Supplementary information
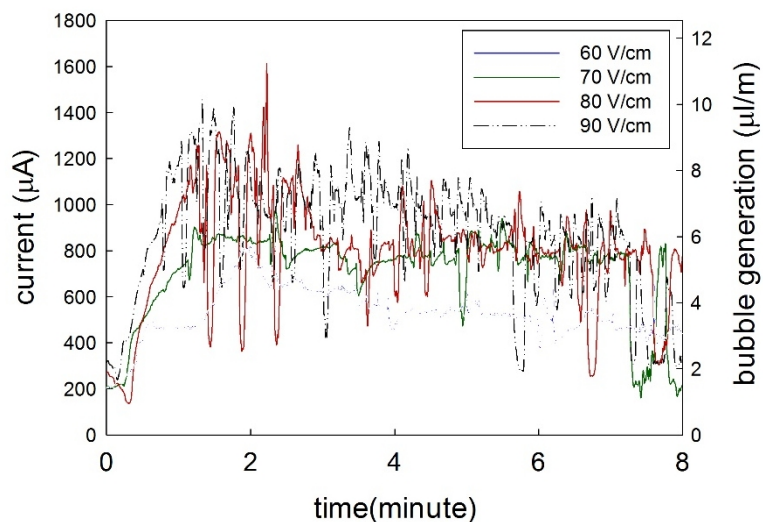

Fig. S1 Current values and calculated bubble (hydrogen) generation by electrolysis, following Faraday's Second Law of Electrolysis (extraction flow rate, 2 μl min^{-1} with 0.1x PBS).

<Faraday's Second Law of Electrolysis>

$$m = (Q\,F^{-1})\,(M\,z^{-1})$$

m (g): the mass of the substance liberated at an electrode, in grams

Q (C): the total electric charge passed through the substance

F (C mol^{-1}): Faraday constant

M (g mol^{-1}): the molar mass of the substance

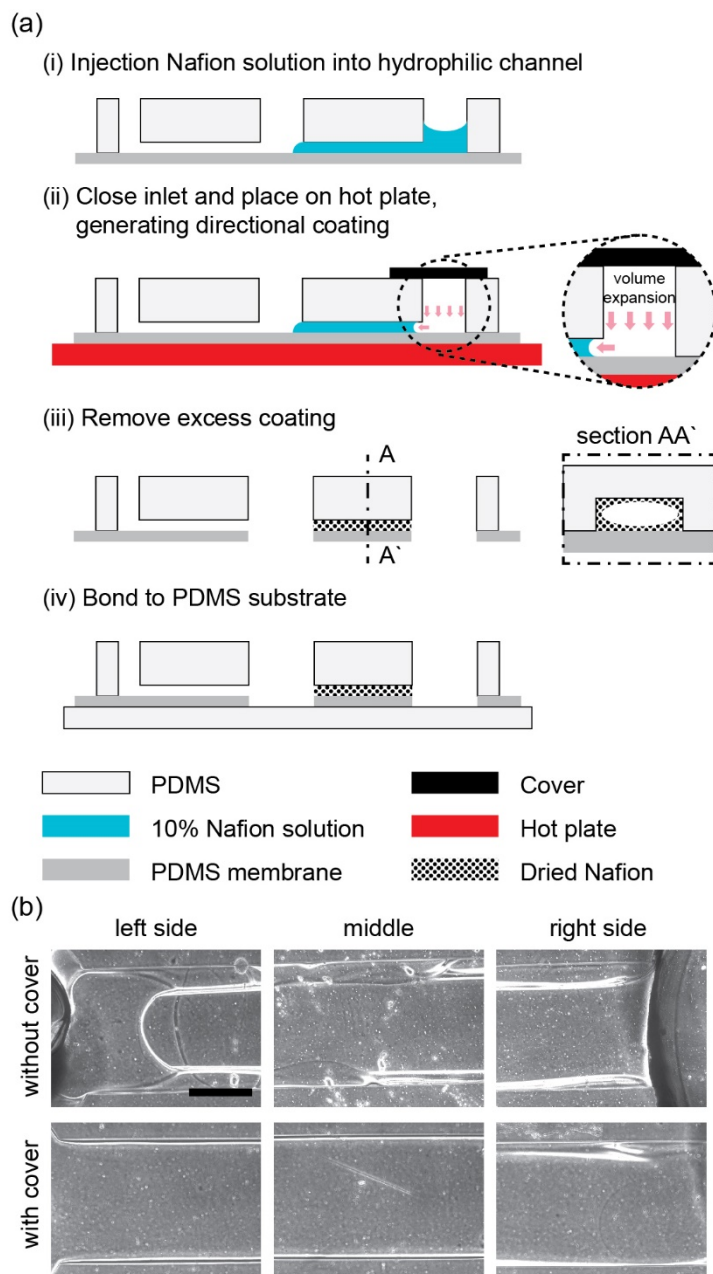z: valency (number of ions of the substance)

Fig. S2 (a) Schematic images showing the sequential fabrication steps for incorporating ion-permselective channels onto a microfluidic network. (b) Phase-contrast microscope images of different coating properties obtained in the absence and presence of the cover. Scale bar, 200 μm.
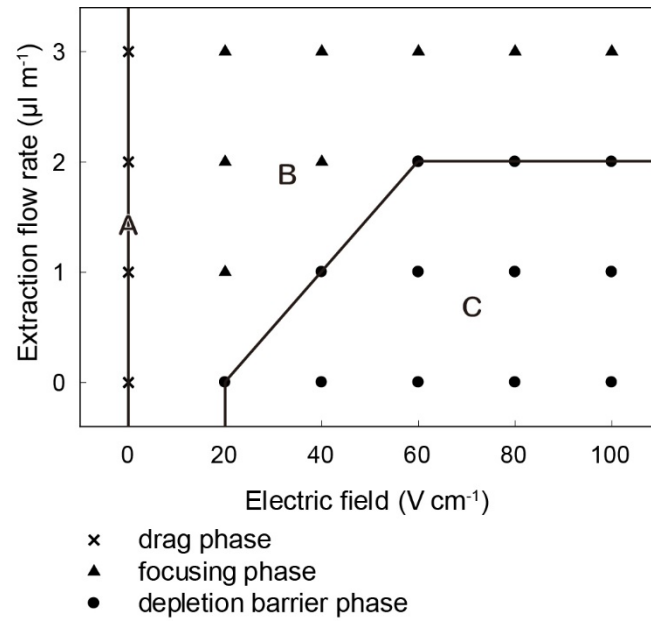
Fig. S3 Activating conditions for the three different phases under various electric fields and extraction flow rates. Region A, B, and C indicate drag, focusing, and depletion barrier phase, respectively.

Stokes' drag force		Electrophoretic force[1]	
$F_D = 6\pi\mu Rv$		$F_{EP} = 6\pi \zeta_p \varepsilon_f aE$	
μ: dynamic viscosity (N S m^{-2})	0.001	ζ_p : zeta potential (mV)	-3.56
R : radius of particle (nm)	100	ε_f : electrical permittivity (C V^{-1} m^{-1})	$6.9 * 10^{-10}$
v : velocity of fluid (mm s^{-2})	2.78 ~ 5.56 (1 ~ 2 μl m^{-1})	a : spherical particle radius (nm)	100
		E : electric field (V cm^{-1})	40 ~ 100
F_D (N)	2.62 ~ 5.24*10^{-11}	F_{EP} (N)	0.88 ~ 2.21 * 10^{-13}

Table S1 Comparison of Stokes' drag force (F_D) and electrophoretic force (F_{EP})

		0 min	5 min	10 min	15 min
Single channel **Extraction flow rate : 2 μl min^{-1}**	Remaining volume (theoretical value)	100	96.0	91.0	86.0
	Concentration fold (theoretical value)	1.00	1.04	1.10	1.16
Multichannel **Extraction flow rate : 10 μl min^{-1}**	Remaining volume (theoretical value)	100	79.8	54.9	29.9
	Concentration fold (theoretical value)	1	1.25	1.82	3.35
	Concentration fold (experimental value)	1	1.04	1.74	3.86

Table S2 Theoretical and experimental values for remaining sample volume and concentration of sample after liquid drainage during depletion-barrier phase.

Reference

[1] Hyoung Kang K, Xuan X, Kang Y, Li D. Effects of dc-dielectrophoretic force on particle trajectories in microchannels. Journal of applied physics. 2006;99:064702--8.