Electronic Supplementary Information (ESI)

Polymeric chemosensor for the detection and quantification of chloride in human sweat. Application to the diagnosis of cystic fibrosis

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S1. Synthesis and characterization of 6-methoxy-1-(pent-4-en-1-yl)quinolin-1-ium bromide (2).

A mixture of 6-methoxyquinoline (2 g, 1.74 mL, 12.6 mmol) and 5-bromopent-1-ene (1 equiv., 12.6 mmol, 1.88 g, 1.49 mL) was stirred in a round bottom flask, under nitrogen atmosphere at 70 °C. The reaction was monitored by TLC analysis (hexane:AcOEt 1:1). After twelve hours, the reaction mixture became a dense oil. Although there was a small amount of starting material it was stopped. Once cooled, the mixture was filtered over 2 cm of silica gel, in a filter plate (pore 2), under vacuum. At the beginning, the quinoline was eluted using AcOEt as mobile phase and then MeOH was added to elute the desired compound. The organic solvent was evaporated under vacuum yielding the pure quinolinium salt.[1] ^{1}H NMR (300 MHz, $CDCl_3$) δ = 10.08 (d, *J* = 5.7 Hz, 1H), 9.13 (d, *J* = 8.4 Hz, 1H), 8.28 (d, *J* = 9.8 Hz, 1H), 8.02 (dd, *J* = 8.4, 5.7 Hz, 1H), 7.79–7.72 (m, 2H), 5.75 (ddt, 16.9, 10.2, 6.4, 1H), 5.30 (t, *J* = 7.5 Hz, 2H), 5.09–4.94 (m, 2H), 4.02 (s, 3H, OCH_3), 2.31–2.22 (m, 2H), 2.21–2.11 (m, *2*H). ^{13}C NMR (75 MHz, $CDCl_3$) δ = 159.65 (C), 146.40 (CH), 145.71 (CH), 135.71 (CH), 132.99 (C), 132.01 (C), 128.66 (CH), 122.24 (CH), 119.57 (CH), 116.46 (CH_2), 108.39 (CH), 57.29 (CH_2), 56.59 (s, 3H, OCH_3), 29.97 (CH_2), 29.09 (CH_2). HRMS (EI) m/z $[M]^+$ calc for $[C_{15}H_{18}NO]$ 228.1388; found: 228.1377. FT-IR (Wavenumbers, cm^{-1}): $\nu_{C=N+}$, 1620.

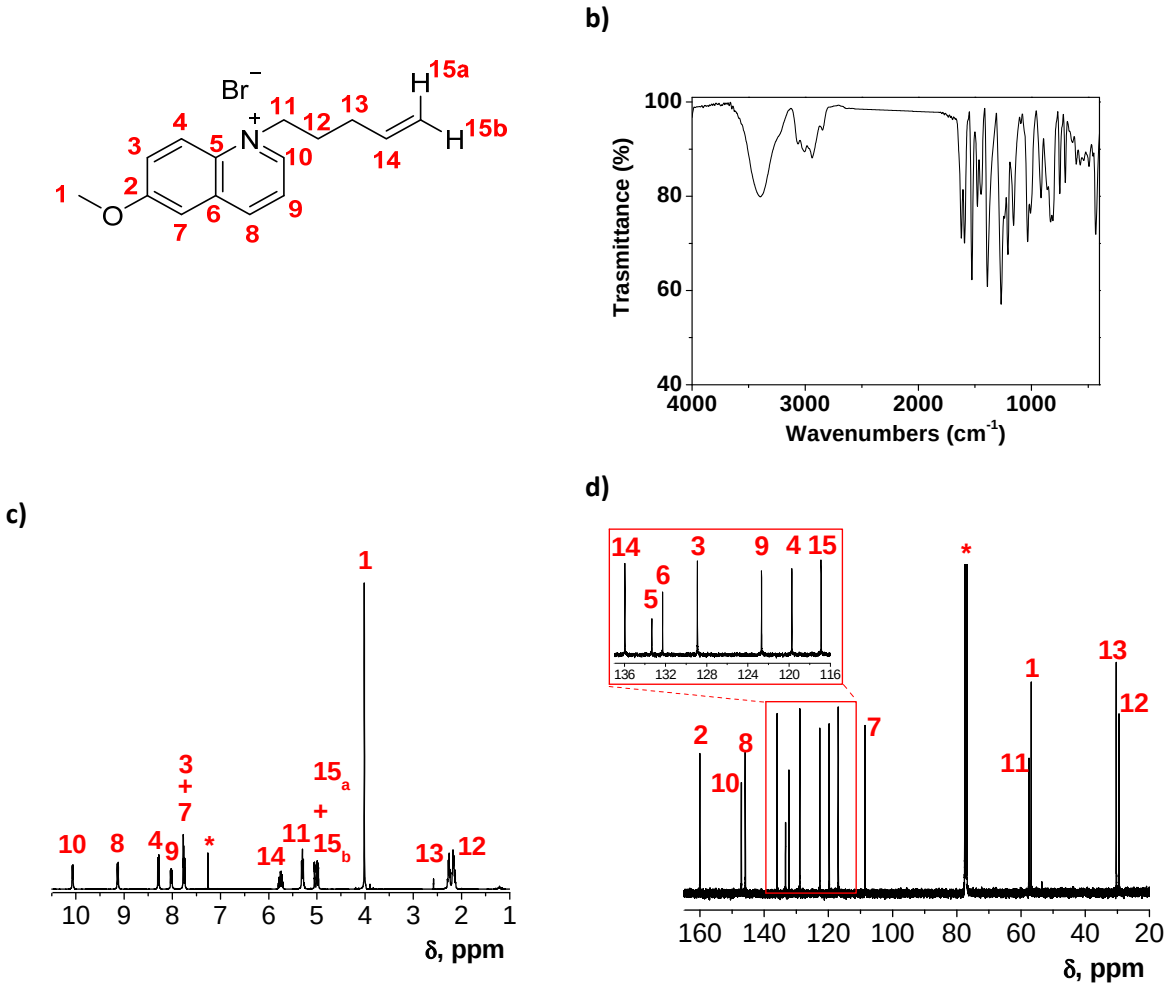

Figure S1. Characterization of ***(2)*** by (a) FTIR, (b) 1H RMN, and (c) 13C RMN. (* = solvent signal, $CDCl_3$)

S2. Materials & procedures

S2.1. Materials

The following materials and solvents were obtained: 2,2-dimethoxy-2-phenylacetophenone (Aldrich, 99%), 1-vinyl-2-pyrrolidone (**VP**) (**Aldrich**, 99%), 2-hydroxyethyl acrylate (**2HEA**) (Aldrich, 96%), 6-metoxiquinoline (Apollo scientific Ltd., 98.3%), sodium chloride (VWR, 99.5%), potassium chloride (VWR, 99%), sodium sulfate (Aldrich, 99%), calcium chloride (VWR, 96%), magnesium chloride (Aldrich, 98%), sodium phosphate (VWR, 96%), lactic acid (VWR, 98%), urea (Aldrich, 99%), D-glucose (VWR, 99.5%), ammonia (VWR, 99.95%), sodium bicarbonate (VWR, 99.5%), quinine sulfate (Aldrich, 98%), sulphuric acid (VWR, 95%), acetone (VWR, 99%).

S2.2. Procedures

For the real measurements in a clinic environment at the Valdecilla Hospital in Santander (Spain), the photographs of the sensory materials were taken on the arm of patients and control people with a smartphone, always including a white reference of PTFE (see Fig. 7, manuscript). Then, the RGB data of photographs were normalized. The normalization was carried out by taking the RGB values of the PTFE of the first photograph and then assigning these values to all PTFE in the photographs with the conventional image processing software used for processing the images (adjust colour curves). In this way, influence of light conditions, temperature, angle, etc., was deeply reduced.

S3. Synthetic sweat preparation

We have prepared a simulation of a generic human sweat by dissolving the species depicted in Table S2 in distilled water. The concentrations of each reagent have been taken from the bibliography for prepare 1L solution: Chloride,[2-9] sodium,[2,5,8-10] potassium,[2,7-9] sulphate,[7,11] calcium,[2,3,7,8] magnesium,[2,3,7] phosphate,[2,7] lactate,[7-9,12] urea,[7,8,12] D-glucose,[7,13] ammonia[8,12] and bicarbonate.[8,9]

Table S2. The table shows the 12 most abundant species in human sweat, their salts, and the quantity in miligrams of each one for prepare 1 liter of the simulated human sweat (**SHS**).

	Species (mg)	**Concentration (%)**	**Concentration (mM)**
Chloride (Cl^-)	Sodium chloride (0)	0.018	5.17
Sodium (Na^+)	Sodium chloride (0)	0.035	15.37
Potassium (K^+)	Potassium chloride (350)	0.018	4.69
Sulphate (SO_4^{2-})	Sodium sulphate (179.5)	0.012	1.26
Calcium (Ca^{2+})	Calcium chloride (18.4)	0.00066	0.17
Magnesium (Mg^{2+})	Magnesium chloride (14.8)	0.00018	0.073
Phosphate (PO_4^{3-})	Sodium phosphate (8.8)	0.00051	0.054
Lactate [$(C3H5O3)^-$]	Sodium Lactate (1151.6)	0.091	10.28
Urea ($CO(NH_2)_2$)	Urea (325,8)	0.032	5.42
D-Glucose ($C_6H_{12}O_6$)	D-Glucose 40,8	0.0041	0.23
Ammonia (NH_3)	Ammonium hydroxide (76.17)	0.0037	2.17
Bicarbonate [(HCO_3)-]	Sodium bicarbonate (201,9)	0.015	2.40

S4. Behaviour Comparison of the discrete molecular model 2 and F2 during titration of chloride in distilled water.

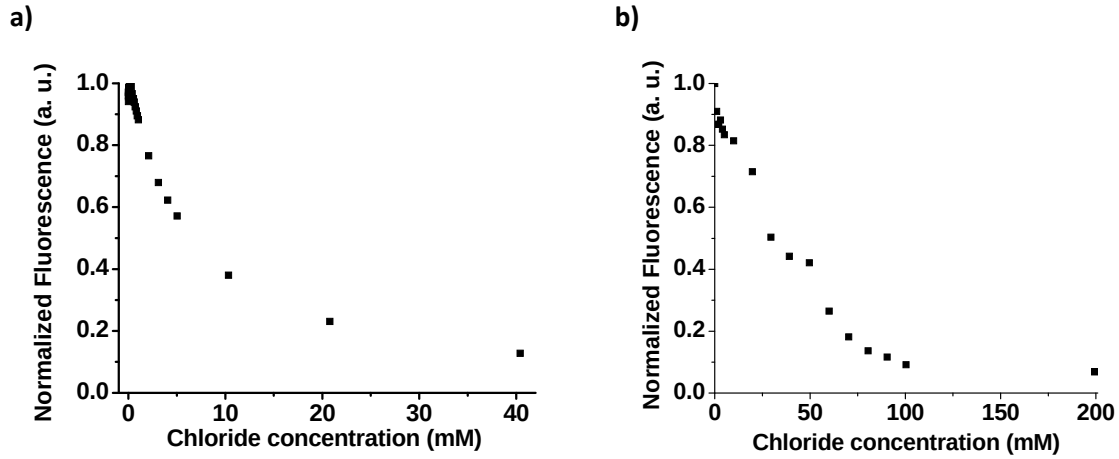

Figure S3. Normalized Fluorescence intensity *vs* chloride concentration both in the titration of chloride with the discrete molecular model **2** (**a**) and the polymeric sensory membrane **F2** (**b**).

S5. Titration of chloride in synthetic human sweat (SHS) with F2 by examining the analysis of the RGB parameters of each disk using a digital picture.

Table S4. RGB data from photographs taken of the **F2** sensory discs after immersion for 1 min at RT in **SHS** solutions containing different quantities of chloride.

Discs	[Cl^-], mM	R	G	B
	5.17	99	254	3
	20.00	92	250	5
	40.00	77	214	15
	60.00	75	201	23
	80.00	82	211	35
	100.00	71	169	48

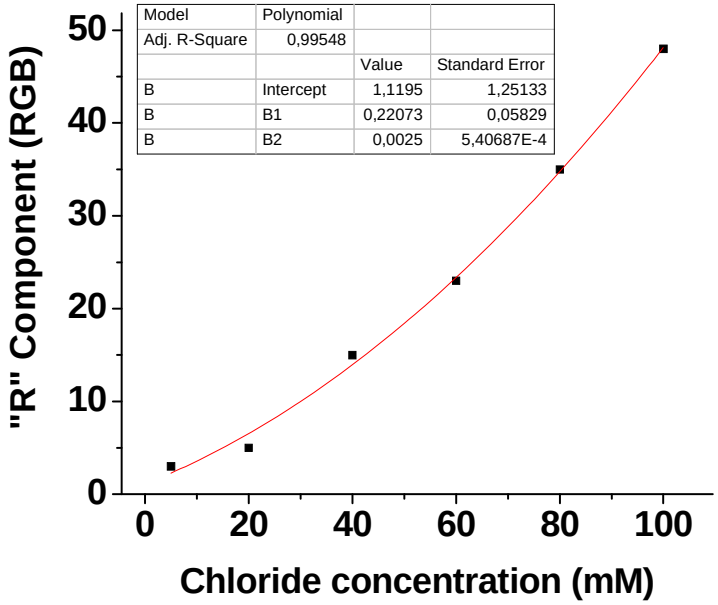

Figure S5. Variation of the **R** component of the RGB parameters *vs* the concentration of chloride (mM). (Inset) Second-degree polynomial based fitting for the quantitative detection of chloride.

S6. pH studies with F2.

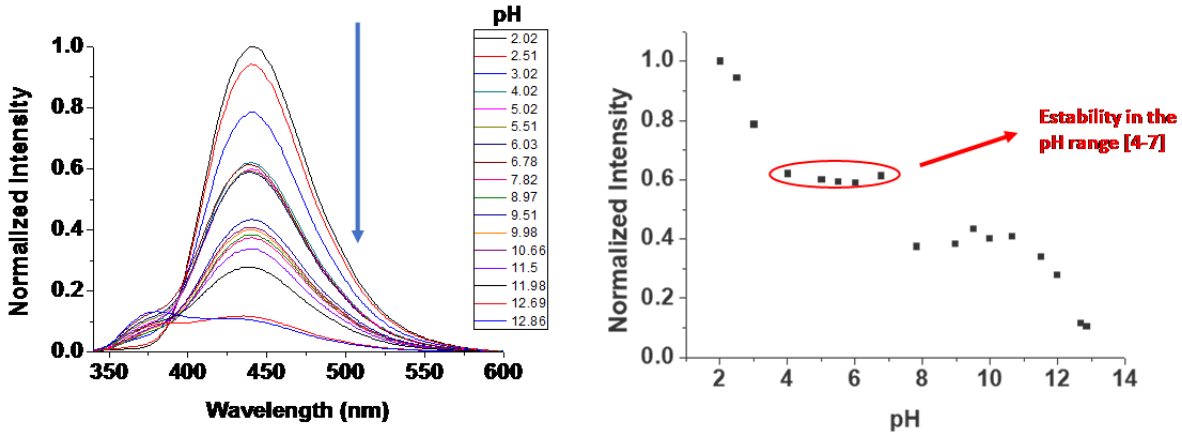

Figure S6. a) Fluorescence spectra of F2 at different pH, **b)** Variation of the fluorescence at 440 nm *vs* the pH.

S7.- Thermogravimetric analysis of F2.

a) **b)**

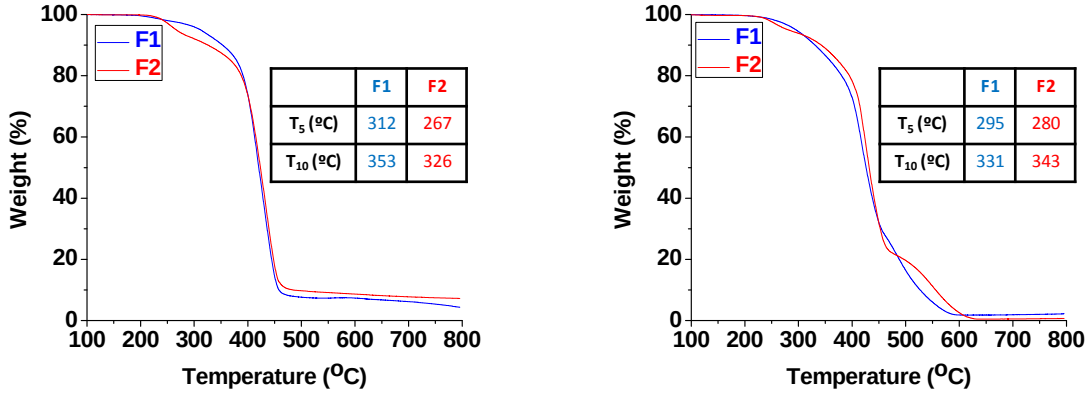

Figure S7. Thermogravimetric curves at 10°C/min for **F1** and F2. **a)** Nitrogen atmosphere, **b)** synthetic air atmosphere.

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