

Scalable approach towards specific and ultrasensitive cation sensing in harsh environmental conditions by engineering the analyte-transducer interface

Sudeshna Mondal,^a Chandramouli Subramaniam^a

^a Department of Chemistry, Indian Institute of Technology Bombay, Powai, Mumbai 400076, India.

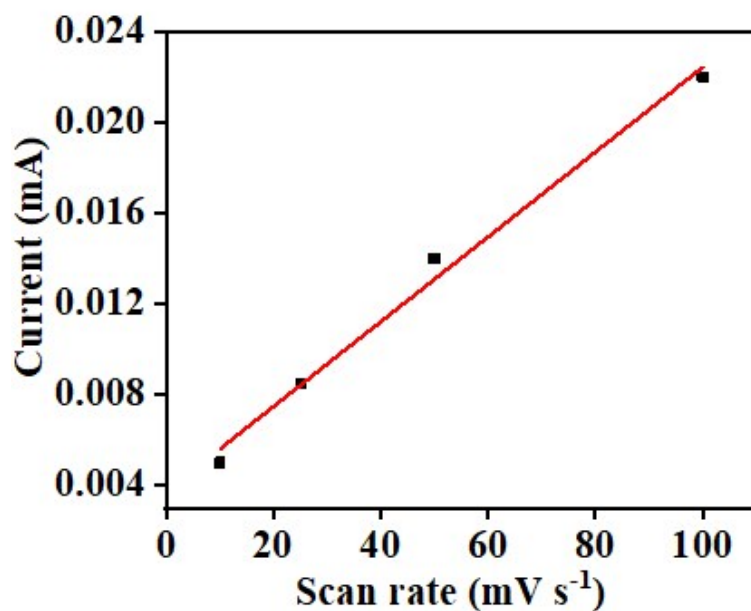


Figure S1. Randles Sevcik plot showing characteristics of an ideally polarized electrode with CNT-thread.

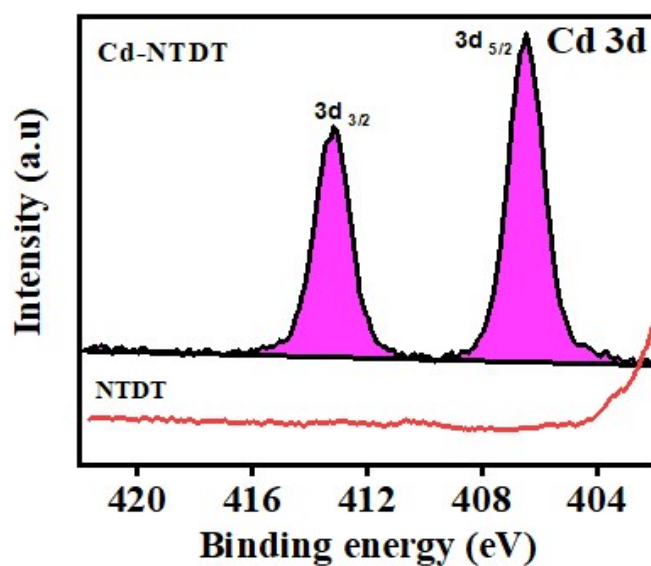


Figure S2. XPS spectra of Cd 3d in Cd-NTDT before and after addition of 10 ppm of Cd²⁺.

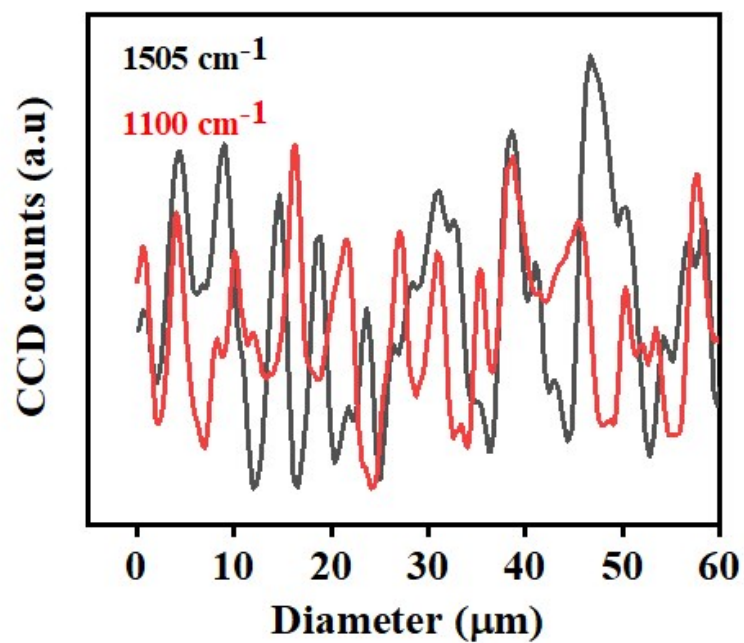


Figure S3. Line intensity profile of $\nu_{\text{bending}}(\text{N-H})$ at 1505 cm^{-1} and $\nu_{\text{stretching}}(\text{C-C})$ at 1100 cm^{-1} of K-Valinomycin ionophore membrane as obtained from Raman spectral mapping.

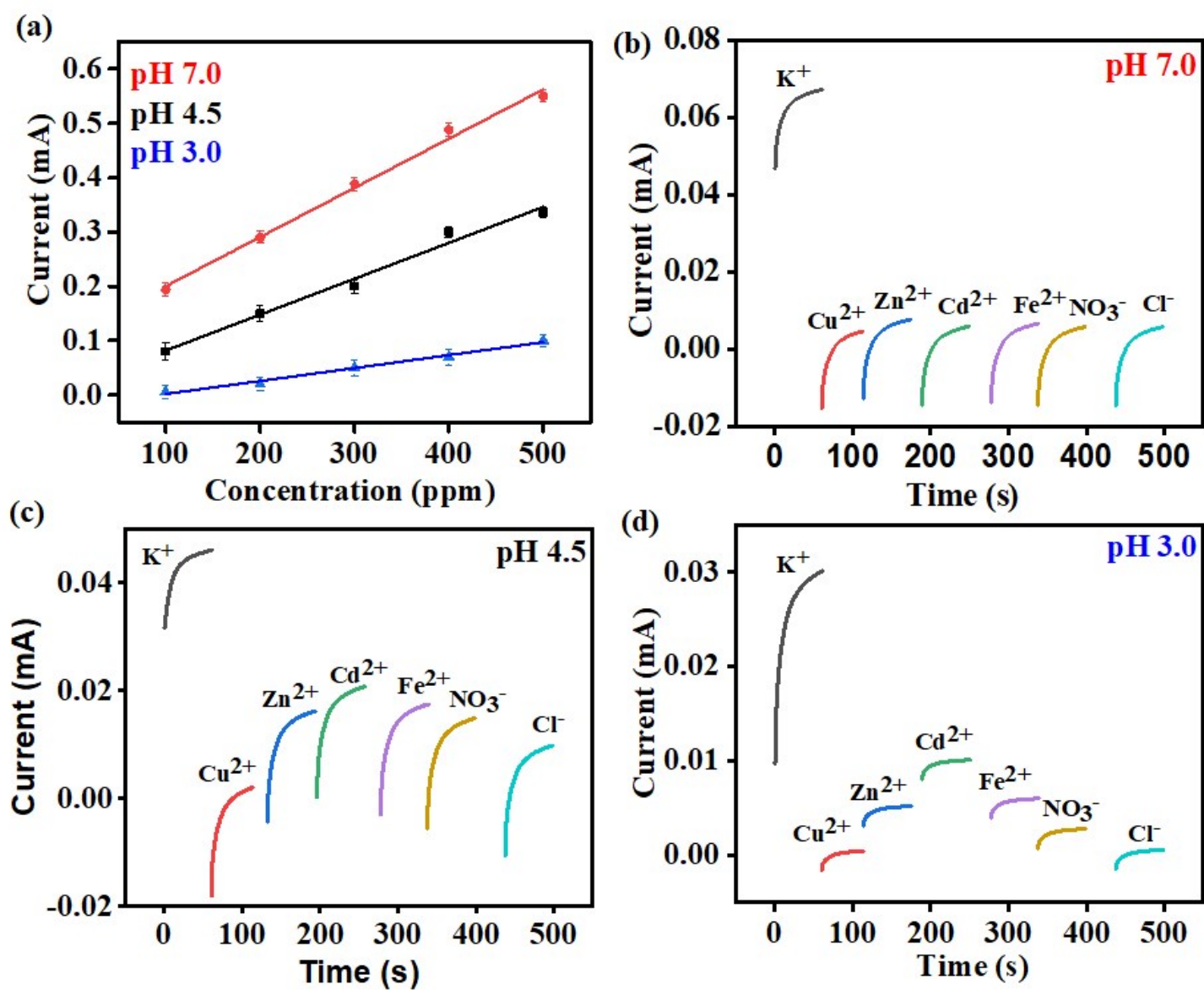


Figure S4. (a) Chronoamperometric studies of K^+ at different pH and concentrations ranging from 100 ppm-500 ppm. Selectivity studies on the K^+ sensor at (b) pH 7.0, (c) pH 4.5 and (c) pH 3.0.

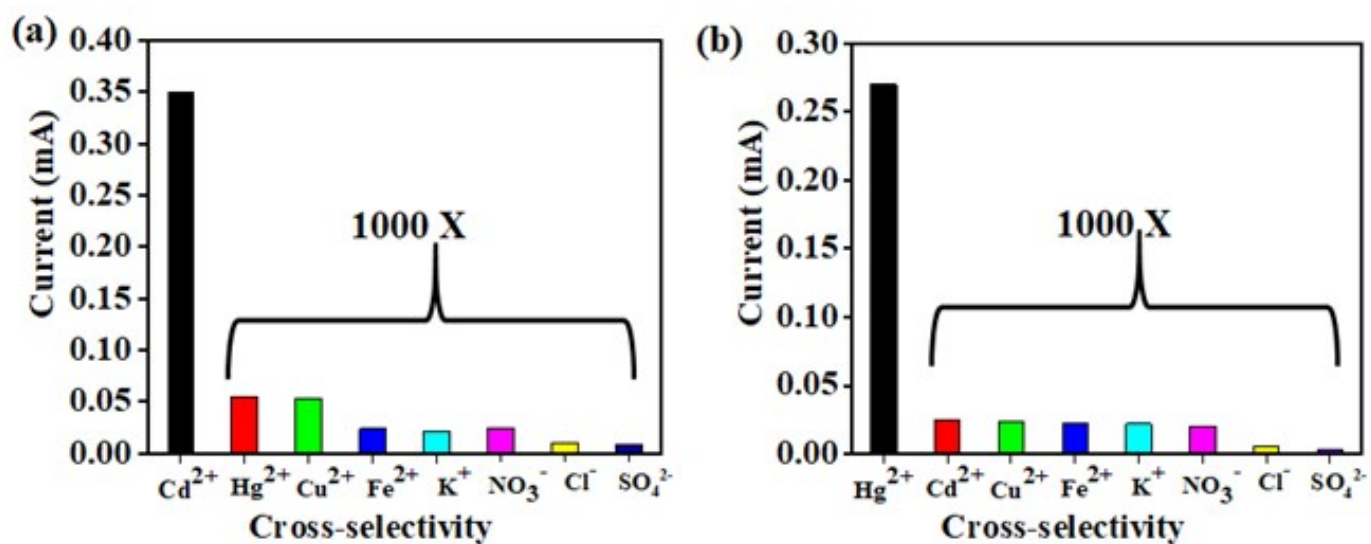


Figure S5. (a) Selectivity studies on the Cd²⁺ sensor in presence of 1000 times excess concentrations of counter ions. (b) Selectivity studies on the Hg²⁺ sensor in presence of 1000 times excess concentrations of counter ions.

Table S1. Analytical characteristics of point-of-care electrochemical platforms for detection of K⁺, Cd²⁺ and Hg²⁺

Electrode (K⁺)	Type of transduction	Linear range (ppm)	Limit of detection (ppm)	Response time (s)	Reference
Textile/polyurethane/ CNTs	solid-contact	10- 10 ⁴	1	5	1
CNTs/ cotton	solid-contact	10-10 ⁴	10	60	2
Carbon/PEDOT/PET	solid-contact	10-10 ⁴	0.01	-	3
Adhesive carbon tape	Inner solution	100-10 ⁴	0.039	5	4
Valinomycin- IM	solid contact	10 – 500	30	10	Present work
Electrode (Cd²⁺)	Type of transduction	Linear range (ppb)	Limit of detection (ppb)	Response time (s)	Reference
Au/Ti-RGO	solid contact	1.0-120	1.0	-	5
Paper strip/SWNTs/ P3OT	solid contact	-	0.13	-	6
RGO/CNT/Bi	solid contact	20 -200	0.6	-	7
NTDT-IM	solid contact	0.1 -2.5	0.12	10	Present work
Electrode (Hg²⁺)	Type of transduction	Linear range (ppb)	Limit of detection (ppb)	Response time (s)	Reference
CNT-thread	solid contact	300-1200	0.2	120	8
EDTAPANI/MWCNTs/SPCE	solid contact	0-2.0	0.003	-	9
Au/PET	solid contact	0-300	-	120	10
NDDC6-IM	solid contact	0.1-2.5	0.10	10	Present work

References

1. M. Parrilla, R. Cánovas, I. Jeerapan, F. J. Andrade, J. Wang, *Adv Healthc Mater.* 2016, 5(9), 996-1001.
2. T. Guinovart, M. Parrilla, A. G Crespo, F. X Rius, F. J. Andrade, *Analyst* 2013, **138**, 5208–5215.
3. A. Alizadeh, A. Burns, R. Lenigk, R. Gettings, J. Ashe, A. Porter, M. McCaul, R. Barrett, D. Diamond, P. White, P. Skeath, M. Tomczak, *Lab Chip* 2018, **18**, 2632–2641.
4. A. A. Stekolshchikova, A. V. Radaev, O. Y. Orlova, K. G. Nikolaev, E. V. Skorb, *ACS Omega* 2019, **4**, 15421–15427.
5. X. Xuan, M. F. Hossain, J. Y Park, *Sci. Rep.* 2016, **6**, 33125.
6. S. T. Mensah, Y. Gonzalez, P. Calvo-Marzal, K. Y. Chumbimuni-Torres, *Anal. Chem.* 2014, **86**, 7269–7273.
7. X. Xuan, J.Y. Park, *Sens. Actuat. B-Chem* 2018, **255**, 1220–1227.
8. D. Zhao, D. Siebold, N.T. Alvarez, V. N. Shanov, W. R. Heineman, *Anal. Chem.* 2017, **89**, 9654–9663.
9. Y. Zhao, X. Yang, P. Pan, J. Liu, Z. Yang, J. Wei, W. Xu, Q. Bao, H. Zhang, Z. Liao, *J. Electron. Mater.* 2020, **49**, 6695-6705.
10. W. Gao, H. Y. Y. Nyein, Z. Shahpar, H. M. Fahad, K. Chen, S. Emaminejad, Y. Gao, L. Tai, H. Ota, E. Wu, J. Bullock, Y. Zeng, D. Lien, A. Javey, *ACS Sens.* 2016, **1**, 866–874.