

Table S2 Complete bill of materials.

Part	Material	Part Number	Source
general patch assembly	release liner	3M 1361	3M
	medical grade double sided adhesive	3M 1577	3M
	non-woven cloth	Tex-Wipe	Fisher Scientific
	medical grade double sided adhesive	3M 1577	3M
	hydrophobic diagnostic adhesive film	3M 9793R	3M
stimulation	non-woven cloth	Tex-Wipe	Fisher Scientific
	membrane	NFX	Synder Filtration
	1 mm acrylic stock	NA	McMaster-Carr
	carbon kapton film	Kapton 200RS100	Dupont
	adhesive skin electrode	Skintact RT41	Skintact
stimulant gel	agarose	A9539	Sigma Aldrich
	carbachol	NA	PCCA
sensor	electrodes	DropSens 550	University of Toledo
	chitosan	NA	University of Toledo
	enzyme	NA	University of Toledo
	fumed silica	S5130	Sigma Aldrich
	gelatin	Knox original gelatine unflavored	Knox
hex wick	ITO PET	G430300	ShelDahl
	SU-8	3050	MicroChem
	Thiol	7-mer (3 cysteine groups, tri-thiol)	Genscript
artificial sweat	proprietary blend	NA	Eccline Systems
sensor characterization	ethanol	2701	Decon Laboratories
	BSA	A2153	Sigma Aldrich
	stearic acid	S5690-500G	Aqua Solutions
	dextrose	D9434-250G	Sigma Aldrich
electrical connection	PBS	BP661-10	Fisher Chemical
	breakout board	FPC stick	Adafruit
	5 pin FFC cable	HF05U-05-ND	Digi-Key
	5 pin FFC cable connector	WM10937CT-ND	Digi-Key
	z-axis tape	3M 9705	3M

Table S3 Layer identification, material and purpose for integrated patch design.

Layer Code	Layer Name	Material	Part Number	Source	Purpose
A1	carrier	release liner	3M 1361	3M	protect patch prior to applying to application
A2	skin adhesive	medical grade double sided adhesive	3M 1577	3M	adhere patch to skin
A3	sensor	electrodes, chitosan, enzyme, <i>etc.</i>	various, see Tab 4.3	University of Toledo	ethanol detection
A4	pump	non-woven cloth	Tex-Wipe	Fisher Scientific	maintain continuous sample flow in wick
B1	hex wick	SU-8, ITO PET, Au, thiol	various, see Tab 4.3	various, see Tab 4.3	collect and deliver sample to sensor
B2	adhesive	medical grade double sided adhesive	3M 1577	3M	adhere wick to both sensor and skin, adhere stimulant assembly to patch
C1	stimulant coupling	non-woven cloth	Tex-Wipe	Fisher Scientific	provide skin contact for stimulant in iontophoresis
C2	membrane	nanofiltration membrane	NFX	Synder Filtration	isolate stimulant from skin until iontophoresis
C3	gel well	1 mm acrylic stock	NA	McMaster-Carr	contain stimulant fluids
C4	stimulant gel	agarose, carbachol	various, see Tab 4.3	various, see Tab 4.3	store stimulant
C5	stimulant electrode	carbon kapton film	Kapton 200RS100	Dupont	iontophoresis
C6	return electrode	EKG electrode	Skintact RT41	Skintact	iontophoresis
C7	vapor seal	hydrophobic diagnostic adhesive film	3M 9793R	3M	prevent evaporation

Table S4 Estimated constants for Eq. 1-3 determined by curve fitting simulations.

subject-trial ID	1-1	1-2	2-1	2-2
C_{SP} (%* $\mu\text{A}^{-1}\cdot\text{h}^{-1}$)	4.62E-14	3.94E-12	1.05E-01	1.46E-13
k_{SP} (h^{-1})	5.94E-03	1.12E-01	1.15E-01	1.98E-01
R_{SP}	3.44E+01	3.09E+00	6.90E+00	7.00E+00
k_d (h^{-1})	1.96E+00	1.00E+00	3.73E-01	2.89E+00
k_{PS} (h^{-1})	1.50E-01	1.74E-02	4.11E+00	1.44E+00
C_{PS} ($\mu\text{A}\cdot\%^{-1}\cdot\text{h}^{-1}$)	2.60E+00	4.55E+01	4.55E+00	1.62E+01
k_{abs} (h^{-1})	4.55E-02	9.45E-02	9.99E-02	6.12E-02
R_{AP}	4.64E+01	4.39E+01	5.00E+01	1.17E+01
MSE	9.60E-03	1.79E-02	3.18E-02	2.68E-03

Optimization settings:

differential evolution

bounds = (0, 50)

tol = 10E-12

maxiter = 3500

Table S5 Model fit results for R² and 95% confidence intervals.

Type	R ² and 95% CI			
	Subject 1		Subject 2	
	Trial 1	Trial 2	Trial 1	Trial 2
Model Data**	0.08 (0.02, 0.13)	0.55 (0.50, 0.60)	0.73 (0.68, 0.78)	0.76 (0.72, 0.80)
Raw Data **	0.32 (-0.01, 0.64)*	0.65 (0.52, 0.77)*	0.64 (0.37, 0.91)*	0.95(0.93, 0.98)*
Model Data Peak Corrected	0.9501 (0.9436, 0.9566)*	0.9855 (0.9840, 0.9870)	0.9992 (0.9990, 0.9993)	0.9986 (0.9984, 0.9988)
Raw Data Peak Corrected	0.81 (0.6570, 0.9624)*	0.9582 (0.9334, 0.9830)	0.9562 (0.9316, 0.9808)	0.8975 (0.8115, 0.9835)

* Exponential fit

** This is for completion purposes as the modeling is irrelevant due to the time lag (see ESI Fig. S6 a and c)

Table S6 Pearson correlations made for linear BAC (and sweat predictive for model data) to ethanol sensor data peak-corrected data.

Pearson Correlation	Subject 1		Subject 2	
Type	Trial 1	Trial 2	Trial 1	Trial 2
Model Data Peak Corrected	NA	0.9927	0.9996	0.9993
Raw Data Peak Corrected	NA	0.9789	0.9779	0.9474