

Supplementary information

Polymeric hydrogel integrating paper-based potentiometric ion-sensing device for determination of sodium ion in human urine

Kanyapat Teekayupak,^a Pattarachaya Preechakasedkit,^b Natthaya Chuaypen,^c

Thasinas Dissayabutra,^c Peter A. Lieberzeit,^d Orawon Chailapakul,^{*a} Nipapan Ruecha,^{*a, b}

Daniel Citterio ^{*e}

^a *Electrochemistry and optical spectroscopy Center of Excellence (EOSCE), Department of Chemistry, Faculty of Science, Chulalongkorn University, Pathumwan, Bangkok 10330, Thailand. Email: corawon@chula.ac.th, nipapan.r@chula.ac.th*

^b *Metallurgy and Materials Science Research Institute, Chulalongkorn University, Soi Chula 12, Phayathai Rd., Pathumwan, Bangkok 10330, Thailand.*

^c *Metabolic Disease in Gastrointestinal and Urinary System Research Unit, Department of Biochemistry, Faculty of Medicine, Chulalongkorn University Bangkok 10330, Thailand*

^d *Department of Physical Chemistry, Faculty of Chemistry, University of Vienna, Waehringer Strasse 42, 1090 Vienna, Austria*

^e *Department of Applied Chemistry, Faculty of Science and Technology, Keio University, 3-14-1 Hiyoshi, Kohoku-ku, Yokohama, Kanagawa 223-8522, Japan. Email: citterio@applc.keio.ac.jp*

* Corresponding authors

Table S1 Printing parameters for all solutions used in device fabrication

Ion selective electrode (s-ISE)		Reference electrode (s-RE)	
Solutions	Printing condition (layers)	Solutions	Printing condition (layers)
CNT ink	10	Ag ink	10
AuNPs	30	FeCl ₃	4
CH ₃ COOLi-hydrogel	10	KCl-hydrogel	10
ISM	8	REM	8

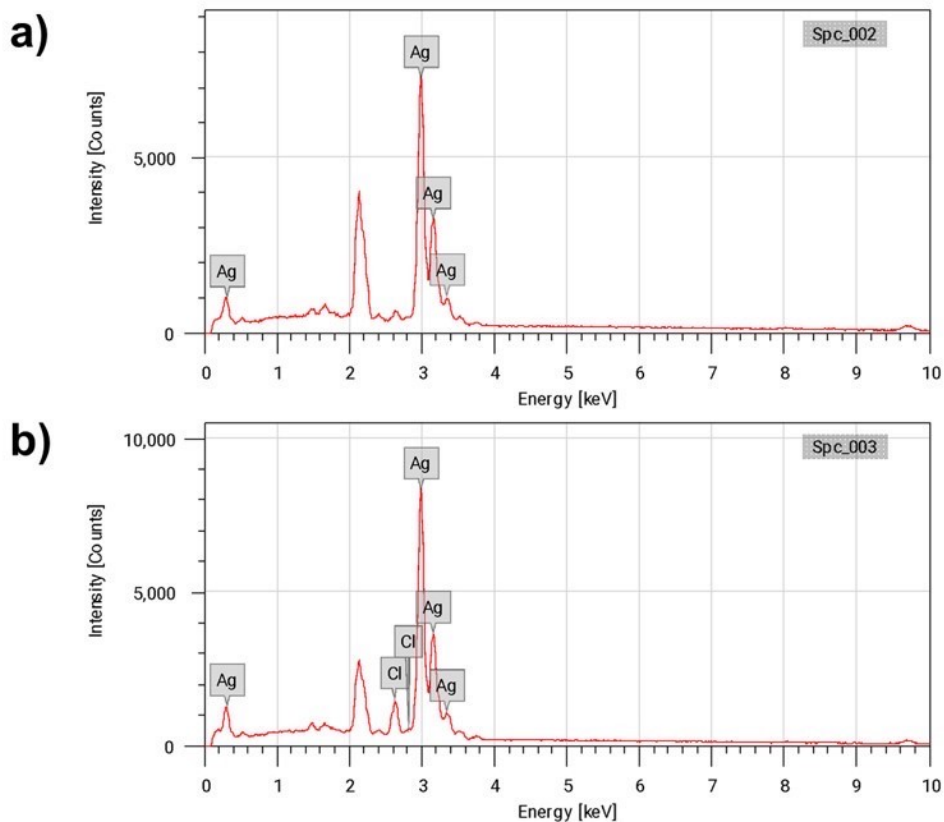


Fig. S1 EDX analysis of a) sintered Ag and b) p-Ag/AgCl electrode on photo paper.

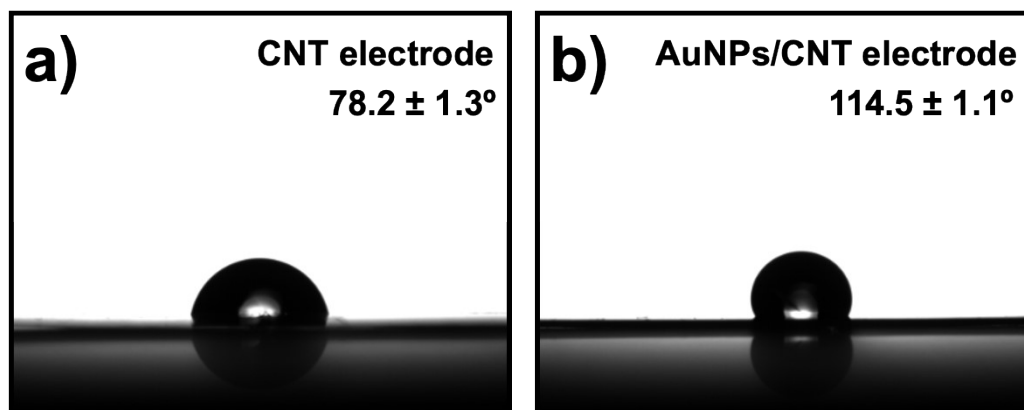


Fig. S2 Contact angle measurements of (a) CNT electrode and (b) AuNPs/CNT electrode.

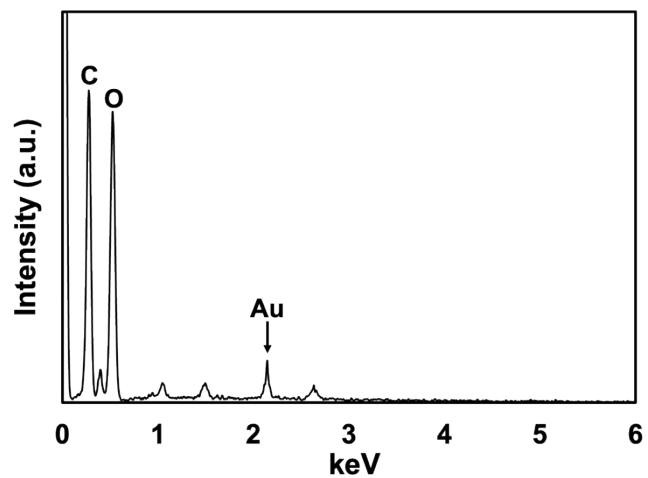


Fig. S3 SEM-EDX spectrum of AuNP modified CNT electrode.

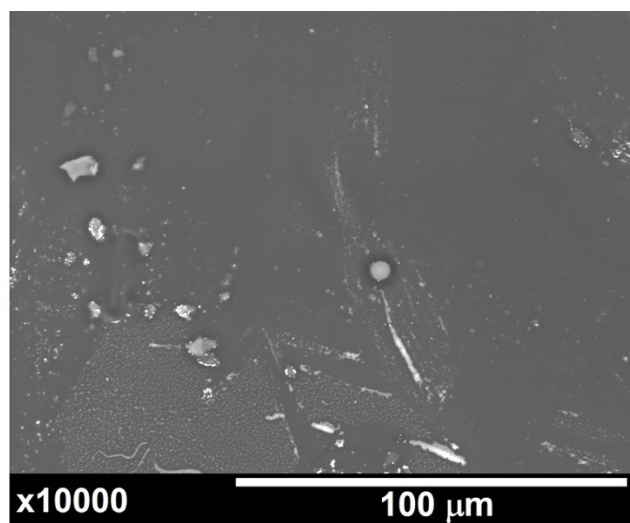


Fig. S4 SEM image of ISM-AuNP/CNT electrode with $\times 10,000$ magnification

Table S2 Analytical performance of ISM-CH₃COOLi hydrogel-AuNP/CNT paper-based ion-sensing devices with different concentrations of CH₃COOLi for sodium ion measurement

CH ₃ COOLi concentration (M)	Linear range (M)	Slope (mV/dec)	<i>E</i> ⁰ (mV)
0.01	10 ⁻⁶ to 1	54.10 ± 0.78	150.41 ± 1.97
0.025	10 ⁻⁶ to 1	55.31 ± 0.92	131.16 ± 2.01
0.05	10 ⁻⁷ to 1	56.42 ± 0.68	190.35 ± 1.55
0.075	10 ⁻⁶ to 1	53.56 ± 0.95	124.01 ± 1.83
0.1	10 ⁻⁵ to 1	45.85 ± 0.87	42.41 ± 1.94
0.2	10 ⁻⁵ to 1	44.92 ± 0.69	27.04 ± 1.61

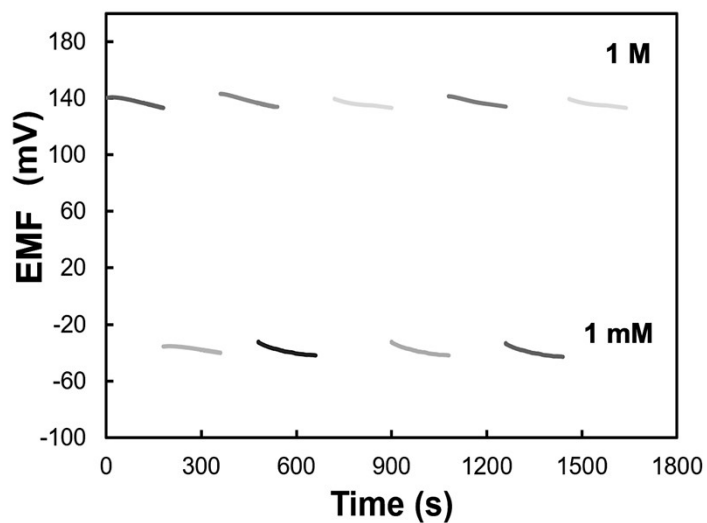


Fig. S5 The repeatability of the ISM-CH₃COOLi hydrogel-AuNP/CNT paper-based ion-sensing devices; each potentiometric response has been obtained by measurements with the same device.

Table S3 Comparison of analytical performances of all-solid-state potentiometric sensors for Na⁺ detection

Solid contact	Linear range (M)	LOD (M)	Sensitivity (mv/decade)	Sample	Refs
PS/AuNPs	10 ⁻⁴ – 10 ⁻²	6.8 × 10 ⁻⁵	50.3 ± 1.3	Urine	1
CNT/Au	10 ⁻³ – 10 ⁻¹	–	60.0 ± 4.0	Sweat	2
POT/Carbon	10 ⁻⁴ – 10 ⁻¹	–	56.4 ± 2.2	Sweat	3
G/ PEDOT:PSS	10 ⁻⁴ – 1	36 × 10 ⁻⁶	62.5 ± 2.1	Urine	4
PEDOT/Carbon	10 ⁻⁵ – 10 ⁻¹	–	55.5 ± 4.9	Sweat	5
POT/SWCNTs	10 ⁻³ – 10 ⁻¹	–	58.6 ± 0.1	Sweat	6
PEDOT:PSS/Au	10 ⁻⁵ – 10 ⁻²	1.67 × 10 ⁻⁶	56.5	Sweat	7
Au/CNT/Au	10 ⁻³ – 1	–	55.5 ± 0.3	Sweat	8
CB/Carbon	10 ⁻⁴ – 1	63 × 10 ⁻⁶	58.0 ± 3.0	Sweat	9
CH ₃ COOLi hydrogel- AuNP/CNT	10 ⁻⁷ – 1	10 ⁻⁷	56.4 ± 0.7	Urine	This work

Abbreviations: PS, Polystyrene; AuNPs, Gold nanoparticles; POT, poly(3-octylthiophene-2,5-diyl); G, Graphene; PEDOT:PSS, Poly(3,4-ethylenedioxythiophene) polystyrenesulfonate; SWCNTs, Single-walled carbon nanotubes; CB, Carbon black

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