Electronic Supplementary Material (ESI) for Analyst.

Supplementary Information

Experimental Section:

Chemicals:
Chromoionophore I, Chromoionophore III, sodium ionophore VIII, sodium ionophore VI, potassium ionophore III, potassium tetrakis[3,5-bis(trifluoromethyl)phenyl]borate (KTFPB), potassium tetrakis[3,5-bis(trifluoromethyl)phenyl]borate (NaTFPB), cyclohexanone, Bis-Tris methane, boric acid, phosphoric acid, acetic acid, NaCl, KCl, $CaCl_2$, and LiCl were purchased from Sigma-Aldrich (St. Louis, MO).

Printing Procedure:

Ink was prepared by dissolving sensing chemicals in cyclohexanone. The ink was filtered using a PTFE 0.22 um filter and then injected into a 16-nozzle Dimatix ink cartridge. Fabric was set within the Dimatix Material Printer DMP-2850 and settings were adjusted to print one layer at 10 um drop spacing frequency unless otherwise specified. Newly printed ISOs were then placed in a room-temperature vacuum for one hour to allow the evaporation of cyclohexanone. The pH optode and cation optode were soaked in pH 4.0 Britton-Robinson buffer and pH 6.5 Bis-Tris-HCl buffer, respectively, for 1 h to wash away loosely adsorbed chemicals. Then, the fabric-based optode was partitioned into roughly 1 cm^2 sections and tested for response.

Hue Extraction:

After an optode was soaked in a solution and lightly dabbed dry with a piece of filter paper, the image of the optode was obtained in a 3D-printed dark box using an iPhone SE. The flash light was used as the sole light source. The optode position was fixed for all tests. Hue values were extracted using the Color Mate app.

Reversibility Test:

The optode was soaked in 0.5 mL of the first solution and gently shaked for 2.5 min. Then, the optode was removed from this solution and lightly dabbed dry with a piece of filter paper. A picture of the optode was taken using the photography method described above and the hue value for the first concentration was obtained. The optode was then transferred to the next solution with the second concentration for 1 minute to prevent contamination of the second concentration by any residual solution on the optode. After the 1-min soaking, the optode was transferred to another solution of the second concentration for the remaining 1.5 min. So, the total soaking time with the second concentration is 2.5 min, and a photo was taken after this soaking to obtain the hue value for the second concentration. The washing solution was always disposed of and replaced as this was to prevent contamination. Aforementioned steps were repeated for each trial.

Fluorescence Imaging:

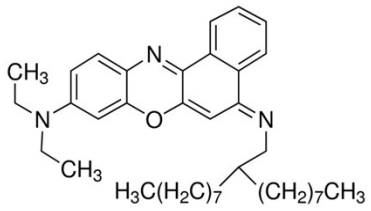
Fluorescence imaging of the dye was performed via Zeiss LSM 710 Confocal Laser Scanning Microscope. Excitation is at 633nm with scanning emission set to 645-750nm. The unmodified Nike Dri-FIT does not have fluorescence in this wavelength range.

Water Contact Angle:

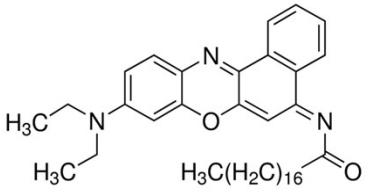
Water contact angle images were taken via ramé-hart Contact Angle Goniometer Model 190. A 1 cm^2 optode printed on Nike DriFit fabric was fixed onto a glass slide. Approximately 15 uL of DI water was dropped onto the fabric surface. Images were captured at the corresponding times as the water diffused into the fabric matrix.

Structures of the sensing chemicals used for pH, Na^+, and K^+ optodes

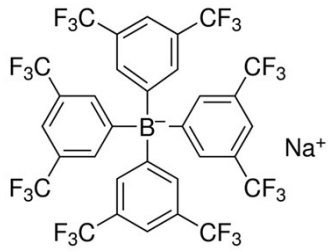
Chromoionophore III



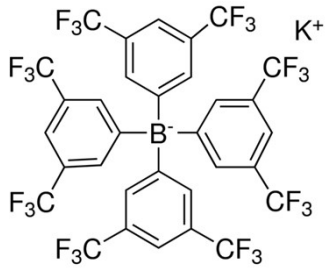
Chromoionophore I



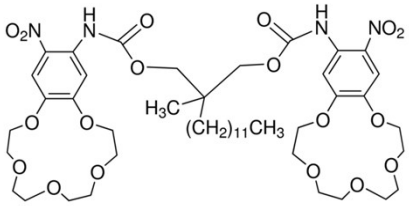
NaTFPB



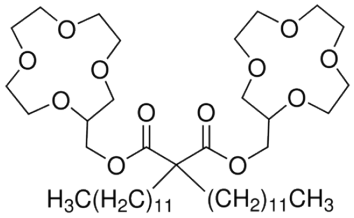
KTFPB



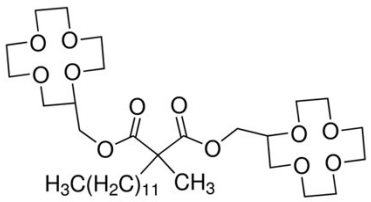
Potassium ionophore III



Sodium ionophore VIII



Sodium ionophore VI



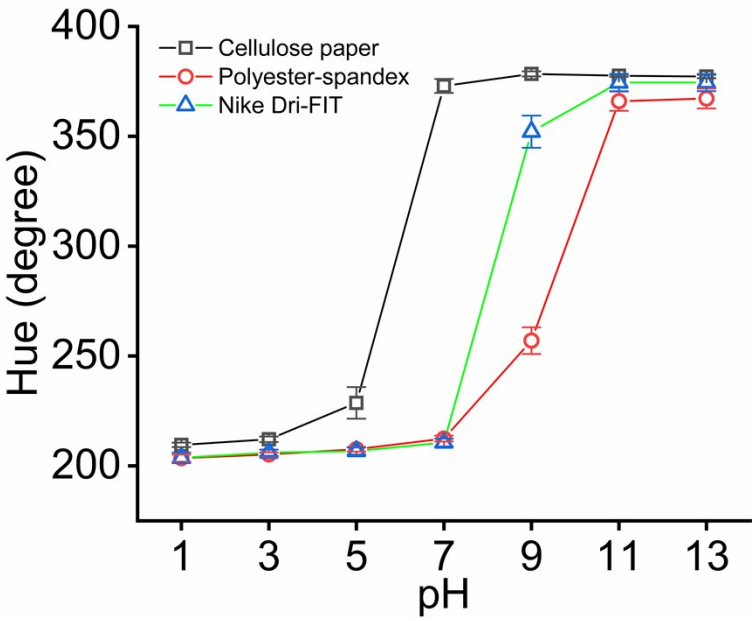


Fig. S1 Hue-based response curves of the Chromoionophore III-based pH optodes on different substrates. Data points in the calibration curve are average ± s.d. for n= 3 sensors.

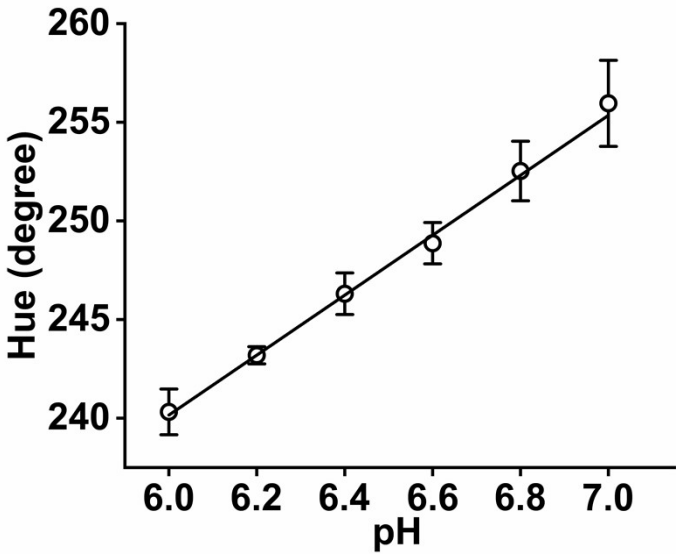


Fig. S2 Hue-based response curve of the pH optode for pH 6.0 to 7.0. Data points in the calibration curve are average ± s.d. for n= 3 sensors.