Electronic Supplementary Material (ESI) for Analytical Methods.

Supplementary Material

Label free electrochemical detection of cardiac biomarker Troponin T using $ZnSnO_3$ perovskite nanomaterials

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Annexure **A**

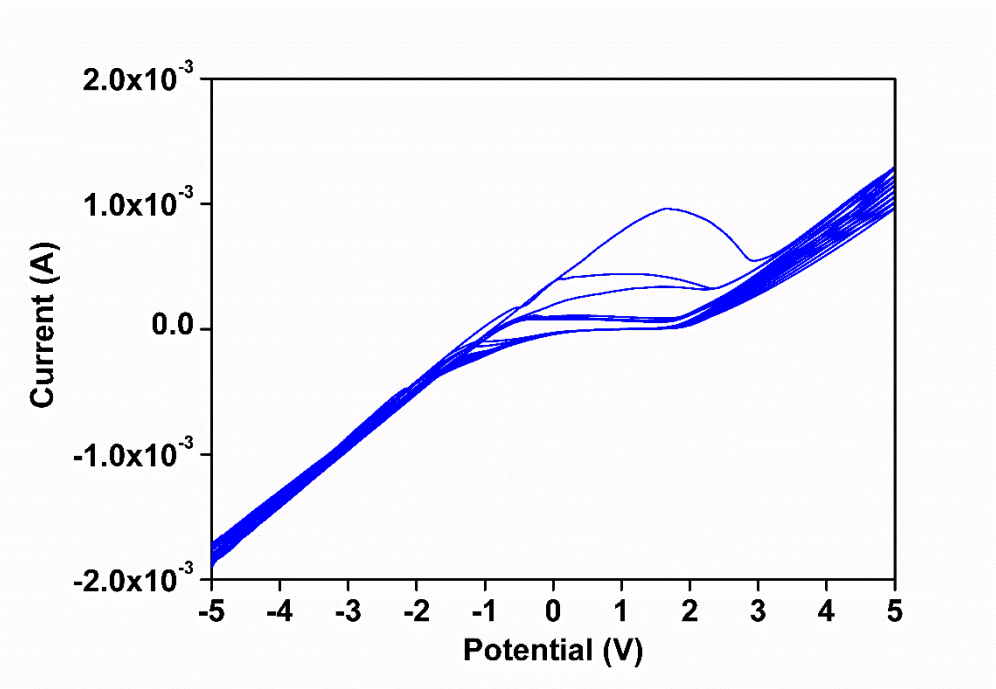


Figure 1. Cyclic voltammograms corresponding to electrochemical deposition of $ZnSnO_3$ thin films on to ITO/PET electrodes

Annexure **B**

Stability analysis of the thinfilm coated working electrodes:

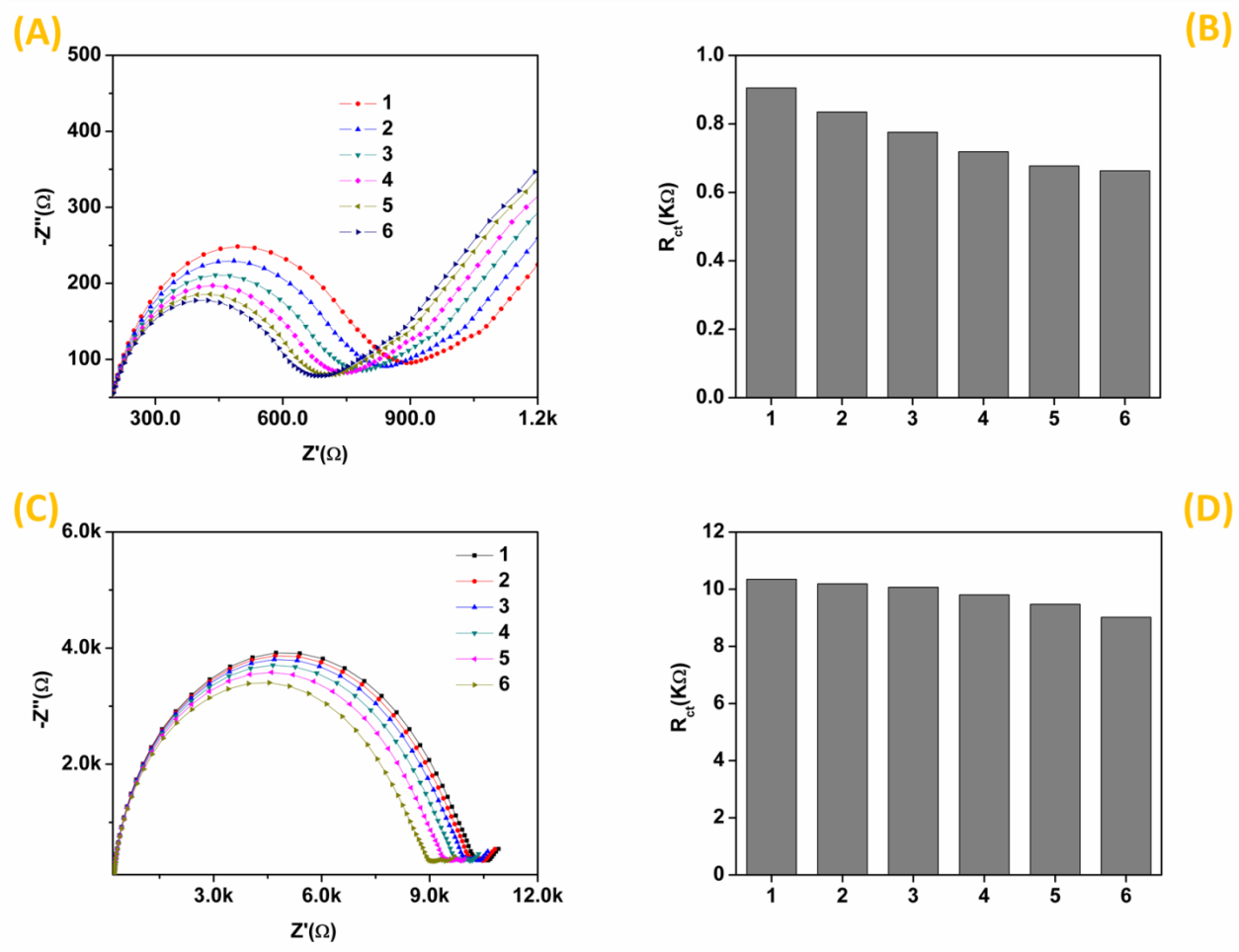


Figure 2: Stability analysis of working electrodes: Nyquist plots for nanomaterial coated GCE (A) and ITO/PET (C) electrodes for 6 washing cycles ; Bar diagram showing the variation in charge transfer resistance of the nanomaterial coated GCE (B) and ITO/PET (D) electrodes corresponding to the Nyquist plots shown in (A) and (C), respectively.

Annexure **C**

XRD analysis of electrodeposited $ZnSnO_3$ thin film:

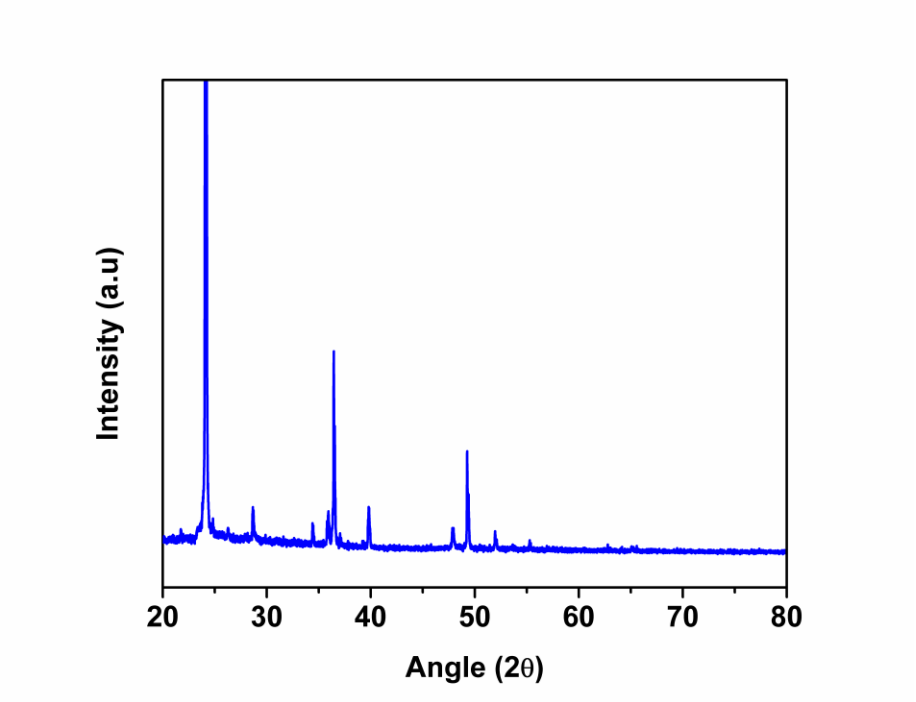


Figure 3: XRD analysis of electrodeposited $ZnSnO_3$ thin film

The above figure shows results for the X-ray diffraction spectroscopy analysis of the electrodeposited Zinc Tin Oxide ($ZnSnO_3$) thin films. The figure shows the presence of distinct peaks corresponding to characteristic crystallographic planes (200), (013), (311), (222), (400), and (042) of $ZnSnO_3$ against respective 2Θ positions, which confirms the synthesis of the desired nanomaterial.

EDX analysis of electrodeposited $ZnSnO_3$ thin film:

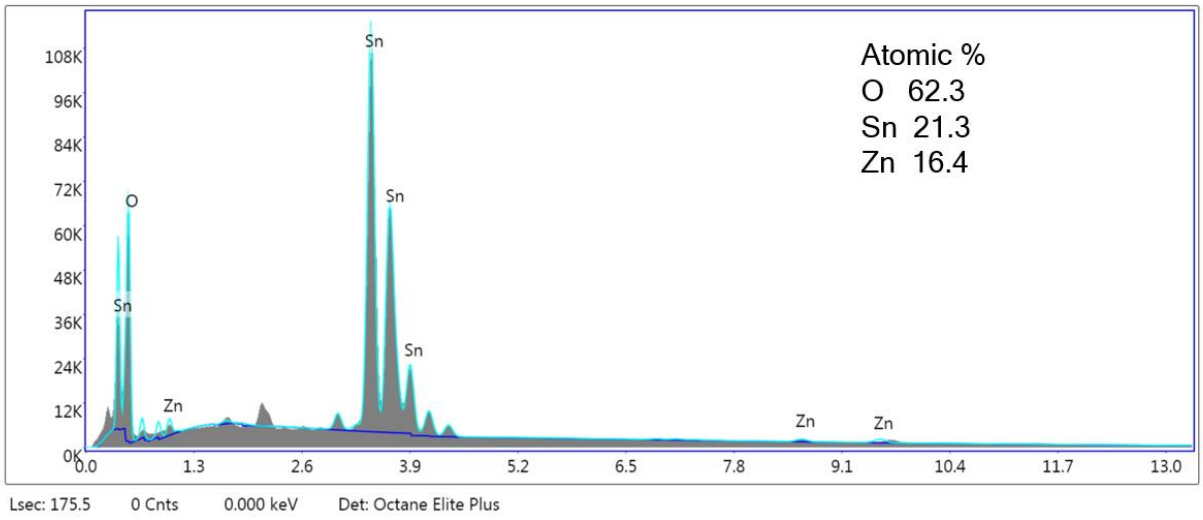


Figure 4: EDX analysis of electrodeposited $ZnSnO_3$ thin film

The above figure shows results for the EDX analysis of the electrodeposited Zinc Tin Oxide ($ZnSnO_3$) thin films. The compositional analysis shows the presence of oxygen (62.3%), tin (21.3%) and zinc (16.4%).

FTIR Spectroscopy of pristine and MPA treated $ZnSnO_3$ thin film:

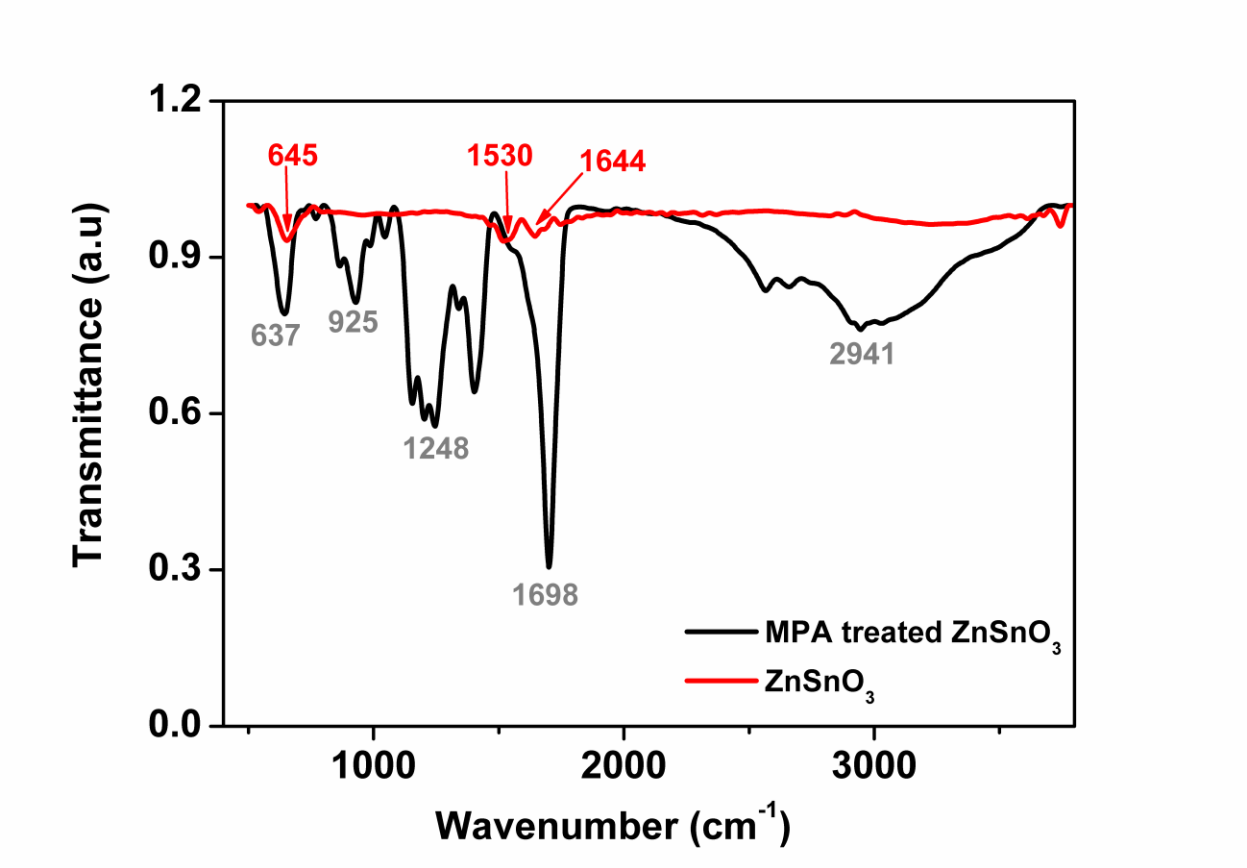


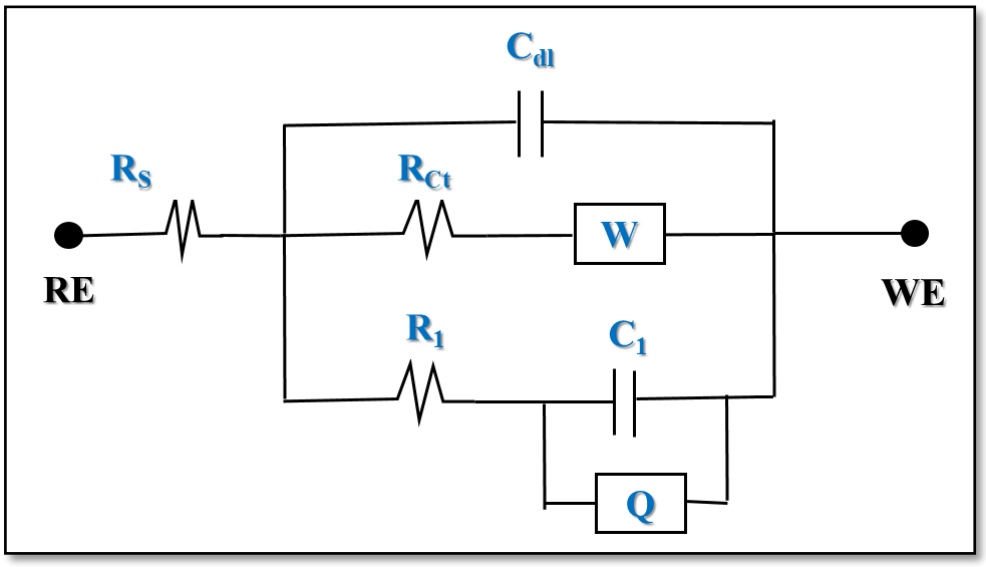
Figure 5: FTIR analysis of pristine and MPA treated $ZnSnO_3$

The above figure shows the FTIR spectrum of Zinc Tin Oxide ($ZnSnO_3$) and Mercaptopropionic acid treated $ZnSnO_3$ nanomaterial. For the pristine $ZnSnO_3$ nanomaterial, the FTIR analysis shows the presence of characteristic peaks at 645 cm^{-1}. For the MPA treated $ZnSnO_3$, broad peak in the range2200-3500 cm^{-1} confirms the presence of –OH bond. Further, single peak at 1698 cm^{-1} is due to -C=O bond stretching and vibrations. Multiple peaks in the range 1000 to 1500 cm^{-1} ensures –C-O bond vibrations. Presence of the above peaks in the FTIR spectrum of the MPA treated nanomaterial confirms the surface functionalization with –COOH functional groups.

Annexure **D**

Electrical Modelling of the electrochemical response:

Equivalent Circuit:



The circuit shown above is a modified Randles equivalent electrical circuit for the detection of Troponin T by binding anti-troponin T antibody, where,

R_s = Solution Resistance

C_{dl} = Double layer capacitance at the interface of electrolyte and electrode

R_{ct} = Charge transfer resistance

W = Warburg impedance

Q = Constant phase element

R_1 = Additional resistance

C_1 = Additional Capacitance

Extracted parameters:

Table1: Extracted parameters for GCE/$ZnSnO_3$

	R_S (Ω)	**R_{ct} (KΩ)**	**C_{dl} (nF)**	**W (Ω)**	**R_2 (Ω)**	**Q (μ)**	**C_2 (nF)**	**Error(%)**
Anti-Tpn-T	158	12.12	356.1	0.000896	208	11.69	210.7	2.5
1 fg/mL	78.6	26.1	354.4	0.000176	981.6	2.893	69.4	1.1
10 fg/mL	82.02	29.97	374.7	0.001656	1174	2.646	77.3	1.2
100 fg/mL	82.44	35.16	374.8	0.001255	1244	2.483	76.41	1.8
1 pg/mL	80.25	38.86	376.5	0.001369	1382	2.266	78.93	1.69
10 pg/mL	81.92	41.56	376.9	0.001964	1587	2.053	79.23	1.26
100 pg/mL	84.79	44.39	374	0.001977	1717	1.932	78.07	1.272
1 ng/mL	82.54	45.82	371	0.001875	1665	1.941	75.85	1.249
10 ng/mL	82.37	48.5	368.8	0.001939	1674	1.907	74.49	1.208
100 ng/mL	81.53	48.22	364.7	0.001986	1683	1.85	72.16	1.178
1 μg/mL	84.48	48.46	365.2	0.002277	1706	1.845	72.4	1.147

Table2: Extracted parameters for ITO/$ZnSnO_3$

	R_S (KΩ)	**R_{ct} (KΩ)**	**C_{dl} (nF)**	**W (Ω)**	**R_2 (KΩ)**	**Q (μ)**	**C_2 (nF)**	**Error(%)**
Anti-Tpn-T	9.731	21.64	15.19	0.0008009	3.548	1.681	102.8	1.3
1 fg/mL	9.593	27.59	16.66	0.0001047	3.433	3.231	118.2	2.4
10 fg/mL	10.236	33.22	18.23	0.0002069	4.129	2.569	120.6	2.1
100 fg/mL	10.892	48.23	20.87	0.0002165	4.846	2.491	122.8	2.7
1 pg/mL	12.79	62.85	22.06	0.0005212	5.484	2.444	124.9	3.01
10 pg/mL	12.97	69.16	23.33	0.000287	5.537	2.33	120.4	3.02
100 pg/mL	13.45	81.79	29.4	0.0003247	6.495	2.052	158.9	3.7
1 ng/mL	13.97	87.29	33.91	0.0002831	7.234	1.92	177.2	3.87
10 ng/mL	13.71	90.91	36.04	0.0002203	7.475	1.864	187.9	3.9
100 ng/mL	14.07	94.86	38.27	0.0002731	7.774	1.809	199.5	3.98
1 μg/mL	14.41	98.85	39.73	0.0002813	7.903	1.731	210.2	4.01