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


# Supplementary Information

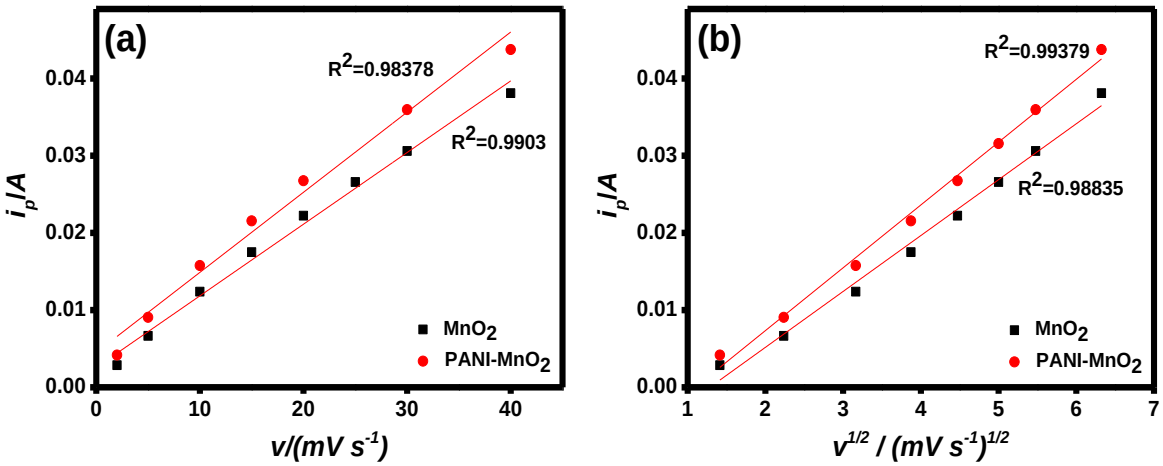
## Synthesis and Electrochemical Evaluation of PANI/δ-$MnO_2$ Electrode for High Performing Asymmetric Supercapacitors

Izan Izwan Misnon* and Rajan Jose**

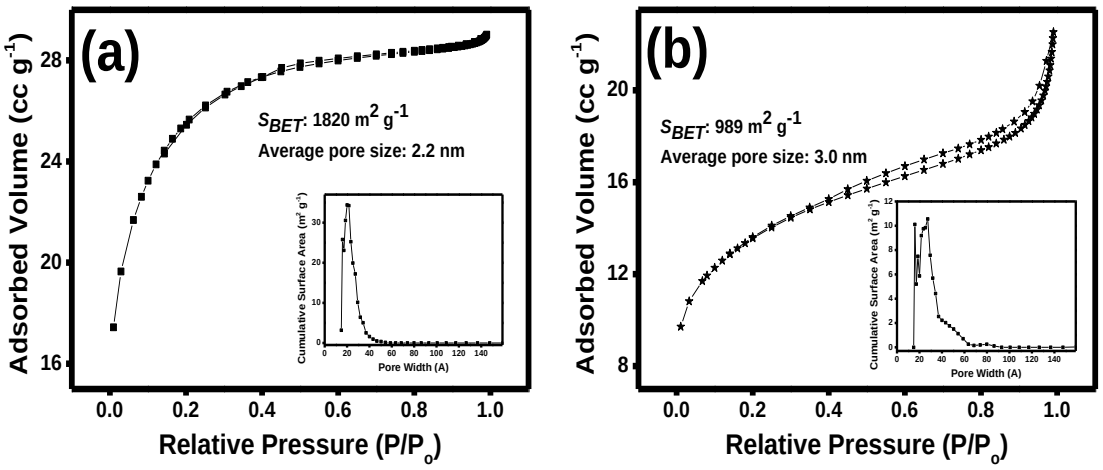
Nanostructured Renewable Energy Materials Laboratory, Faculty of Industrial Sciences & Technology; Universiti Malaysia Pahang, 26300 Kuantan, Malaysia

E-mail: * iezwan@ump.edu.my(I.I. Misnon); **rjose@ump.edu.my (R. Jose)

**S1**. Anodic peak current ($i_p$) as a function of (a) scan rate and (b) square root scan rate in 6M KOH. Both plot show linear increment of peak current as scan rate is increase.



**S2.**The nitrogen adsorption–desorption isotherm for (a) AC and (b) OMC and porosity analysis for (c) AC and (d) OMC.



**S3.**The calculation of mass ratio for ASC cell fabrication and theoretical $C_S$ from individual CV analysis. (calculation not using Eq. 7 as the electrode is purposely for making full cell device)

| **Anode** | **$C_S$ of anode at 10 mV $s^{-1}$ (F $g^{-1}$)** | **Cathode** | **$C_S$ of cathode at 10 mV $s^{-1}$ (F $g^{-1}$)** | **Mass ratio ($m_-/m_+$)** |
|---|---|---|---|---|
| PANI-$MnO_2$ | 606 | AC | 177 | 1.34 |
| | | OMC | 180 | 1.32 |

**Mass ratio for PANI-$MnO_2$//AC**

$$\frac{m_-}{m_+} = \frac{C_{S+} \times \Delta V_+}{C_{S-} \times \Delta V_-}$$

$$\frac{m_-}{m_+} = \frac{606(F/g) \times 0.45V}{177(F/g) \times 1.15V}$$

$$\frac{m_-}{m_+} = \frac{606(F/g) \times 0.45V}{177(F/g) \times 1.15V}$$

$$\frac{m_-}{m_+} = 1.34$$

**Theoretical $C_S$ for PANI-$MnO_2$//AC**

$$\frac{1}{C_{total}} = \frac{1}{C_+} + \frac{1}{C_-}$$

$$\frac{1}{C_{total}} = \frac{1}{606(F/g))} + \frac{1}{177(F/g)}$$

$$\frac{1}{C_{total}} = \frac{(177+606)(F/g)}{107262(F/g)^2} = \frac{783}{107262(F/g)}$$

$$C_{total} = 137(F/g)$$

# Supplementary Information

**Table S1.** Extracted data for surface PCs and total PCs on each electrode.

| **Electrode** | **Surface PCs contribution (F $g^{-1}$)** | **Total PCs (F $g^{-1}$)** | **Surface PCs contribution (%)** |
|---|---|---|---|
| $MnO_2$ | 136 | 157 | 87 |
| PANI–$MnO_2$ | 223 | 420 | 54 |

# Supplementary Information

**Table S2.** Ion radius, solvated ion radius, molar conductivity and ionic mobility of electrolyte ions.

| **Ion** | **Ion Radius (Å)** | **Solvated ion Radius (Å)** | **Molar conductivity (cm2 Ω-1 mol-1)** | **Ionic mobility (μ 10-5 cm2 s-1 v-1)** |
|---|---|---|---|---|
| $Na^+$ | 0.95 | 3.58 | 50.1 | 5.2 |
| $K^+$ | 1.33 | 3.31 | 73.5 | 7.6 |
| $SO_4^{2-}$ | - | 3.79 | 79.8 | 8.3 |
| $OH^-$ | - | 3.00 | 198 | 20.6 |

**Table S3.** Effect of PANI on the electrode resistance at current density 1 A $g^{-1}$.

| **Electrode** | **IR drop (mV)** | **Resistance (Ω)** |
|---|---|---|
| $MnO_2$ | 9.56 | 1.08 |
| PANI–$MnO_2$ | 3.00 | 0.86 |