Electronic Supplementary Material (ESI) for Analyst.

Supporting Information for:

Ion concentration polarization for pre-concentration of biological samples without pH change

Youngkyu Cho,[a] Junghyo Yoon,[b] David Wonbin Lim,[b] Jaehoon Kim,[b] Jeong Hoon Lee,[c] and Seok Chung*[a,b]

[a]*Department of IT convergence, Korea University, 145 Anam-ro, Seoungbuk-gu, Seoul 02841, Korea*

[b]*School of Mechanical Engineering, Korea University, 145 Anam-ro, Seoungbuk-gu, Seoul 02841, Korea*

[c]*Department of Electrical Engineering, Kwangwoon University, 20 Gwangun-ro, Nowon-gu, Seoul 01897, Korea*

*Author for correspondence : sidchung@korea.ac.kr

Contents:

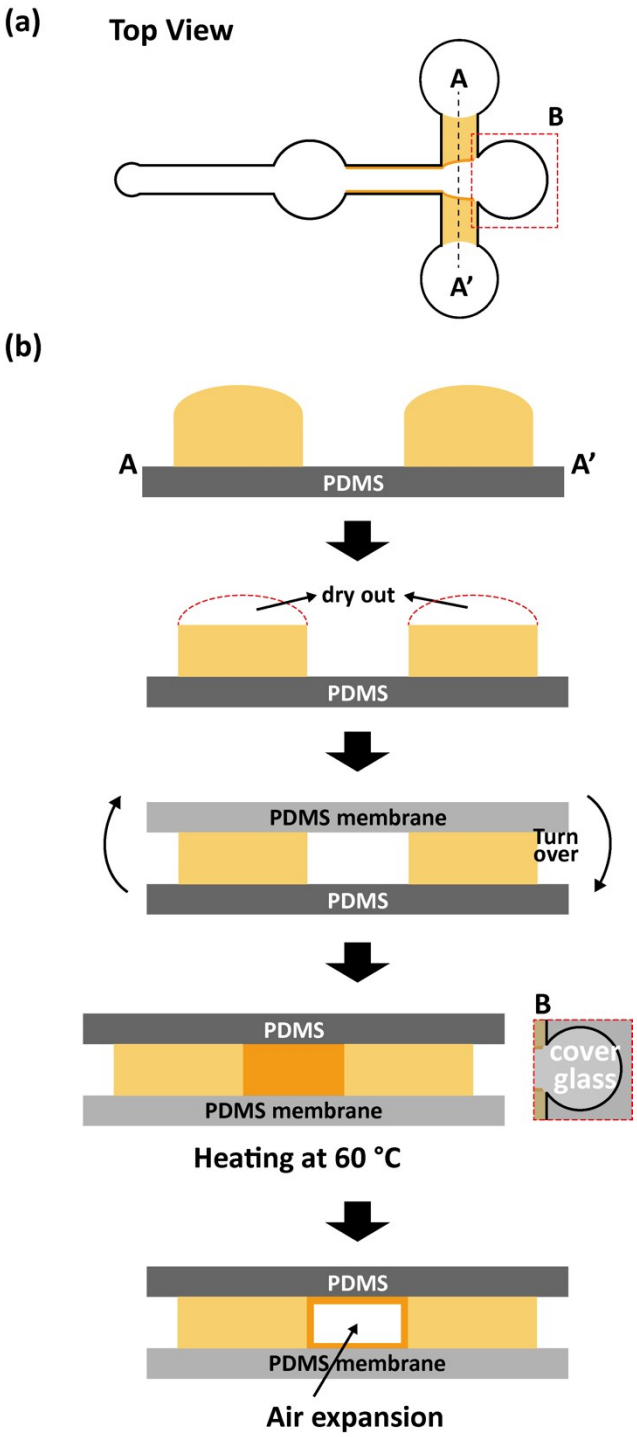

Fig. S1 (a) Top view of a single channel pre-concentration device. (b) Fabrication process of filling and coating the Nafion in the device.

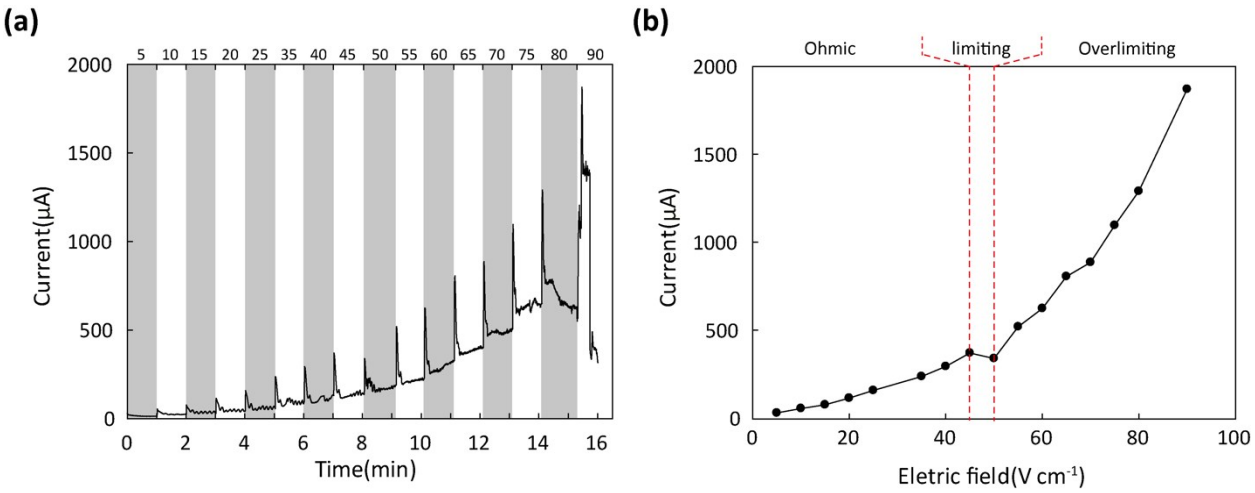

Fig S2. (a) Current pattern in each electric field during 60 seconds. Above number of graph mean electric field, V cm^{-1}. (b) Peak current in each electric field and distribution of Ohmic, limiting and over-limiting regimes.

Method		Initial volume	Concentration fold (time)	Measuring	Ref.
On chip analysis (straight micro-channel)	without ground buffer channel	0.054μL	~10^3 (20minutes)	Fluorescence intensity	1
		0.08μL	~10^6 (60minutes)	Fluorescence intensity	2
	with ground buffer channel	0.05μL	~10^4 (60minutes)	Fluorescence intensity	3
		0.038μL	~10^4 (5minutes)	Fluorescence intensity	4
		2μL	~10^4 (22minutes)	Fluorescence intensity	5
		0.013μL	~500 (15minutes)	Fluorescence intensity	6
		< 1μL	~100 (30minutes)	Fluorescence intensity	7
		< 1μL	~$4*10^3$ (30minutes)	Fluorescence intensity	8
		0.042μL	~10^3 (10minutes)	Fluorescence intensity	9
Extractable	Straight channel with ground buffer channel	0.05μL/min	~20 (200minutes)	Cell count	10,11
	Draining buffer concentration	100μL	~4 (15minutes)	ELISA	12
	Draining buffer concentration without pH change	40μL	~3.3 (15minutes)	ELISA	

Table S1. Comparing with previous pre-concentration methods using ion concentration polarization (ICP). (Gray row means our developed pre-concentration method. On chip analysis method's initial volume is calculated based concentrated channel specification since the volume isn't indicated in references.)

Pressure driven flow Flow rate : 1ul/min		**Electoosmotic flow(EOF)[13]** $V_{av} = -E\varepsilon_r\varepsilon_0\frac{\zeta}{\mu}$	
Channel width (μm)	500	E : electric field (V cm^{-1})	20~100
Channel height (μm)	170	ε_r : Dielectric constant of the medium (PBS)	8
		ε_0 : The permittivity of the vacuum (C V^{-1} m^{-1})	$8.85*10^{-12}$
		ζ : Zeta potential at the shear plane (mV)	-25
		μ : dynamic viscosity (N S m^{-2})	0.001
V_{av} (μm/s)	196.08	V_{av} (μm/s)	$3.54\sim17.7*10^{-3}$

Table S2. Comparison of Pressure driven flow and electroosmotic flow (EOF) in main channel

		5min	**10min**	**15min**	**20min**
Single Channel (initial volume : 40μL)	**Drained volume (μL) (Theoretical value)**	-	10	-	20
	Theoretical value (Fold)	-	1.33	-	2
	Experimental value (Fold)	-	1.3	-	2.1
Dual Channel (initial volume : 40μL)	**Drained volume (μL) (Theoretical value)**	10	20	30	-
	Theoretical value (Fold)	1.3	2	4	-
	Experimental value (Fold)	1.1	2.1	3.3	-
Theoretical value equation		$Theoretical\ value(Flod) = \frac{Initial\ volme}{Initial\ volme - Drained\ volume}$			

Table S3. Theoretical and experimental value chart after buffer drainage during single channel and dual channel concentrator operating and theoretical value equation.

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