Electronic Supplementary Information

A rapid conductometric sensor for analysis of cyanide using imidazole based receptor

Anirban Paul[a,b], Mosarrat Perween[a,b], Sukdeb Saha[a,b], Divesh N. Srivastava[a,b], Amitava Das[a,b,c]**

a Analytical Division and Centralized Instrument Facility, CSIR-Central Salt and Marine Chemicals Research Institute, Gijubhai Badheka Marg, Bhavnagar 364002, India.

b Academy of Scientific and Innovative Research-CSMCRI, Gijubhai Badheka Marg, Bhavnagar 364002, India.

c Organic Chemistry Division, CSIR-National Chemical Laboratory, Dr. Homi Bhabha Road, Pune 411008, India.

Fax: +91-0278-2567562; Tel: +91-278-2567760; E-mail: dnsrivastava@csmcri.org (D. N. Srivastava), a.das@ncl.res.in (A. Das).

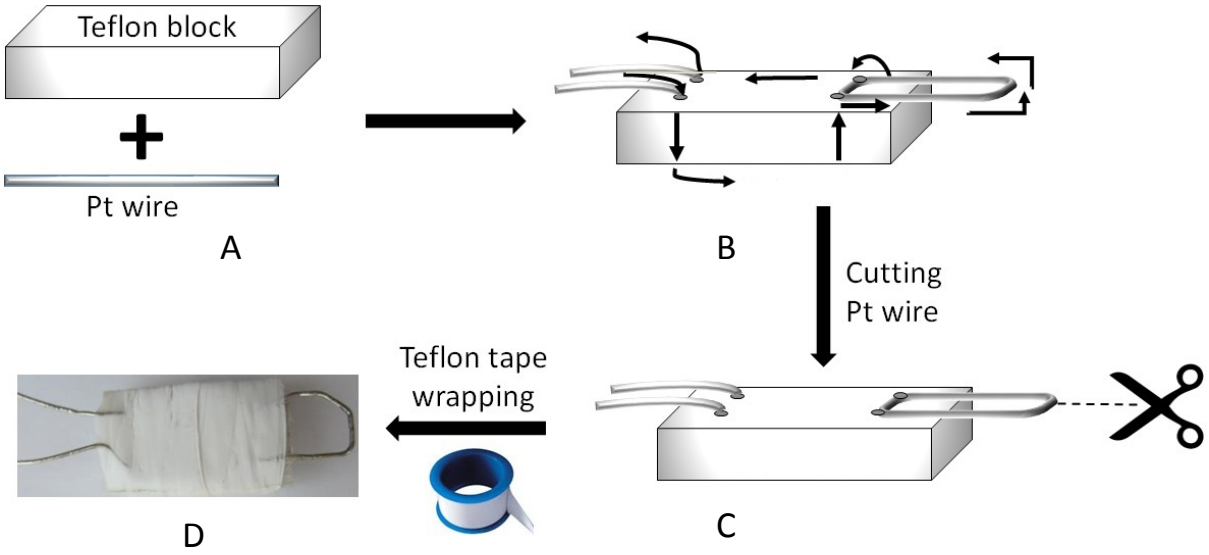

Teflon block
Pt wire
A
B
Cutting
Pt wire
C
Teflon tape
wrapping
D

Fig. S-1.

Schematic diagram of the fabrication of the device for electropolymerization. D) Actual image of the device.

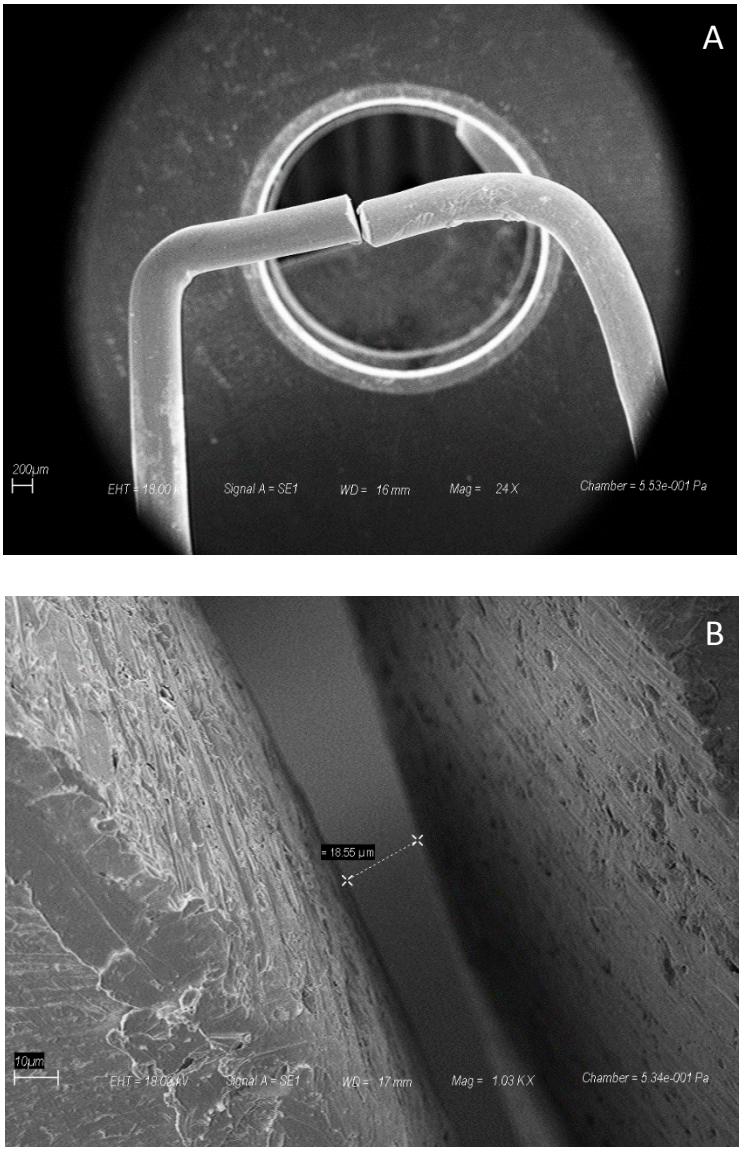
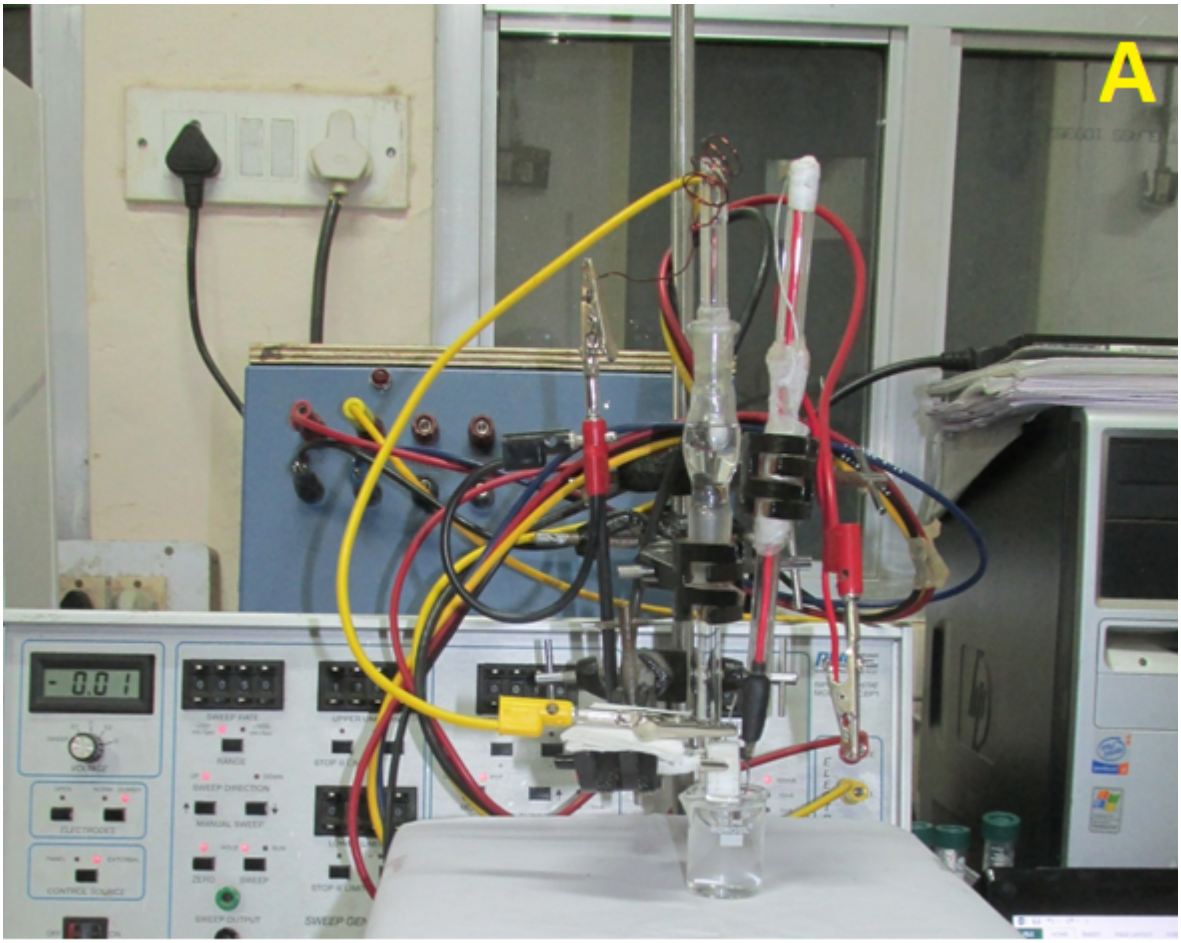


Fig. S-2. A) SEM image of the closed side of the device; B) Magnified view of the device showing the separation between two edges of platinum electrode.



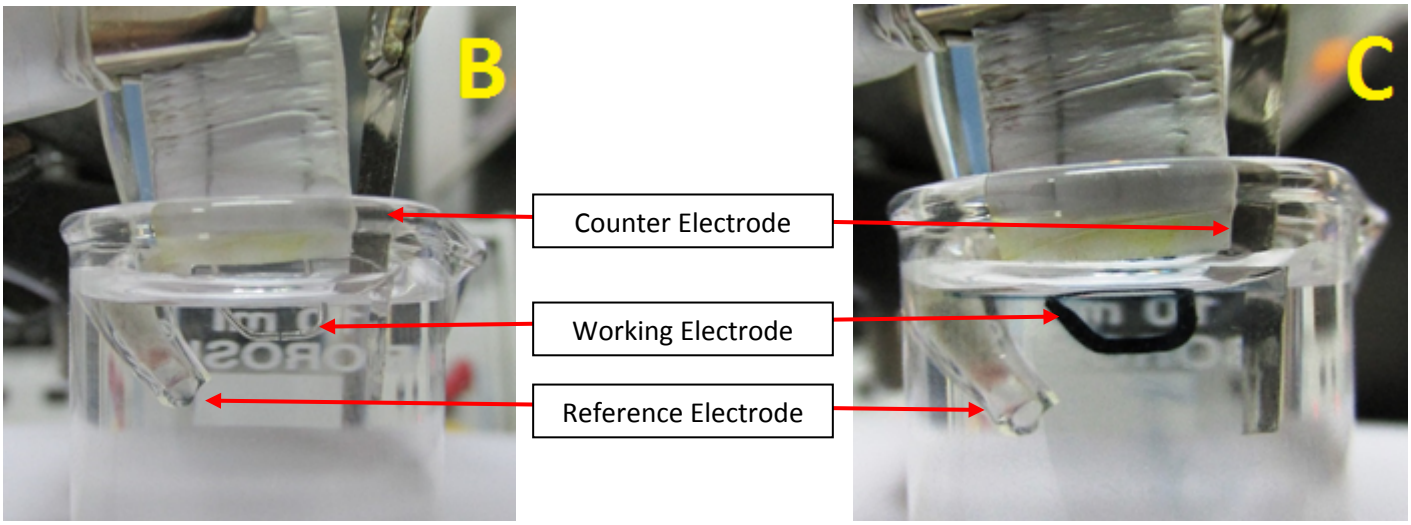


Fig. S-3. A) Photograph of complete experimental setup; Arrangement of counter, working and reference electrode B) before polymerization; C) after polymerization.

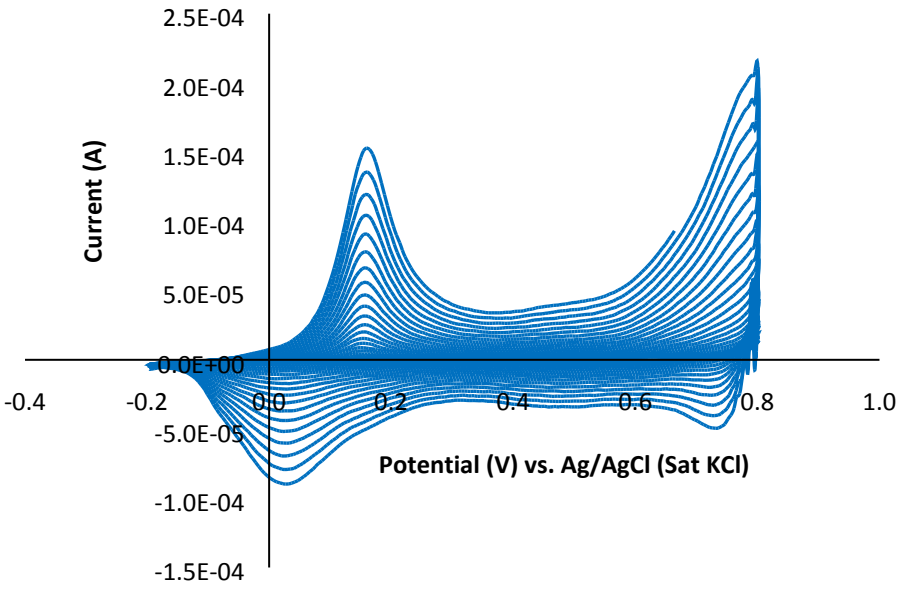


Fig. S-4. Cyclic voltammogram of aniline polymerization.

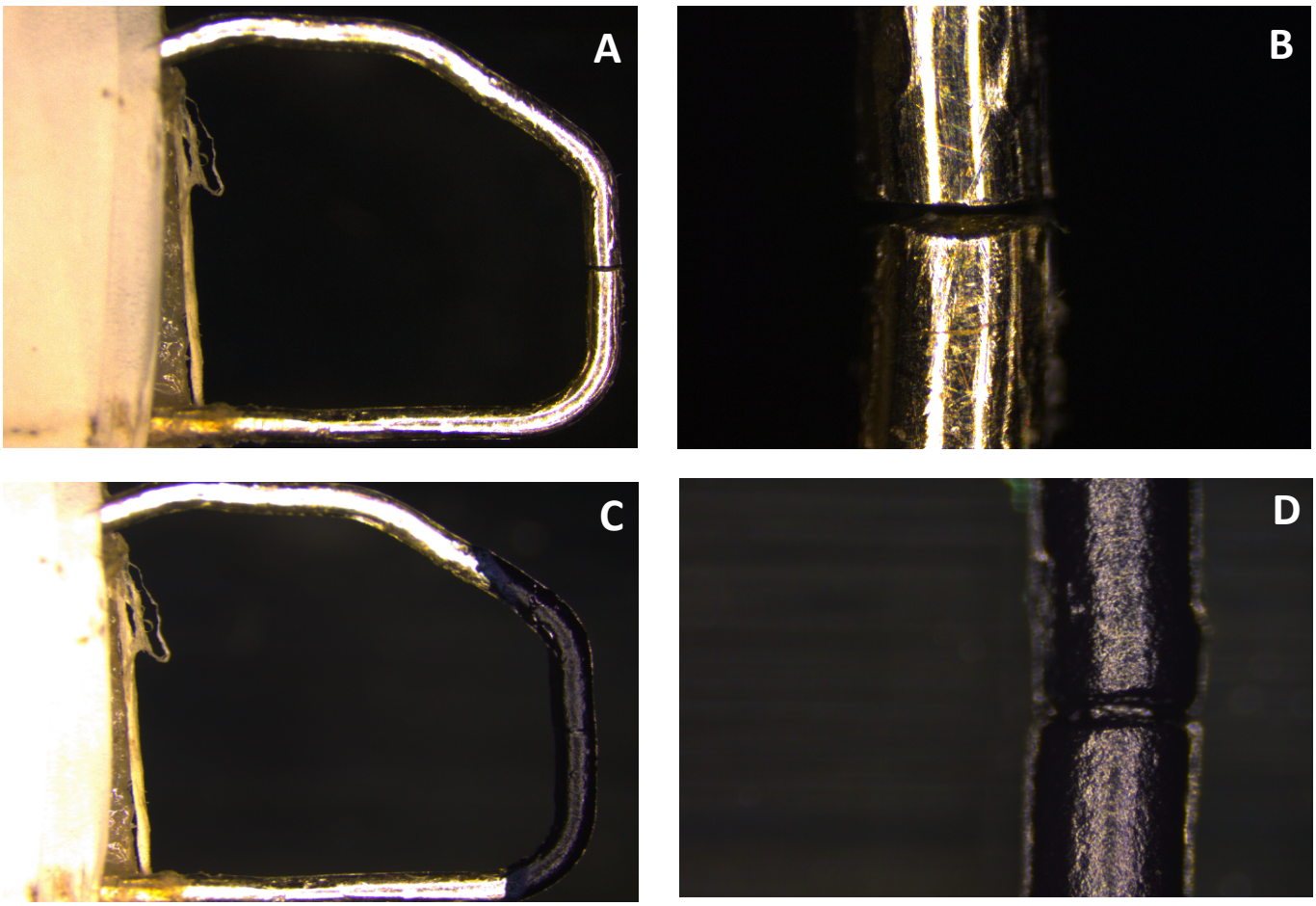


Fig. S-5. Photograph of the device before and after bridging of polyaniline A & B) Low and high magnified image before polymerization; C-D) Low and high magnified image after polymerization.

:

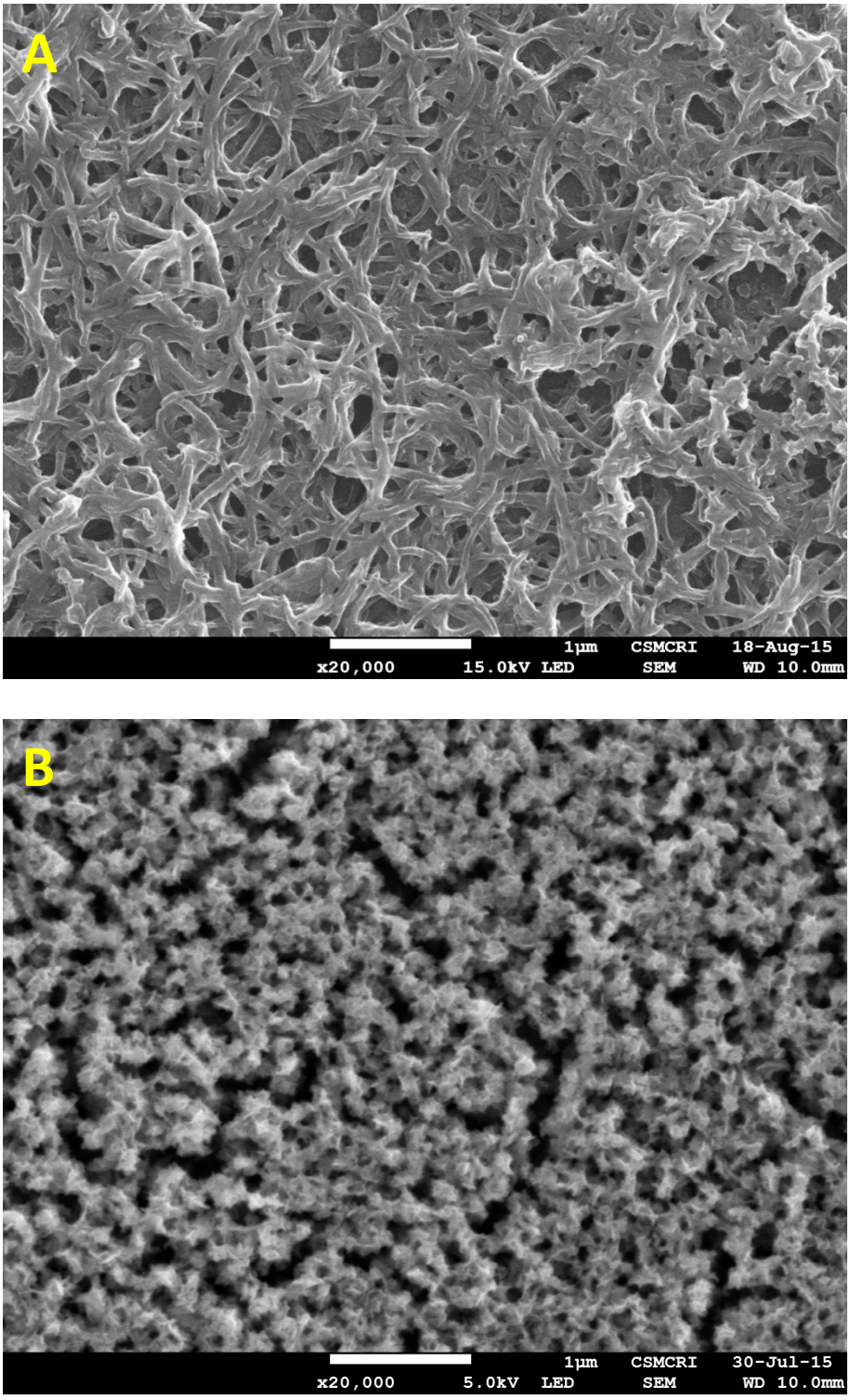


Fig. S-6. A) FE-SEM image of electrochemically polymerized polyaniline at -200 mV potential having close packed fibrous structure unsuitable for immobilization. B) FE- SEM image of the same at 400 mV potential having porous and open structure suitable for immobilization of analyte.

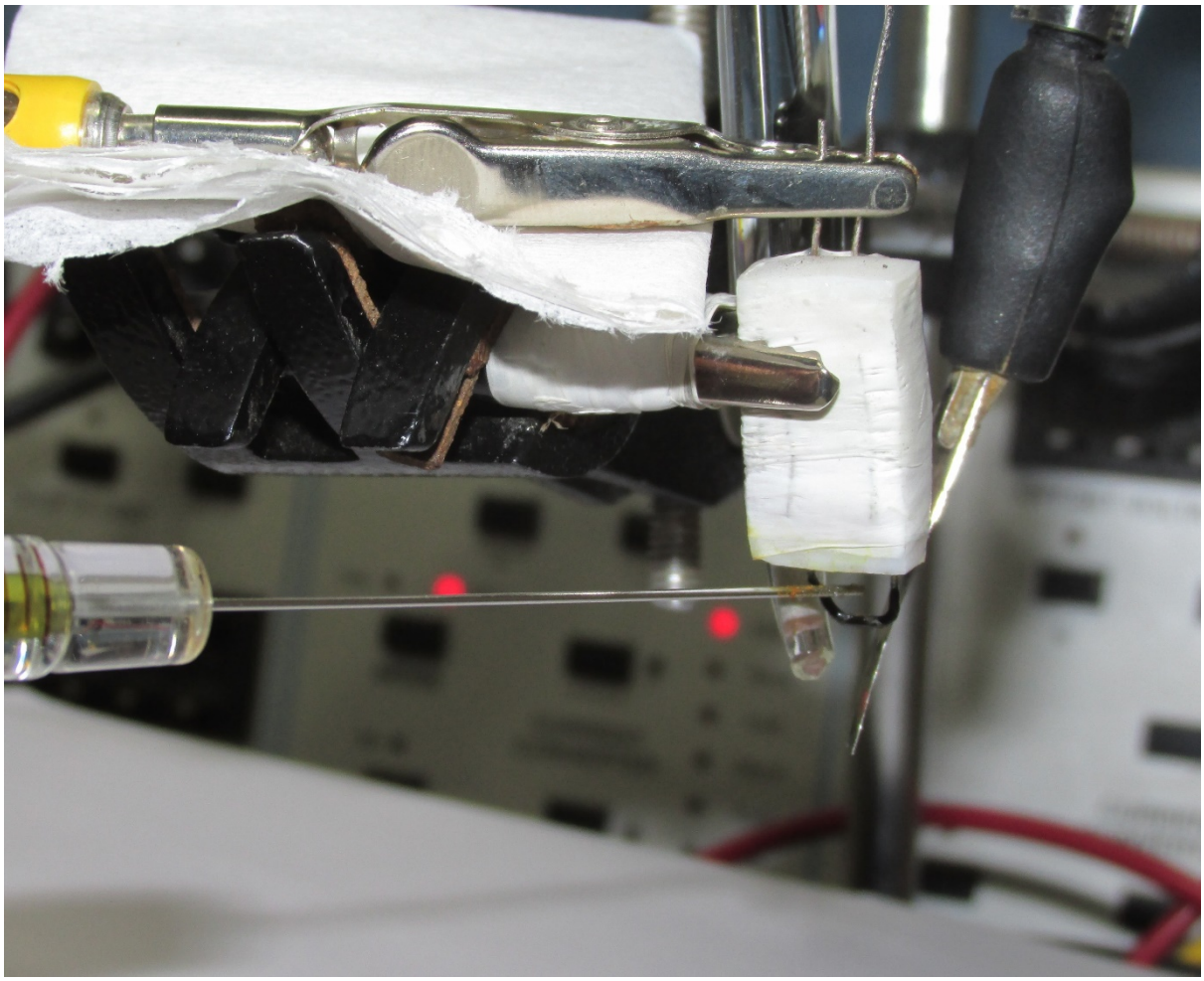


Fig. S-7. Photograph of the process of immobilization of receptor in the device.

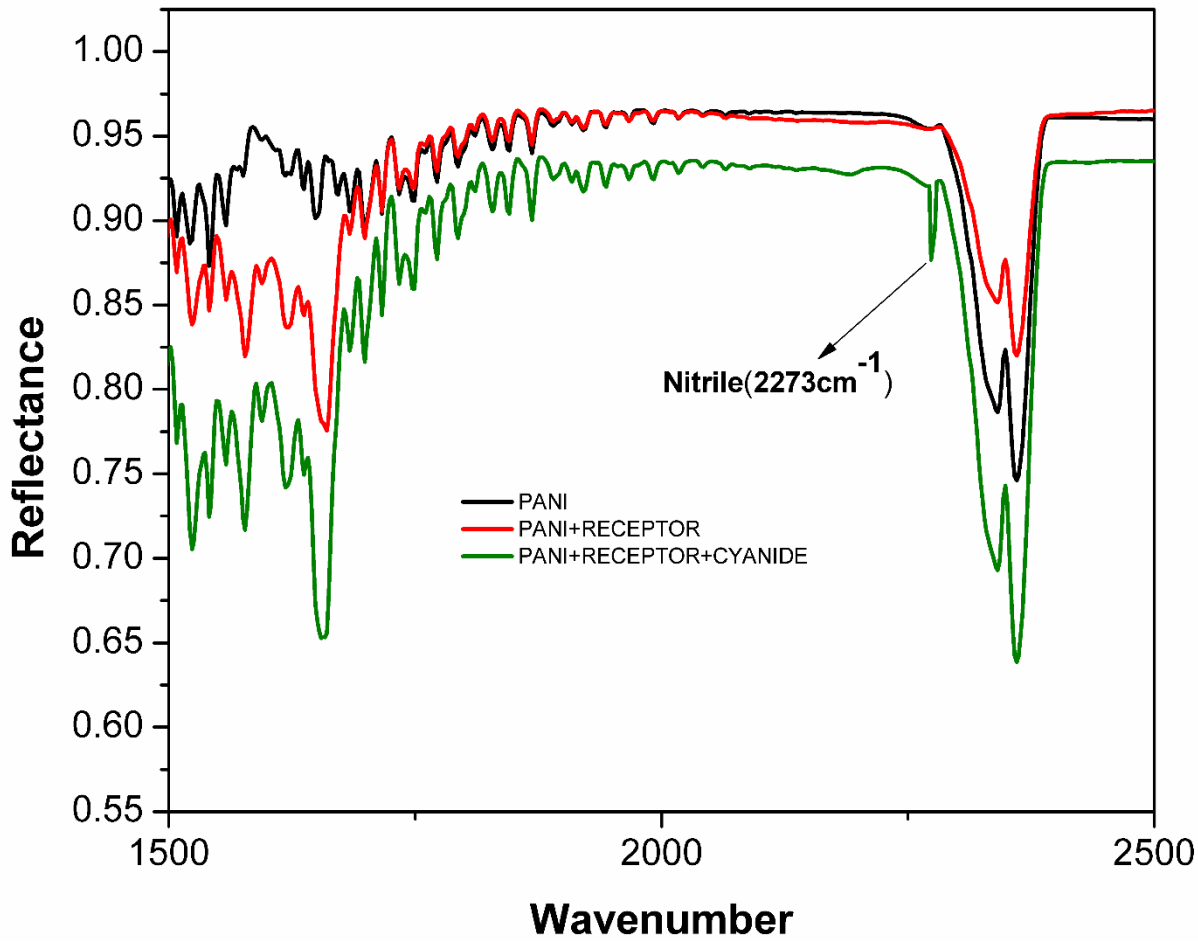


Fig. S-8. Comparative FT-IR spectra of polyaniline, binary mixture of polyaniline and receptor and tertiary mixture of polyaniline, receptor and cyanide.

Table S-9. List of selected cyanide sensors reported in literature with their MDL.

Method	MDL[#] (mol/Lit)	Lin. Range (mol/Lit)	Ref.*
Amperometry	2×10^{-5}	$< 1\times10^{-6}$	1
SET	2×10^{-5}	$< 16\times10^{-6}$	2
Voltametry	1×10^{-8}	$< 2\times10^{-6}$	4
Chrono-amperometry	2×10^{-10}	$< 3\times10^{-12}$	6
Colorimetry	2×10^{-6}	$< 1\times10^{-4}$	8
Colorimetry	8×10^{-5}	$< 3\times10^{-7}$	10
Fluorescent	8×10^{-10}	$< 1\times10^{-3}$	12
Amperometry	4×10^{-4}	$< 3\times10^{-6}$	17
Amperometry	4×10^{-3}	$< 3\times10^{-5}$	22
Amperometry	2×10^{-6}	$< 8\times10^{-4}$	23

[#] MDL stands for minimum detection limit.

* Please see list of publications in manuscript.

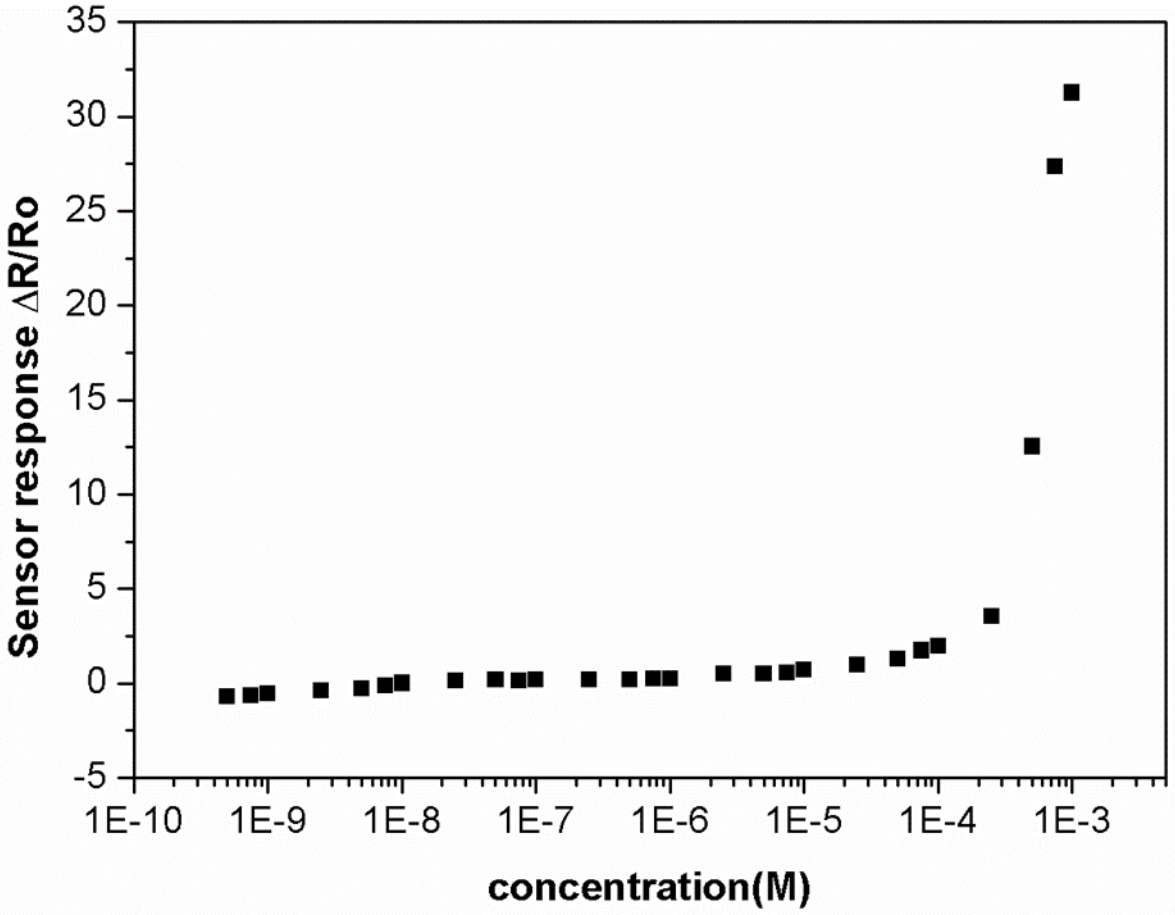


Fig. S-10. General plot of sensor response covering all the three segments as discussed in section 3.3 in main text.

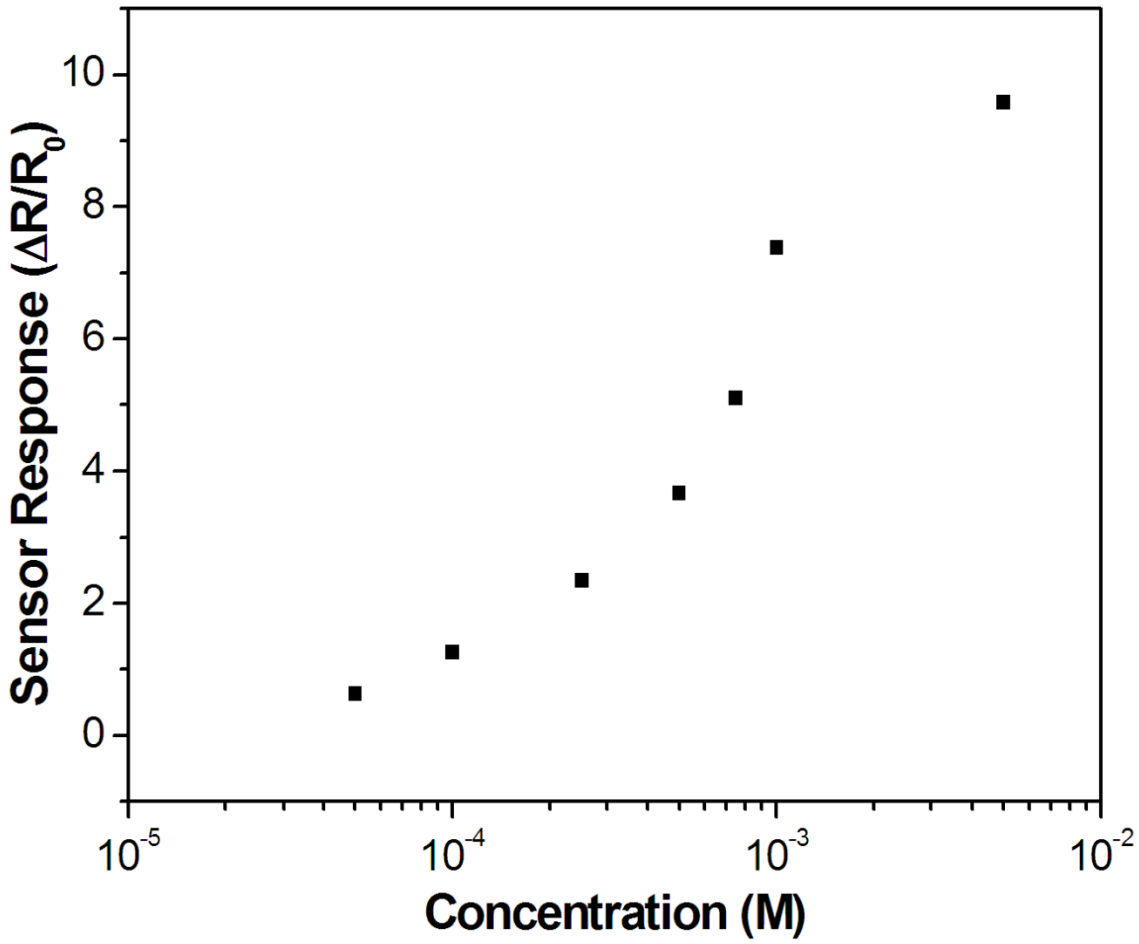


Fig. S-11. The sensor response without immobilization of receptor at 400 mV potential.

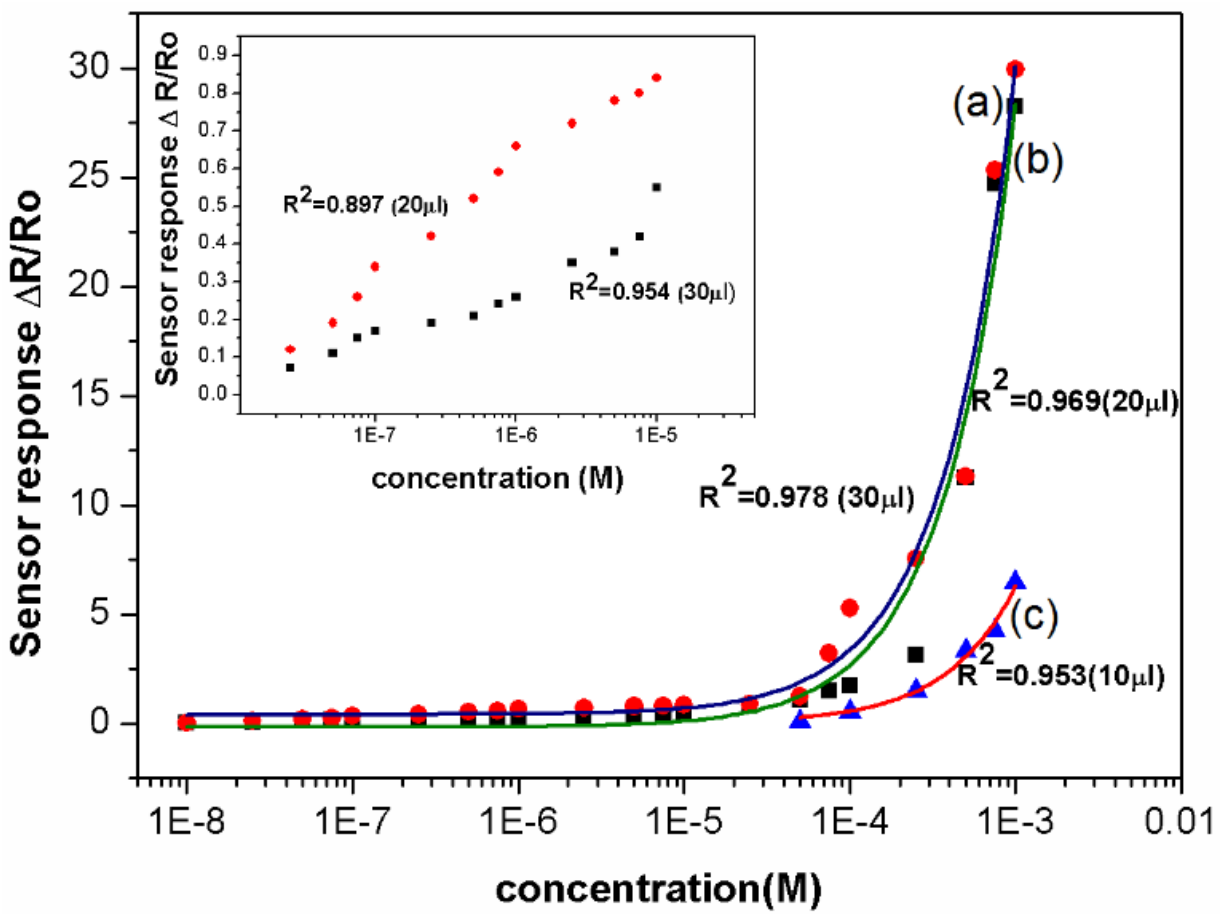


Fig. S-12. Effect of amount of receptor on sensor response (a) 30 μL loading; (b) 20 μL loading; (c) 10 μL loading.

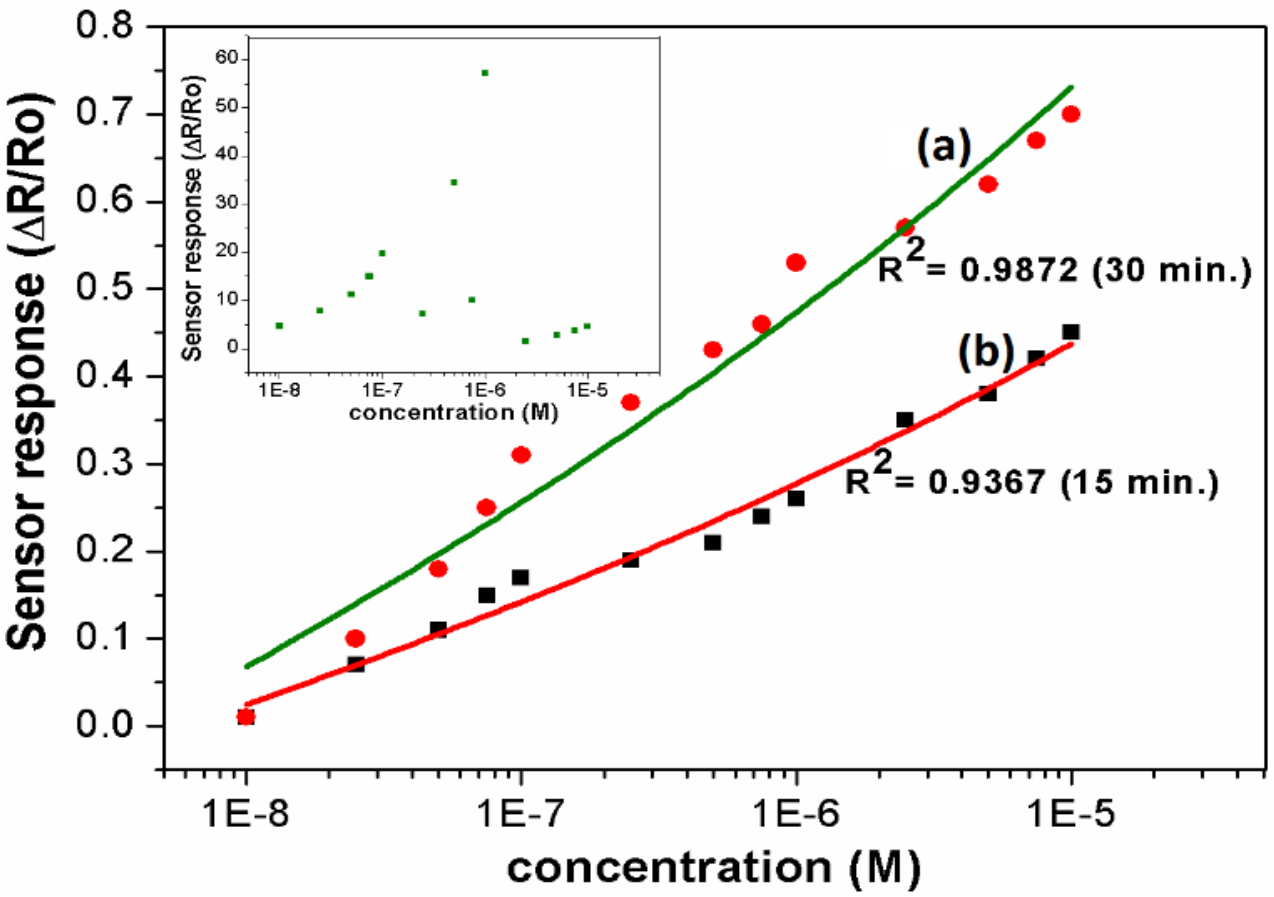


Fig. S-13. Effect of equilibration time on the sensor response (a) 30 minutes; (b) 15 minutes. [*In*-set: Sensor response recorded with 5 minutes response time in segment two].

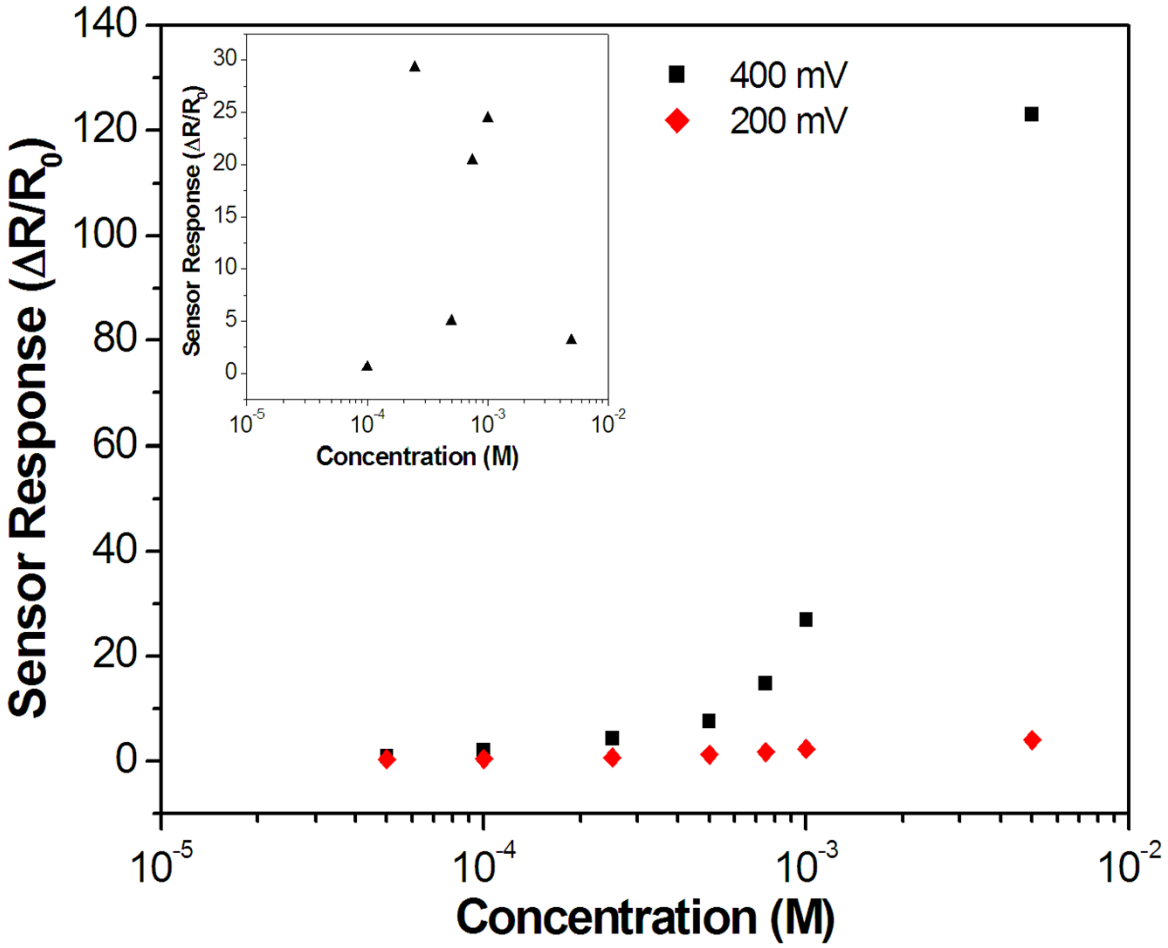


Fig. S-14. The sensor response as a function of electrochemical states vs. Ag/AgCl; A) at +400 mV; B) at +200 mV [Inset: sensor response at -200 mV].

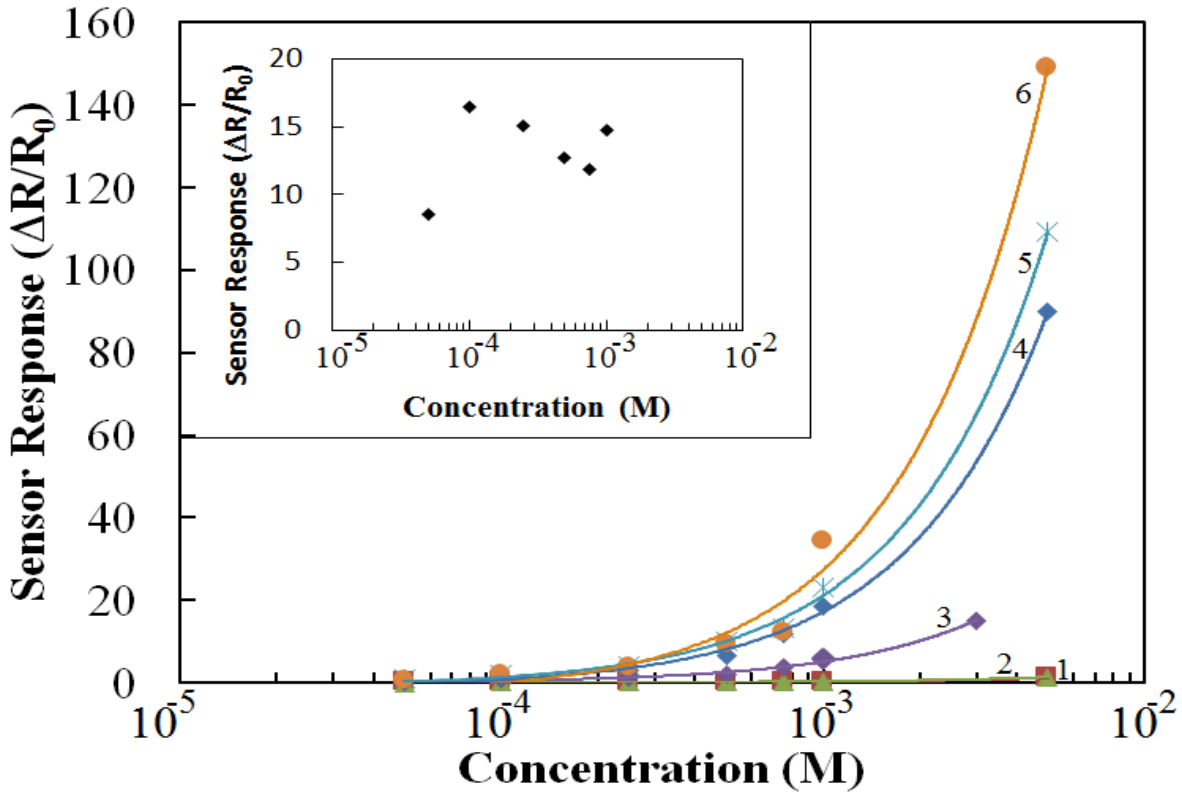


Fig. S-15. Effect of pH on sensor response; (1) pH= 1, (2) pH= 2, (3) pH =3, (4) pH=4, (5) pH=5 & (6) pH=6. (*In-set*: sensor response at pH=9).

Table S-16. Solvation enthalpy of anions.

Anion	**$-\Delta H^0_{hyd}$ (kJ/mol)**
F^-	515
Cl^-	381
I^-	307
NO_2^-	405
NO_3^-	314
SO_4^{2-}	1495
CO_3^{2-}	1314
CN^-	68

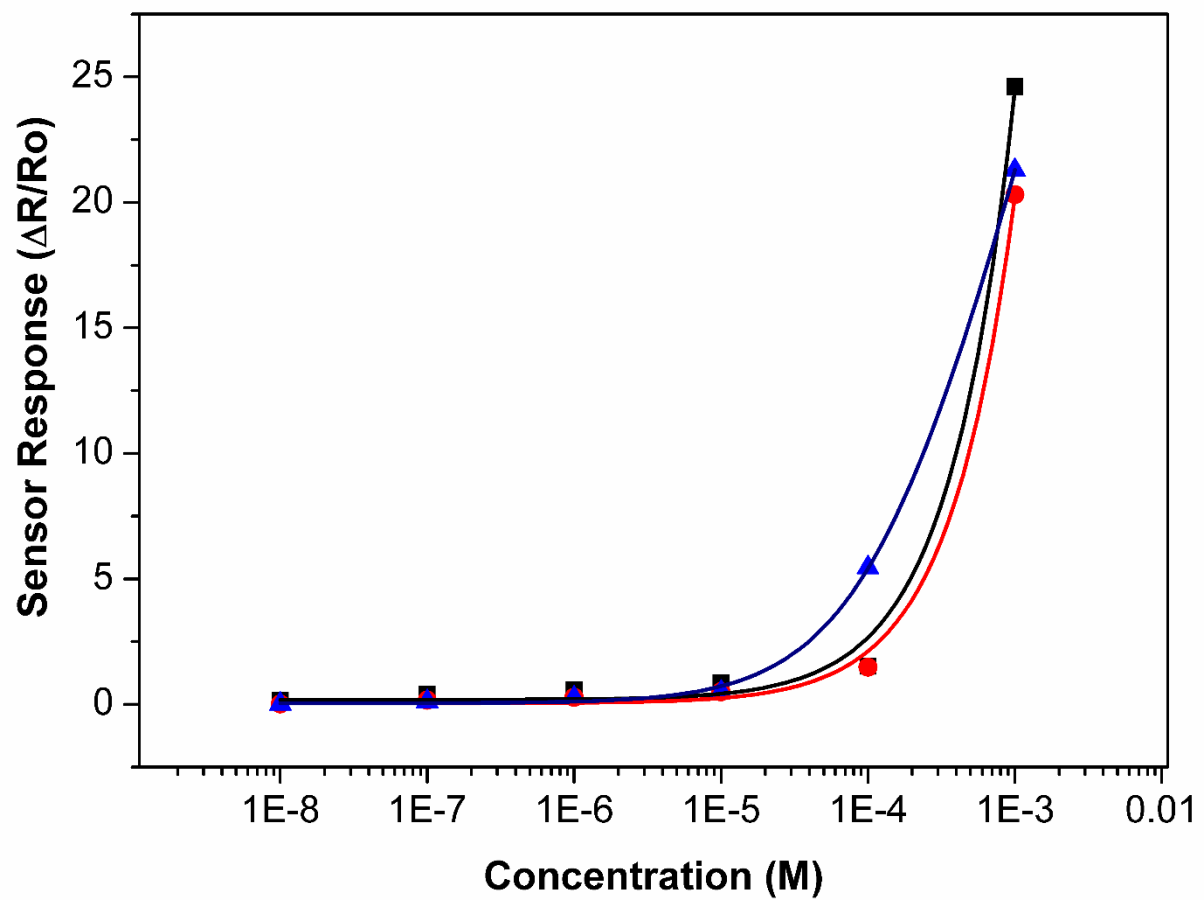


Fig. S-17: Three repeated sensor responses after transfusion of cyanide in wastewater taken from river Garga, Jharkhand in India.