photolithography, Electrochemical oxidation and screen-printing	Hydrophilic polymer	Saturated KCl, AgCl	50 mM NaOH/KH_2PO_4 buffer containing 0.1 M KCl at pH7.0	240	120	9
Screen-printing	None	Saturated KCl in UV curing resin	1.0 M KNO_3 solution (pH: N/A)	180	100	10
Screen-printing (Reference electrode synthesized in the current study)	PDMS-PEG	Saturated KCl in PDMS film	Phosphate buffer solution at pH 7.0	120	Longer than 1680	14