Simple and Rapid Nicotine Analysis Using Disposable Silica Nanochannels-Assisted Electrochemiluminescence Sensor

Yi Xiao[1,3], Suhua Chen[1,2], Guocan Zhang[1], Zhimao Li[1], Han Xiao[1], Chuanpin Chen[4], Chunlian He[1*], Ran Zhang[1*], Xiaoping Yang[1*]

1. Key Laboratory of Study and Discovery of Small Targeted Molecules of Hunan Province, Department of Pharmacy, School of Medicine, Hunan Normal University, Changsha 410013, Hunan, China.

2. Hunan Provincial Maternal and Child Health Care Hospital, Changsha 410008, Hunan, China.

3. Key Laboratory of Chemical Biology and Traditional Chinese Medicine Research (Hunan Normal University), Ministry of Education.

4. Xiangya School of Pharmaceutical Sciences, Central South University, Changsha, Hunan, 410013, China.

*Corresponding authors. Email address: Xiaoping.Yang@hunnu.edu.cn.; ZR13971@hunnu.edu.cn; chunlianhe69@163.com.

Table of Content

S1. Designed size of and photograph of the disposable sensor

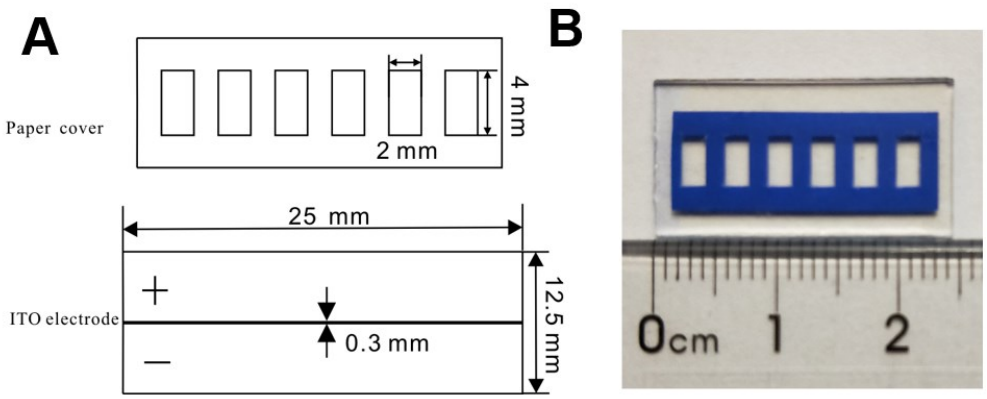

Fig. S1. A) Designed size of the ITO electrode and paper cover for the sensor; B) Photograph of the SANs-ECL sensor

S2. Morphology of the SANs membranes

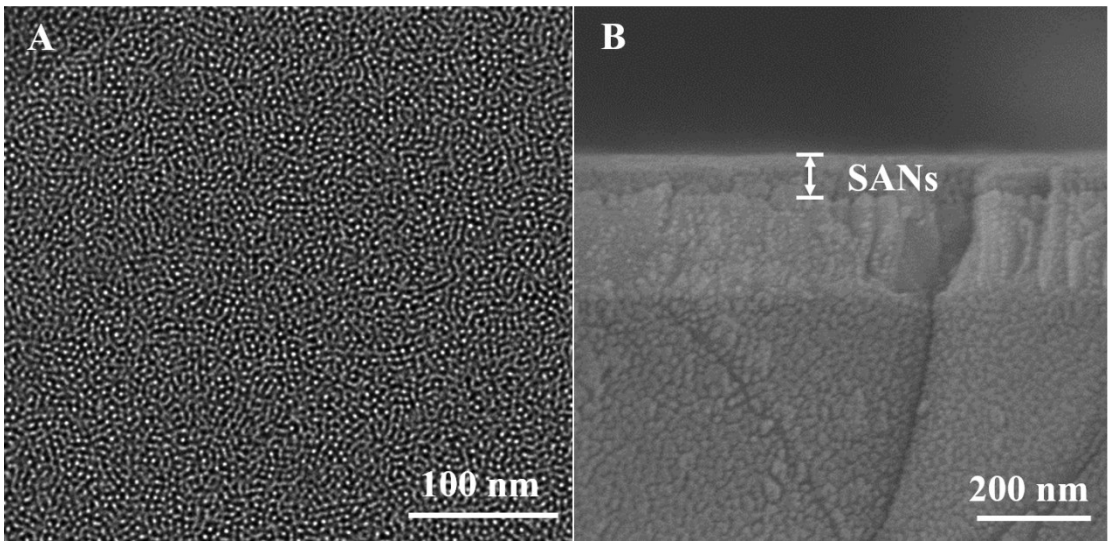

Fig. S2. Morphology of the SANs membranes. A) TEM image shows the integrity of the SANs membranes. The white pores structure reveals the vertically aligned nanochannels (scale bar is 100 nm). B) SEM image shows the SANs membrane is above the indium tin oxide sputtered glass (scale bar is 200 nm).

S3. Chemical structure of nicotine and $Ru(bpy)_3Cl_2$

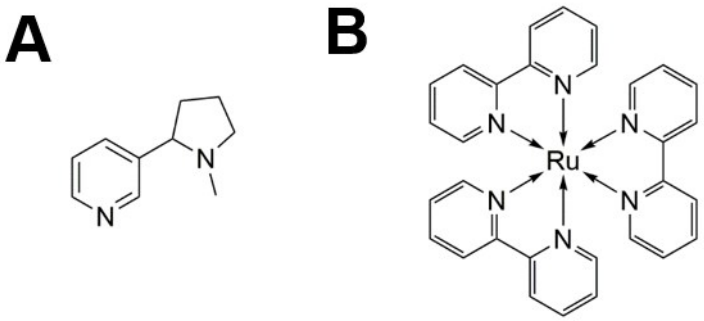

Fig. S3. Chemical structure of (A) nicotine and (B) $Ru(bpy)_3Cl_2$

S4. Optimization of ECL Detection conditions

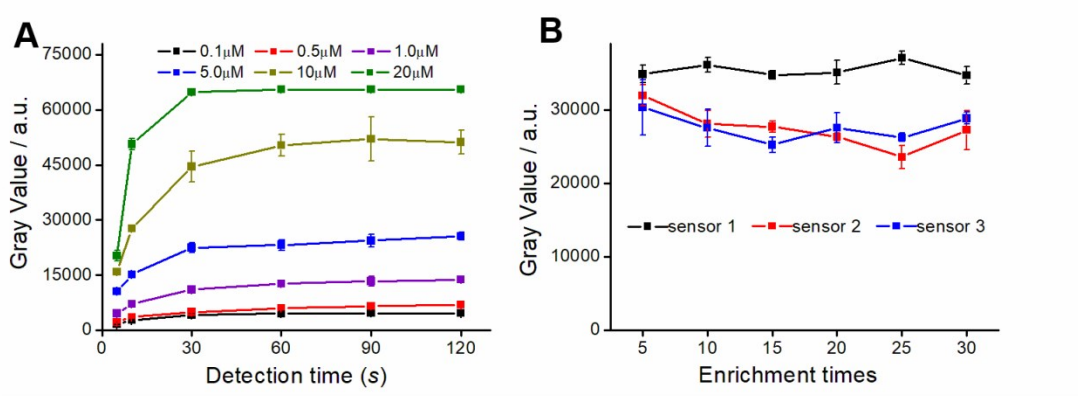

Fig. S4. Optimization of ECL detection conditions. (A) detection time, and (B) enrichment times.

S5. Analytical results for nicotine in nicotine products

Table S1. Analytical results for nicotine in commercial products

Sample	Fitting equation	Dynamic range (μM)	LOD (nM)	R^2
Cigarette	Y=1455.57+2503.73X	0.10-15.00	41.52	0.99
E-cigarette	Y=466.33+2314.70X	0.10-15.00	45.78	0.98
Nicotine gum	Y=319.37+2470.22X	0.10-15.00	63.88	0.98
Nicotine lozenge	Y=557.54+2414.64X	0.10-15.00	27.82	0.99

S6. Comparison of analytical performance of the disposable sensor with other methods

Table S2. Comparison of analytical performance of the disposable sensor with other methods

Analyte	Method	Dynamic range (μM)	LOD/LLOQ[a] (nM)	Ref.
Nicotine	BSA-PoPD electrode	1.83×10^{-4} –1.01×10^{3}	5.50×10^{-2}	1
	Nano-TiO_2 sensor	2.00 – 540.00	13.40	2
	Pt DEN ITOs	0.10–100.00	69.00	3
	GC/MS	Not applicable	2.77×10^{3}	4
	LC−MS/MS	0.10 –10.16	101.71[a]	5
	SANs-ECL sensor	0.10– 15.00	27.82	This work

BSA-PoPD electrode, bovine serum albumin and poly-o-phenylenediamine film modified electrode; Pt DEN ITOs, Pt dendrimer-encapsulated nanoparticles on indium tin oxide electrodes; GC/MS, gas chromatography/mass spectrometry; LC-MS/MS, liquid chromatography-mass spectrometry/mass spectrometry.

References

1. J. C. Liang, F. M. Han and Y. Chen, *Electrochem. Commun.*, 2012, **24**, 93-96.
2. M. Shehata, S. M. Azab, A. M. Fekry and M. A. Arneer, *Biosens. Bioelectron.*, 2016, **79**, 589-592.
3. Y. Kim and J. Kim, *Anal. Chem.*, 2014, **86**, 1654-1660.
4. W. J. Wu, D. L. Ashley and C. H. Watson, *Anal. Chem.*, 2002, **74**, 4878-4884.
5. J. Regueiro, A. Giri and T. Wenzl, *Anal. Chem.*, 2016, **88**, 6500-6508.