Electronic Supplementary Material (ESI) for New Journal of Chemistry.

Supplementary Information

Self-supported 3D Coral-like Copper/ Polydiphenylamine on Nickel Foam: Multifunctional Exploration of Overall Electrochemical Water Splitting, Alcohol Oxidation Reaction and Supercapacitor Applications

Asha Raveendran[a], Mijun Chandran[b], Soo Chool Lee[c], Masoom Raza Siddiqui[d], Saikh Mohammad Wabaidur[d], Ragupathy Dhanusuraman[a,e]*

[a]*Nano Electrochemistry Lab (NEL), Department of Chemistry, National Institute of Technology Puducherry, Karaikal - 609609, India*

[b]*Department of Chemistry, Central University of Tamil Nadu, Thiruvarur, 610005, India*

[c]*Research Institute of Advanced Energy Technology, Kyungpook National University, Daegu 41566, Republic of Korea*

[d]*Chemistry Department, College of Science, King Saud University, Riyadh 11451, Saudi Arabia*

[a,e]*Nano Electrochemistry Laboratory (NEL), Central Instrumentation Facility (CIF), School of Physical, Chemical and Applied Sciences, Pondicherry University, Pondicherry, 605014, India*

Corresponding Author:

Prof.Ragupathy Dhanusuraman, MRSC

Email: ragu@pondiuni.ac.in; ragu.nitpy@gmail.com

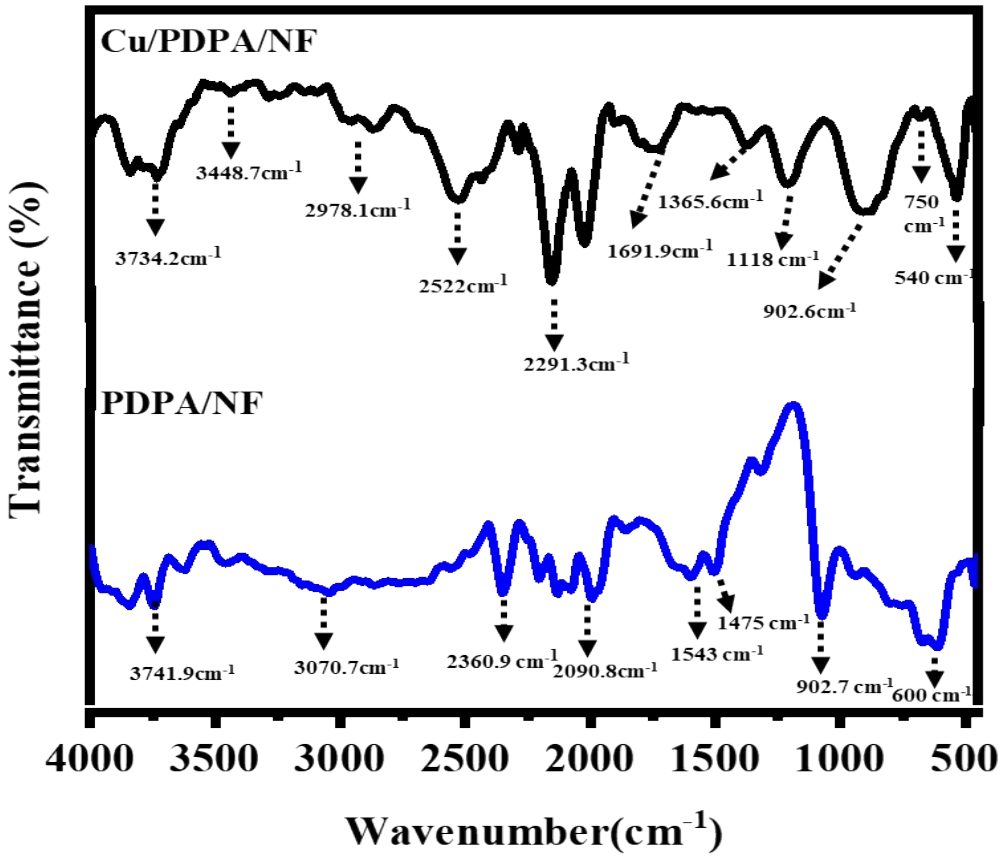

Fig S1. FTIR analysis of PDPA/NF and Cu/PDPA/NF

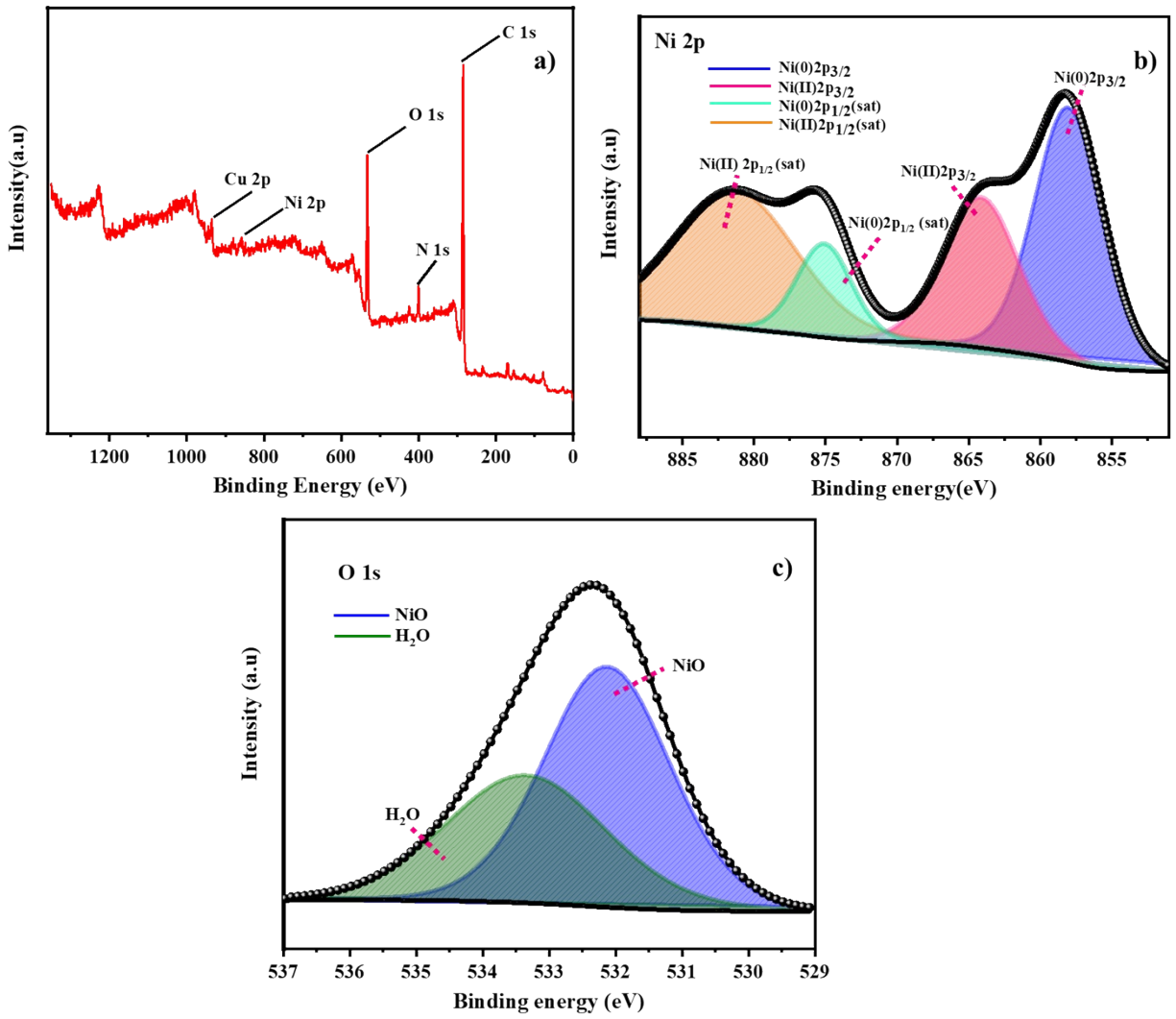

Fig. S2. X-ray photoelectron spectroscopy (XPS) spectra of (a) Overall XPS survey spectra of Cu/PDPA/NF and XPS spectra of (b) Ni 2p and (c) O 1s

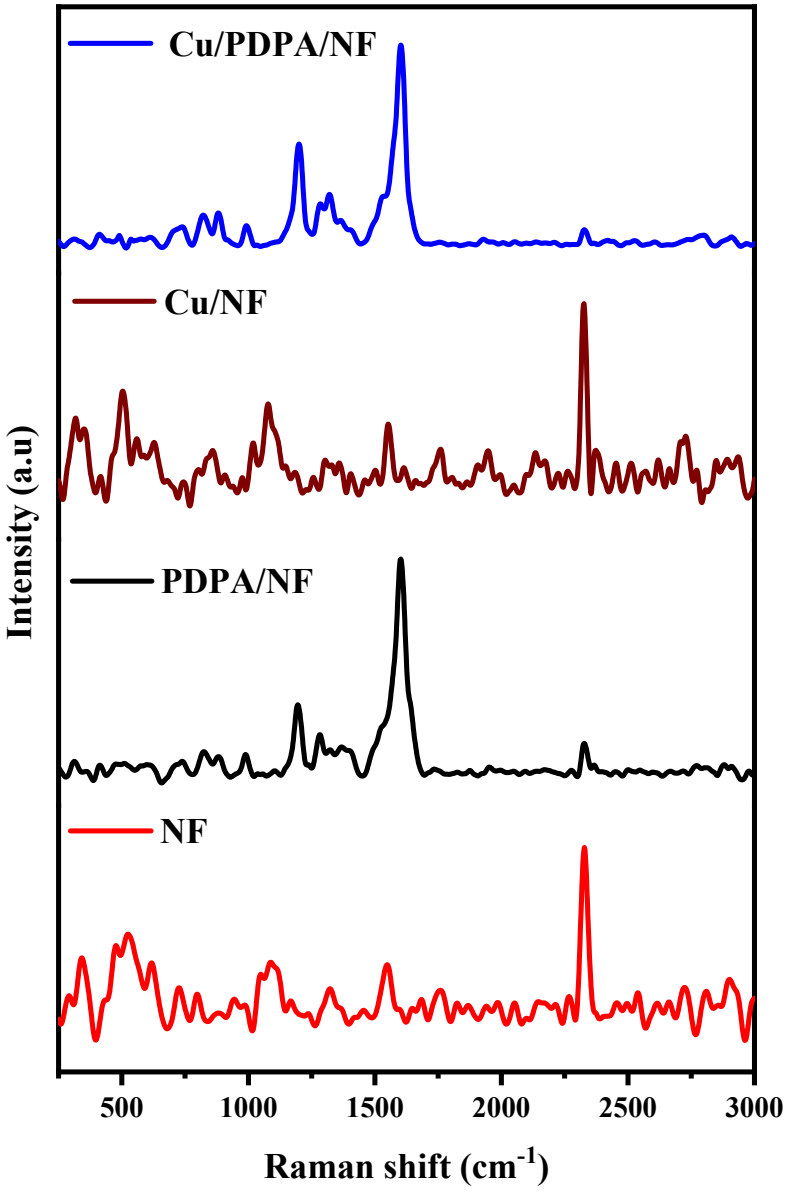

Fig S3. Raman analysis of NF, Cu/PDPA, PDPA/NF and Cu/PDPA/NF

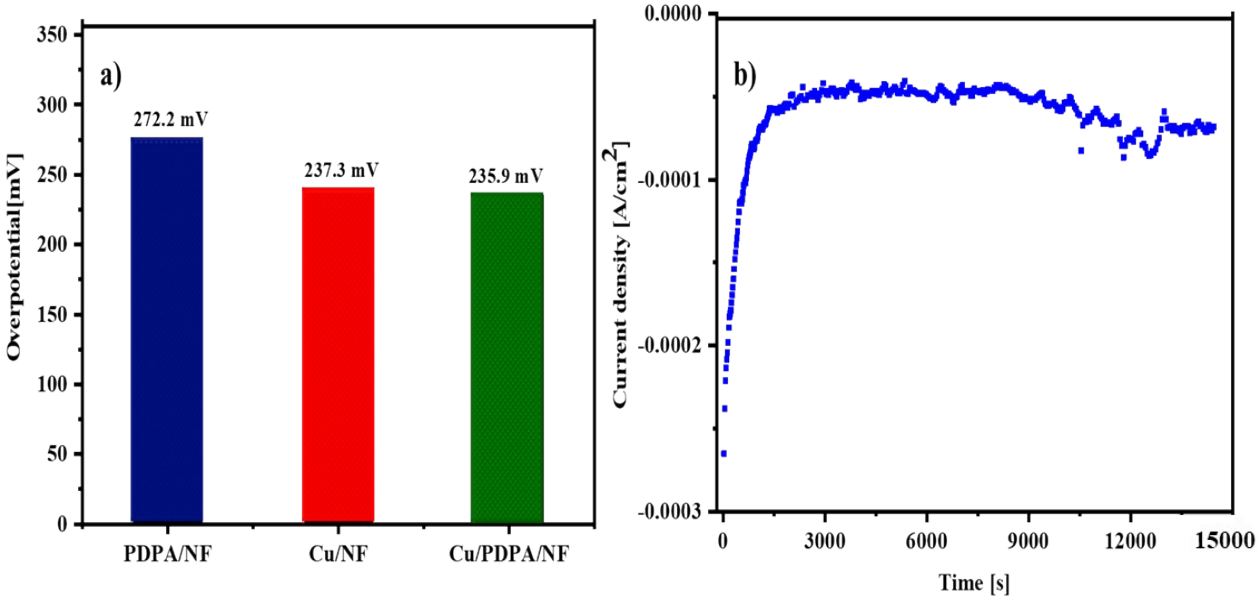

Fig S4. (a) Overpotential of Cu/PDPA/NF, PDPA/NF and Cu/NF at 10mAcm^{-2} (HER)

(b) Long-term durability test of of Cu/PDPA/NF during Hydrogen evolution reaction

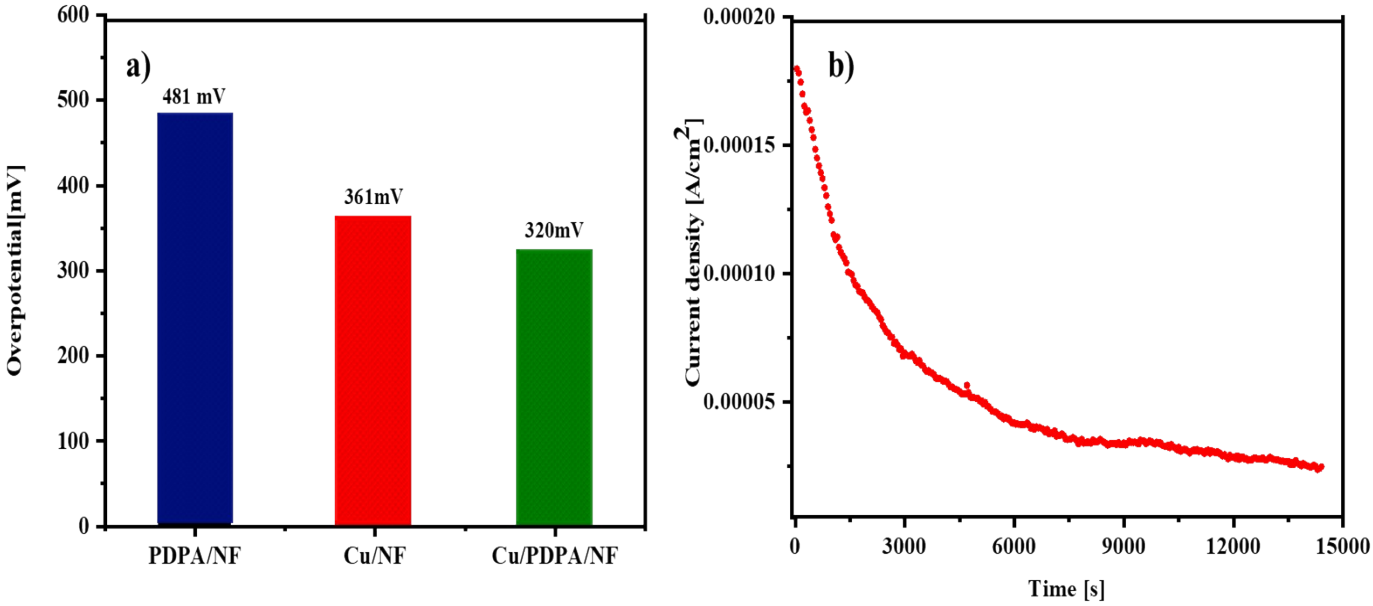

Fig S5. (a) Overpotential of Cu/PDPA/NF, PDPA/NF and Cu/NF at 10mAcm^{-2} (OER)

(b) Long-term durability test of of Cu/PDPA/NF during Oxygen evolution reaction

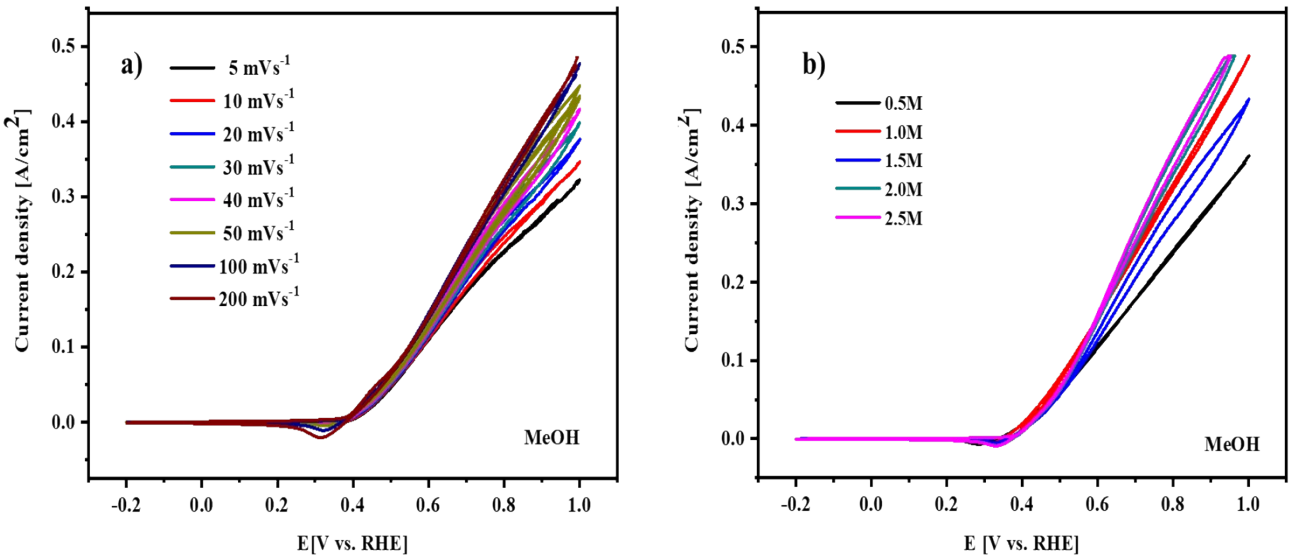

Fig S6. (a) CV plot of Cu/PDPA/NF in the presence of different methanol concentrations 0.5-2.0M in 1.0 M KOH at scan rate of 50 mVs^{-1} (b) Cyclic Voltammogram of Cu/PDPA/NF at varying scan rates such as 5 to 200 mV/s in 0.1M KOH+ 1.0M Methanol.

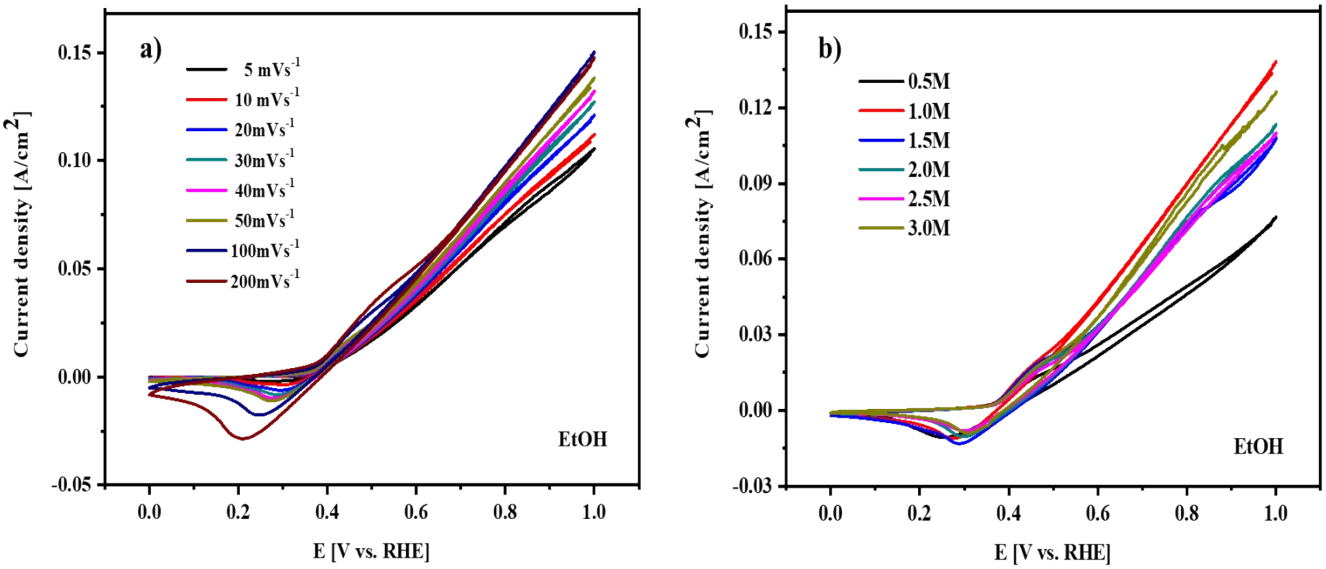

Fig S7. (a) CV plot of Cu/PDPA/NF in the presence of different Ethanol concentrations 0.5-2.0M in 1.0 M KOH at scan rate of 50 mVs^{-1} (b)Cyclic Voltammogram of Cu/PDPA/NF at varying scan rates such as 5 to 200 mV/s in 1.0 M KOH+ 1.0M Ethanol

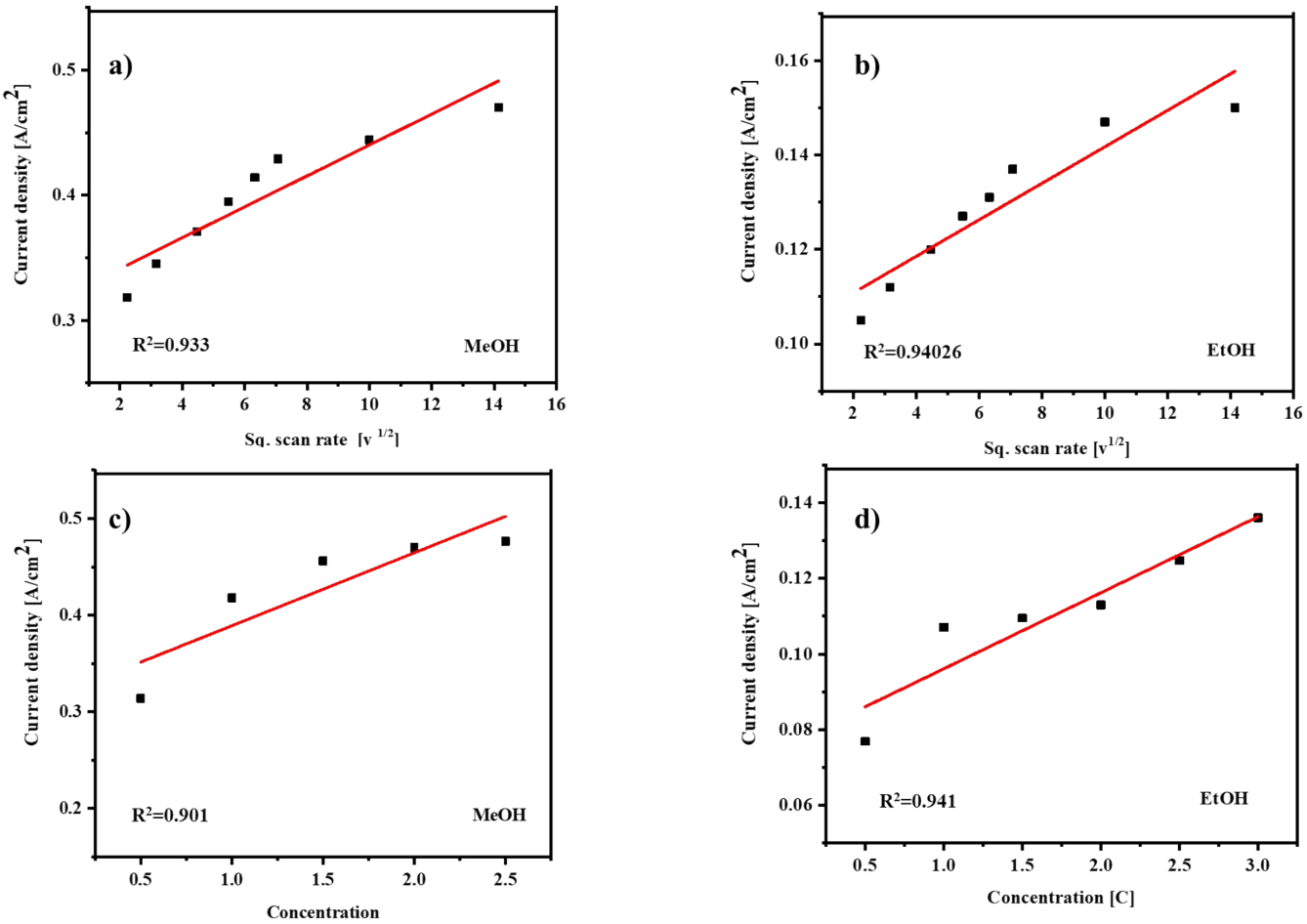

Fig S8. linear relationship between (scan rate)$^{1/2}$ and current density of Cu/PDPA/NF for (a) Methanol (b) Ethanol and linear relationship between concentration and current density (c) Methanol and (d) Ethanol

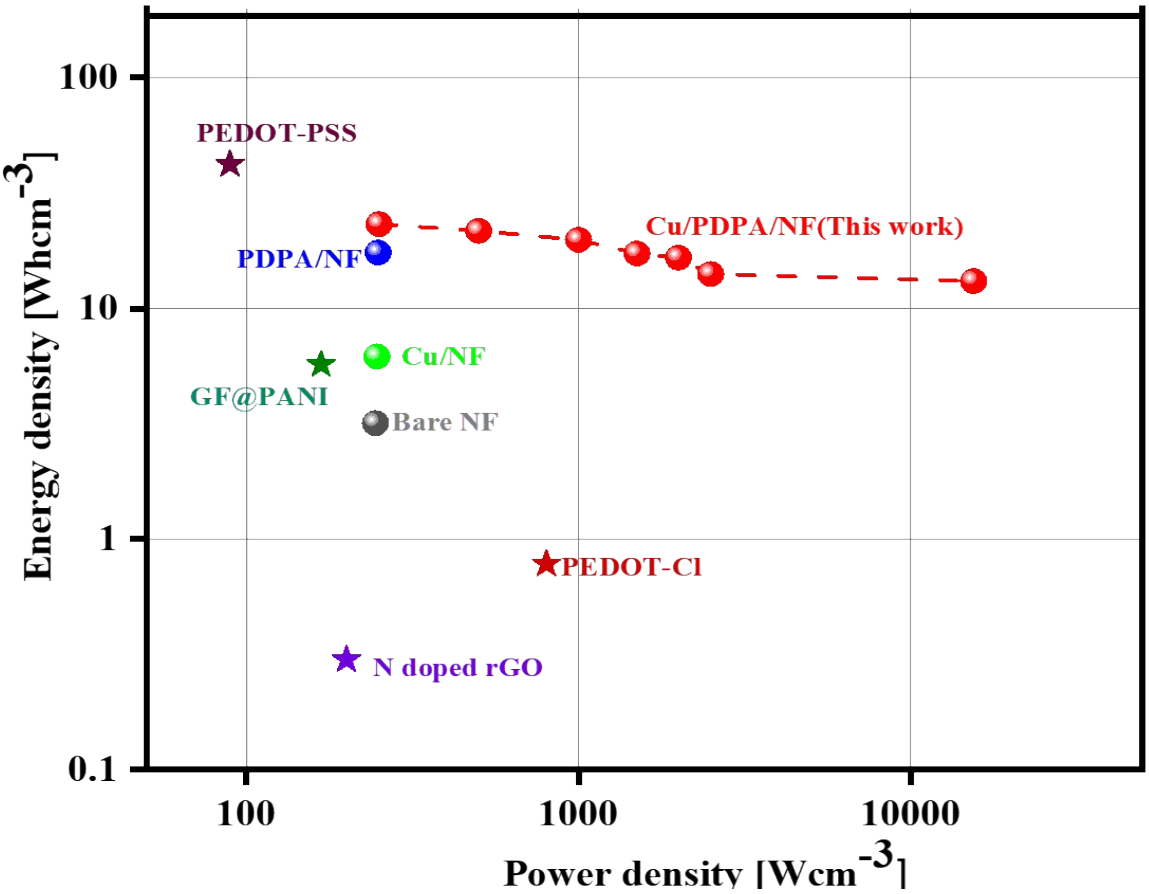

Fig S9. Areal Ragone plot comparing Cu/PDPA/NF reported here to other polymer based and 2D capacitors including N-doped rGO[1], PEDOT-Cl[2], PEDOT:PSS[3] and GF@PANI FSSC[4]

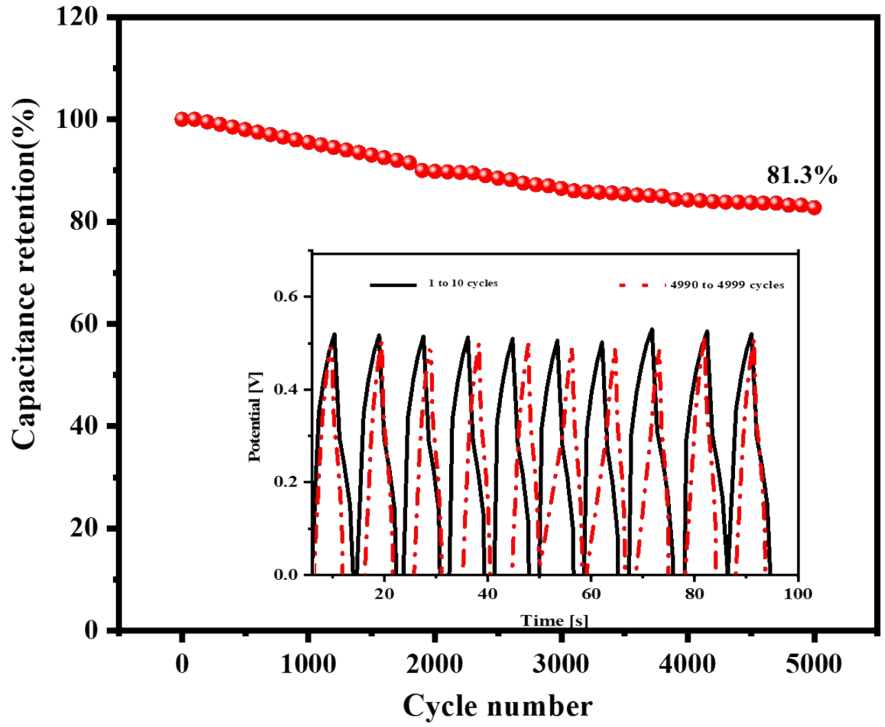

Fig S10. Percentage of Capacitance retention v/s. Cycle number of Cu/PDPA/NF with the comparison of first and last five cycles of 5000 cycles of the cyclic stability

Table S1. Comparison on of Electrolyte medium, Tafel slope & Overpotential of

	Electrolyte medium	**Tafel slope (mv dec^{-1})**	**Overpotential (mV)@10mAcm^{-2}**	**Reference**
CuONS	0.2M borate buffer	59	540	[5]
$(Co_{0.21}Ni_{0.25}Cu_{0.59})_2Se_2$	1MKOH	53	278	[6]
$Cu_3(BTC)_2$MOF	1MKOH	108	330	[7]
Fe_2O_3@CuO	1MKOH	41	398	[8]
Polycrystalline $Cu(OH)_2$	1MKOH	78	550	[9]
$CuFe_2O_4$	1MKOH	94	340	[10]
CuSe/NF	1MKOH	89	297	[11]
Cu_2Se/NF	1MKOH	62.4	200	[12]
Cu/PDPA/NF	1MKOH	47	320	**This work**

Cu/PDPA/NF in Oxygen Evolution reaction with other copper based electrocatalysts.

1. S. Liu, J. Xie, H. Li, Y. Wang, H. Y. Yang, T. Zhu, S. Zhang, G. Cao and X. Zhao, *Journal of Materials Chemistry A*, 2014, **2**, 18125-18131.
2. L. Zhang, W. Viola and T. L. Andrew, *ACS applied materials & interfaces*, 2018, **10**, 36834-36840.
3. W. Liu, C. Lu, H. Li, R. Y. Tay, L. Sun, X. Wang, W. L. Chow, X. Wang, B. K. Tay and Z. Chen, *Journal of Materials Chemistry A*, 2016, **4**, 3754-3764.
4. X. Zheng, L. Yao, Y. Qiu, S. Wang and K. Zhang, *ACS Applied Energy Materials*, 2019, **2**, 4335-4344.
5. S. M. Pawar, B. S. Pawar, B. Hou, J. Kim, A. T. A. Ahmed, H. S. Chavan, Y. Jo, S. Cho, A. I. Inamdar and J. L. Gunjakar, *Journal of Materials Chemistry A*, 2017, **5**, 12747-12751.
6. X. Cao, E. Johnson and M. Nath, *Journal of Materials Chemistry A*, 2019, **7**, 9877-9889.
7. H. Li, Y. Liu, F. He, H. Yang, Z. Li, Q. Zhou and K. Tang, *International Journal of Hydrogen Energy*, 2020, **45**, 21540-21546.
8. Y. Gao, N. Zhang, C. Wang, F. Zhao and Y. Yu, *ACS Applied Energy Materials*, 2019, **3**, 666-674.
9. S. Cui, X. Liu, Z. Sun and P. Du, *ACS Sustainable Chemistry & Engineering*, 2016, **4**, 2593-2600.
10. M. Li, Y. Xiong, X. Liu, X. Bo, Y. Zhang, C. Han and L. Guo, *Nanoscale*, 2015, **7**, 8920-8930.
11. B. Chakraborty, R. Beltrán-Suito, V. Hlukhyy, J. Schmidt, P. W. Menezes and M. Driess, *ChemSusChem*, 2020, **13**, 3222-3229.
12. W. Shi and J. Lian, *International Journal of Hydrogen Energy*, 2019, **44**, 22983-22990.

Reference