

Supplementary information

Translation of a chemical reaction to electrical signal generation: An organic-inorganic complexation strategy

Venkata K Perla, Sarit K Ghosh, Kaushik Mallick*

Department of Chemical Sciences, University of Johannesburg, P.O. Box: 524, Auckland Park, 2006, South Africa.

* Corresponding author

E-mail: kaushikm@uj.ac.za (K. Mallick)

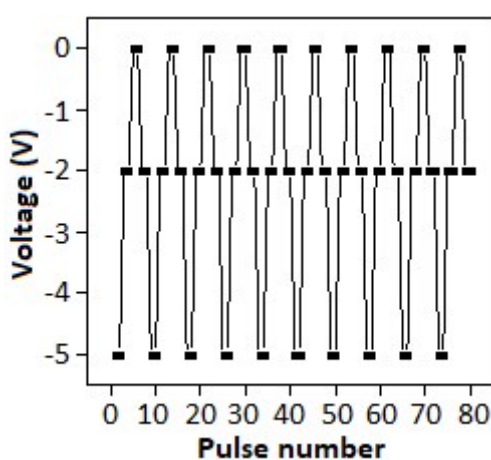


Figure S1: The Write-Read (1)-Erase-Read (0) pulse employed to the device D (I) and after the addition of cysteine, 5 μ L of 30 mM, D (Ib).

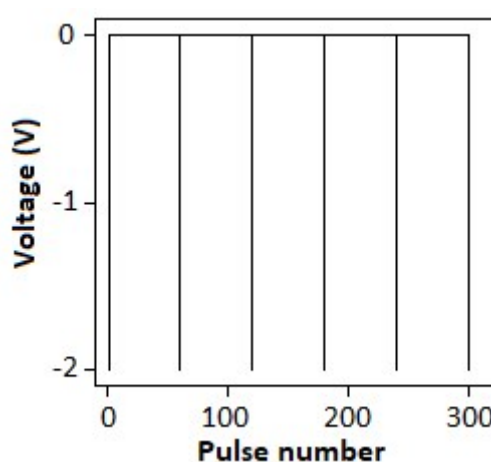


Figure S2: For the retention study, a pulse train applied to the device (Au-PACS-Au) consist of -2 V for 0.1 sec with time interval of 60 sec.

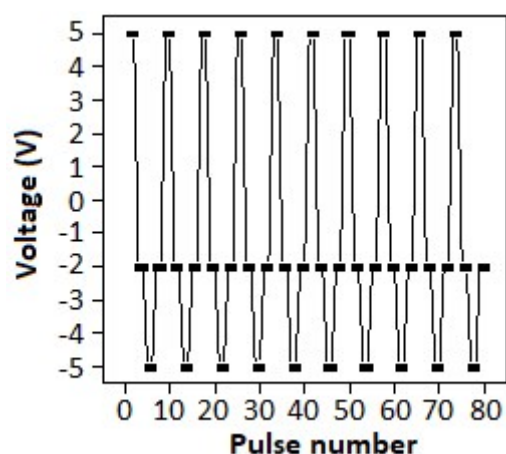


Figure S3: The Write-Read (1)-Erase-Read (0) pulse employed to the device Au-PACS-Au.

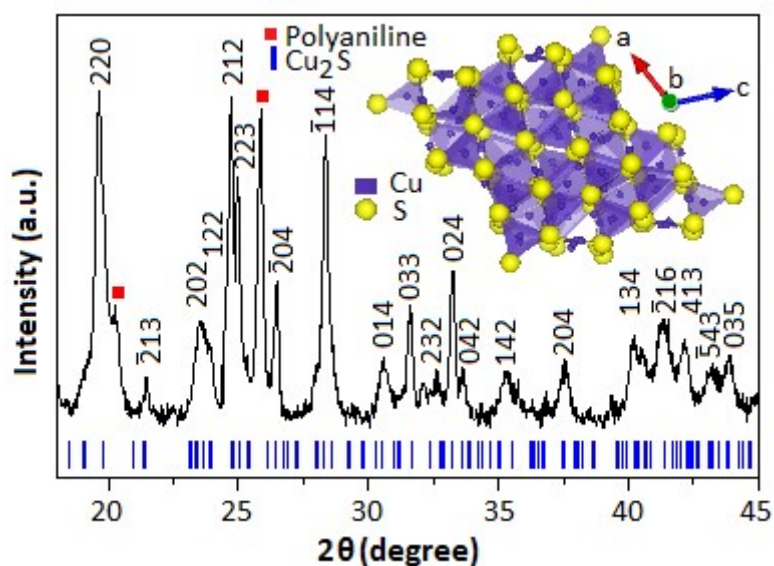


Figure S4: X-Ray diffraction pattern of the PACS material within the 2θ range from 18° to 45° .

The X-Ray diffraction spectrum of the PACS material with in the 2θ range of $18^\circ - 45^\circ$, is displayed in figure S4. The PACS XRD peaks of the PACS material is corroborated with the JCPDS card number 83-1462, suggest the formation of monoclinic form of Cu_2S and belongs to the space group of $P2_1/c$. All the major peaks are indexed with the hkl values within the spectrum. The unit cell representation of Cu_2S shown in figure S4, inset and cell parameters are $a = 15.2$, $b = 11.8$ and $c = 13.5 \text{ \AA}$, and $\alpha = \gamma = 90^\circ$ and $\beta = 116.3^\circ$. The peaks around 20.2 , 25.4° (marked in RED) indicates the presence of polyaniline in the PACS material.^{R1}

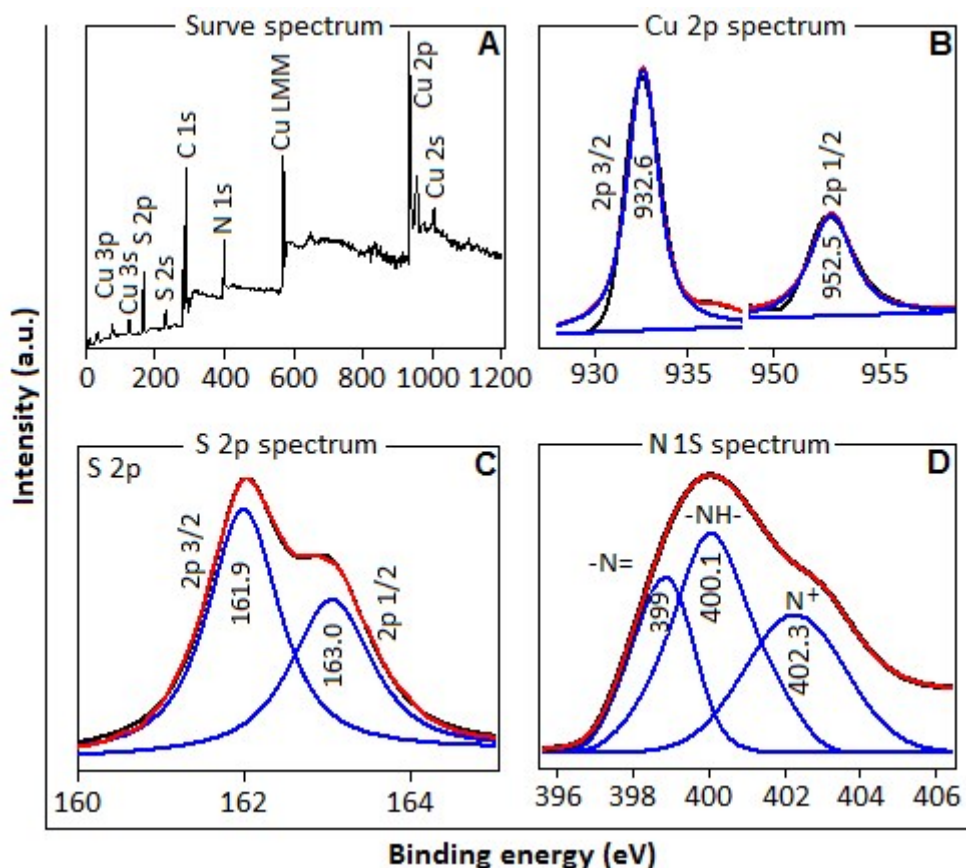


Figure S5: (A) X-ray Photoelectron survey spectrum of the PACS and the deconvoluted high resolution spectra of (B) Cu 2p, (C) S 2p and (D) N 1s.

The polyaniline stabilized copper sulfide nanoparticles (PACS) was further analysed with X-ray photoelectron spectroscopy (XPS) technique, and the complete XPS survey spectrum of the PACS is displayed in figure S5 that confirmed the presence of nitrogen, carbon, sulphur and copper in the material. In the high resolution XPS spectra, figure S5, (B), the Cu 2p peak is split into Cu 2p_{3/2} (932.6 eV) and Cu 2p_{1/2} (952.5 eV) peaks with a peak separation of 19.9 eV, in agreement with those reported in the literature,^{R2} suggesting copper valence state in the PACS is +1. In addition, the high intensity Cu LMM Auger peak at 569 eV is most likely the characteristic of Cu (I).^{R3} Figure S5 (C) exhibits S 2p core level spectrum where the two peaks with the binding energy values of 161.9 and 163.0 eV correspond to S 2p_{3/2} and S 2p_{1/2}, and the lower energy peak (2p_{3/2}) indicates the formation of Cu₂S in the PACS material.^{R3} The high-resolution spectrum of N 1S, Figure S5 (D), after deconvolution displayed the three peaks positioned at 399.0, 400.1 and 402.3 eV attributed to quinoid phenyl structure (-N=), benzenoid structure (-NH-) and quaternary ammonium structure (N⁺), respectively.^{R4}

Reference:

- R1. B. S. Singu, P. Srinivasan and S. Pabba, *J. Electrochem. Soc.*, 2012, **159**, A6-A13.
- R2. S. Chang, M. Chiang, C. Chiang, F. Yuan, C. Chen, B. Chiu, T. Kao, C. Lai, H. Tuan, *Energy Environ. Sci.*, 2011, 4, 4929-4932.
- R3. S1. L. Jin, L. Cai, D. Chen, W. Wang, H. Shen and F. Zhang, *J. Mater. Sci.* 2019, **54**, 12650-12658.
- R4. S. H. Patil, A. P. Gaikwad, S. D. Sathaye and K. R. Patil, *Electrochim. Acta*, 2018, **265**, 556-568.