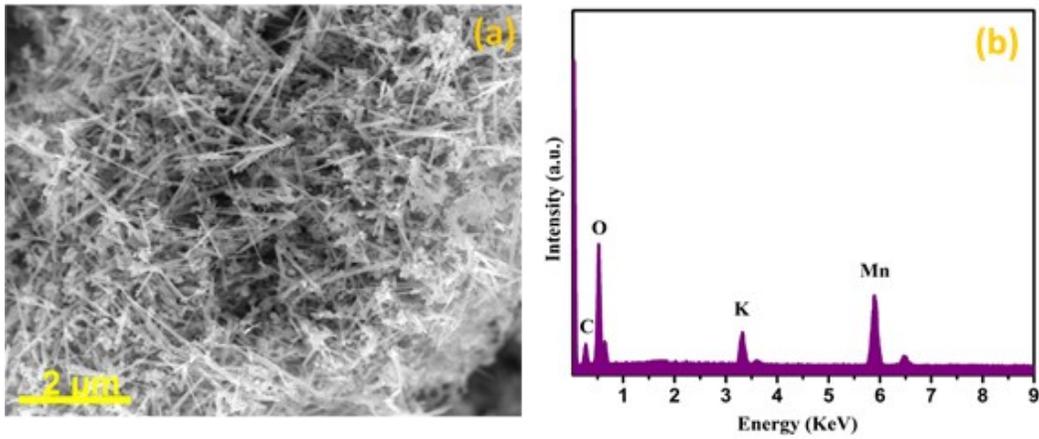
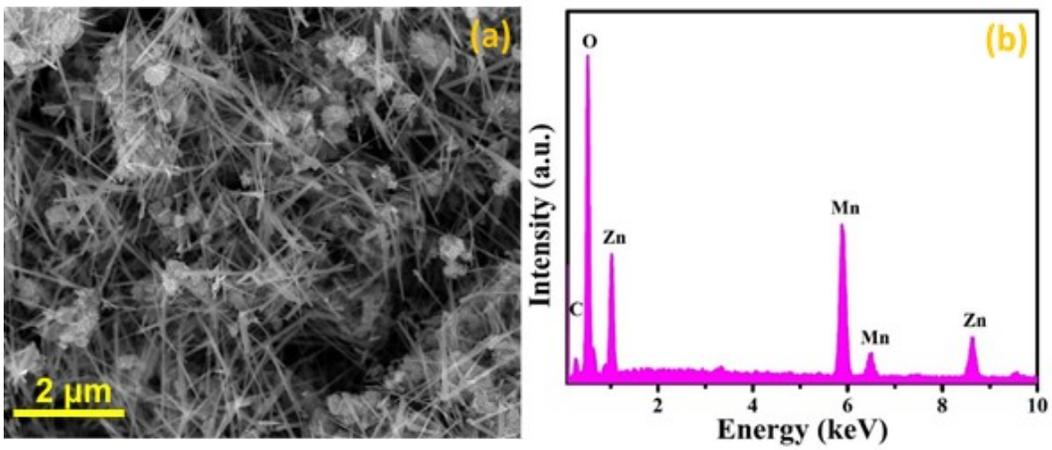


## **Supplementary information**

**Synergistic Effect of one-dimensional MnO<sub>2</sub>/ZnO binary nanocomposite as an advanced electrode for high energy density and stable asymmetric supercapacitor**



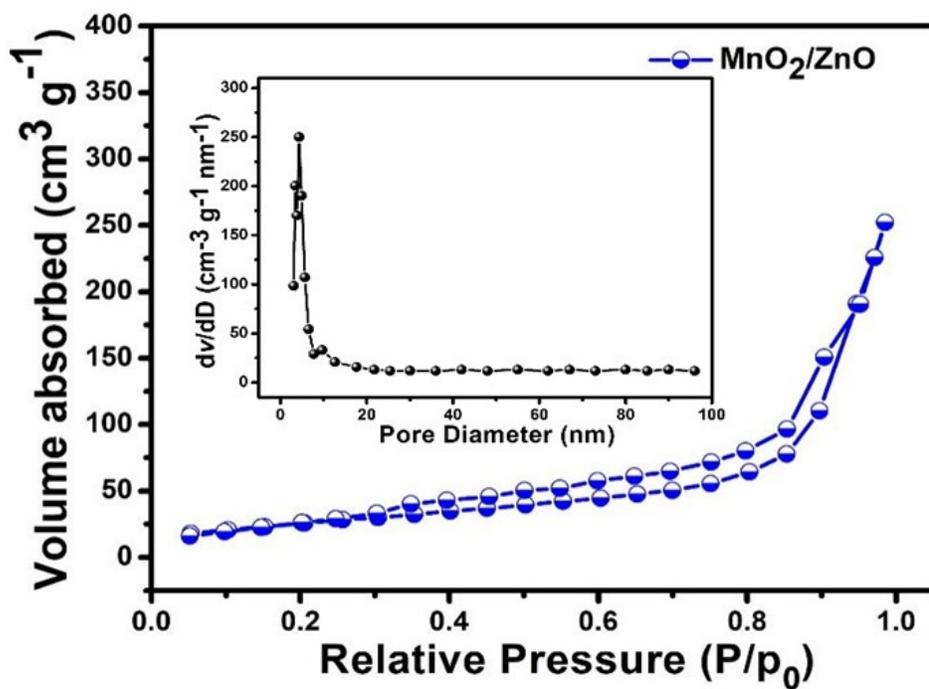
**Fig. S1.** (a) SEM images of MnO<sub>2</sub> at low magnification (b) EDX of MnO<sub>2</sub> nanostructure.



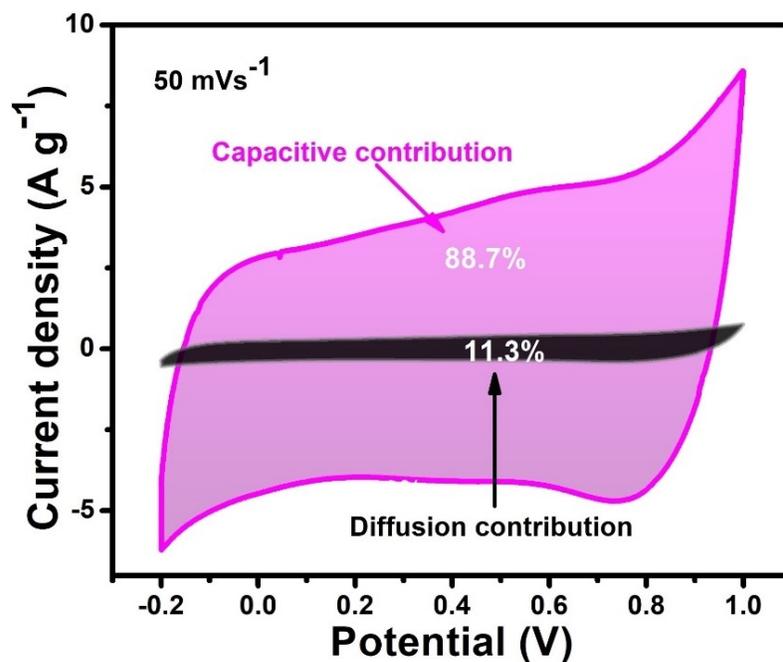
**Fig. S2.** (a) SEM images of MnO<sub>2</sub>/ZnO at low magnification (b) EDX of MnO<sub>2</sub>/ZnO nanostructure.

**Table. S1.** Shows the specific elemental content (wt%) of each constituent element in the  $\alpha$ -MnO<sub>2</sub>/ZnO structure.

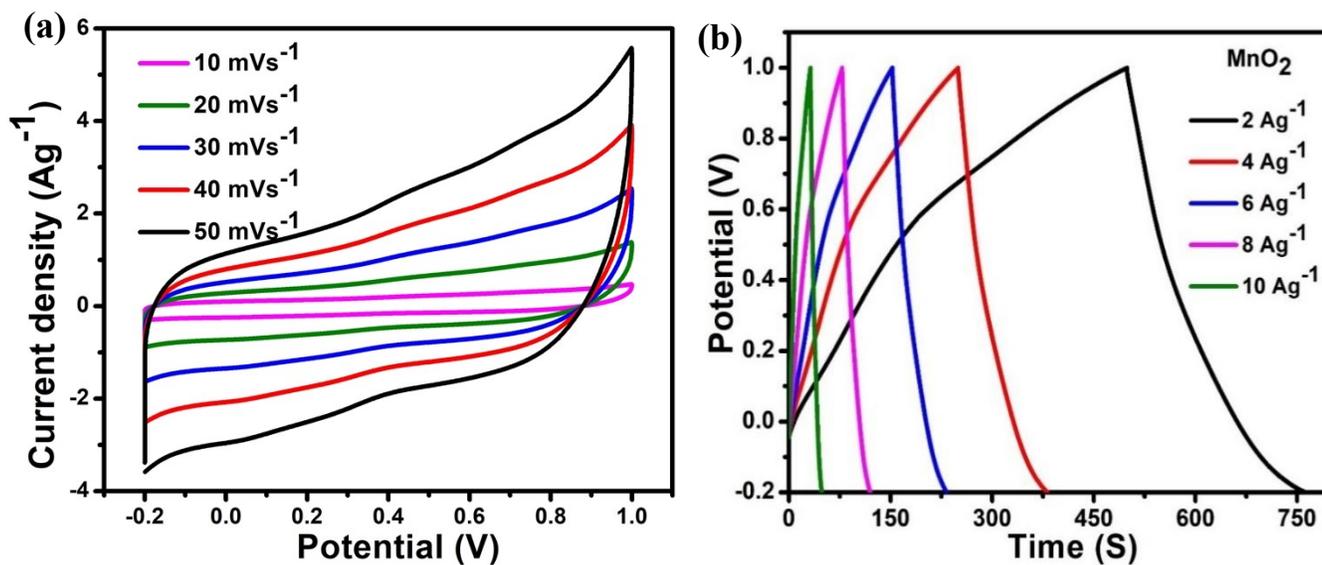
Elements	Wt%
O	34.4
Mn	46.5
Zn	15.6
C	3.5



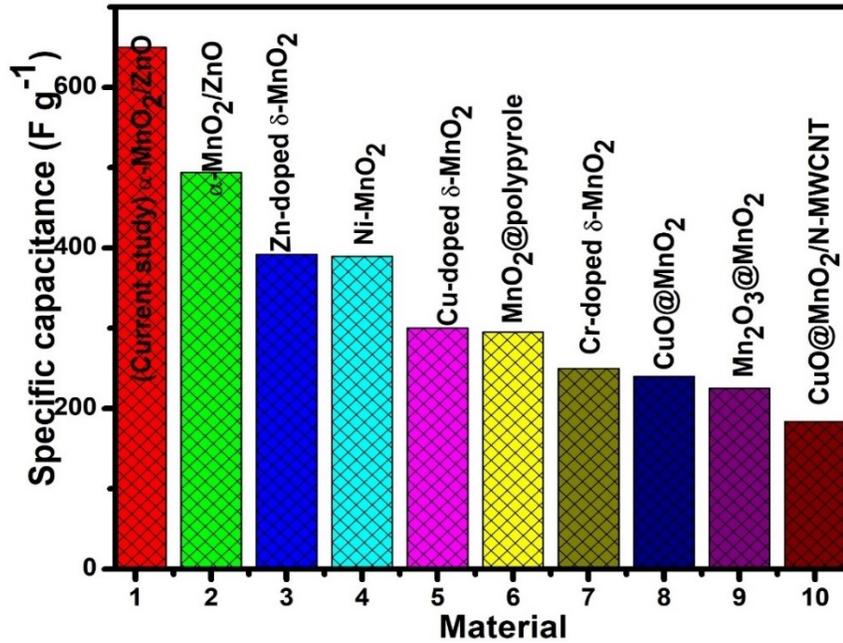
**Fig. S3.** Nitrogen adsorption-desorption isotherm of  $\alpha$ -MnO<sub>2</sub>/ZnO structure (inset shows the corresponding pore size behavior).



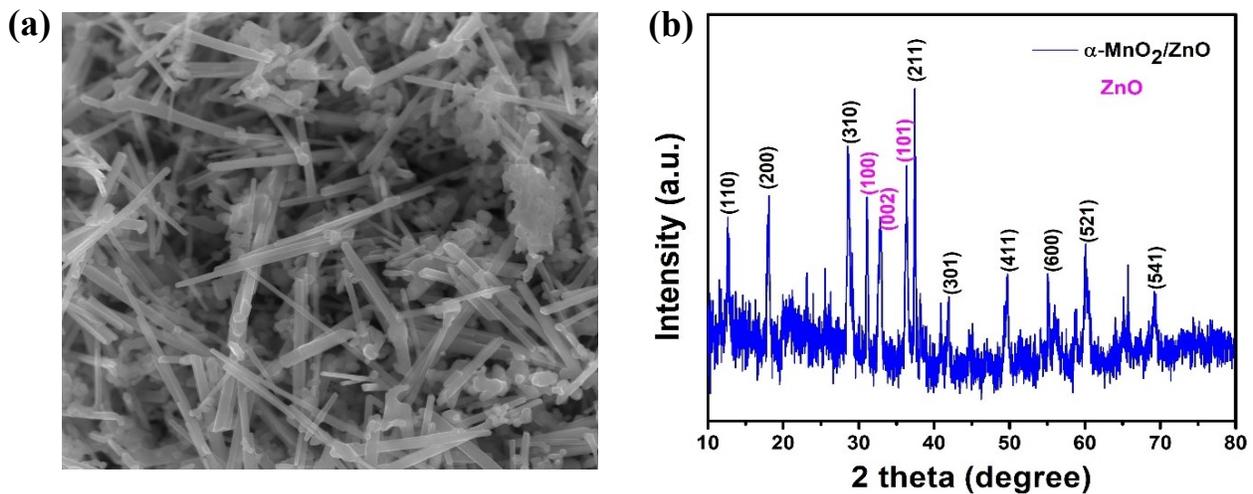
**Fig.S4.** Capacitive contribution (purple) and diffusion contribution (black) ratio of  $\alpha$ - $\text{MnO}_2/\text{ZnO}$  electrode at  $50 \text{ mVs}^{-1}$ .



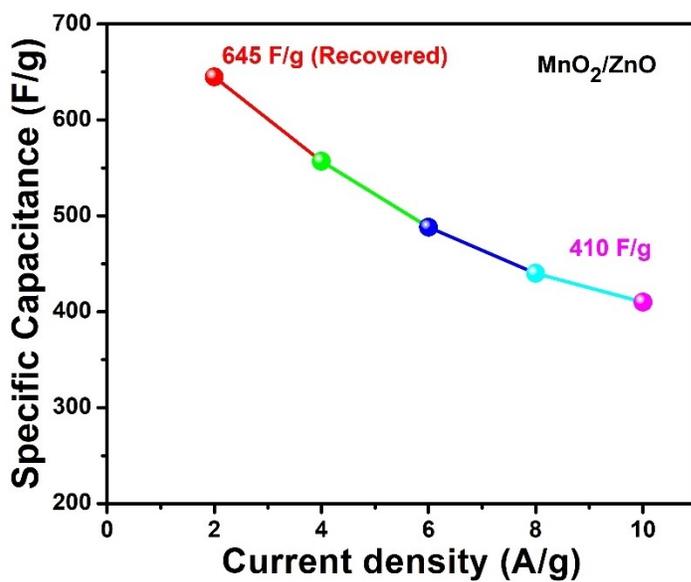
**Fig. S5.** (a) CV response pristine  $\text{MnO}_2$  electrode at 10 to  $50 \text{ mV s}^{-1}$  (b) GCD curves of  $\alpha$ - $\text{MnO}_2$  electrode at 2 to  $10 \text{ A g}^{-1}$ .



**Fig. S6.** Comparative analysis of specific capacitance between previously reported MnO<sub>2</sub>-based work and current research work (α-MnO<sub>2</sub>/ZnO).



**Fig. S7.** (a) SEM image of α-MnO<sub>2</sub>/ZnO structure after 6000<sup>th</sup> cycles test (b) XRD pattern of α-MnO<sub>2</sub>/ZnO structure after 6000<sup>th</sup> cycles test.



**Fig.S8.** The specific capacitance of  $\alpha$ -MnO<sub>2</sub>/ZnO electrode after high current to low current.

**Table. S2.** The table shows that the electrode's mean capacitance decreases with increasing current density, with SD and SE.

Current density (A/g)	Mean capacitance (F/g)	SD (F/g)	SE (F/g)
2	500	±132.3	±76.4
4	436.7	±104.1	±60.1
6	386.7	±90.2	±52.1
8	331.7	±83.4	±48.2
10	290.0	±75.4	±42.8

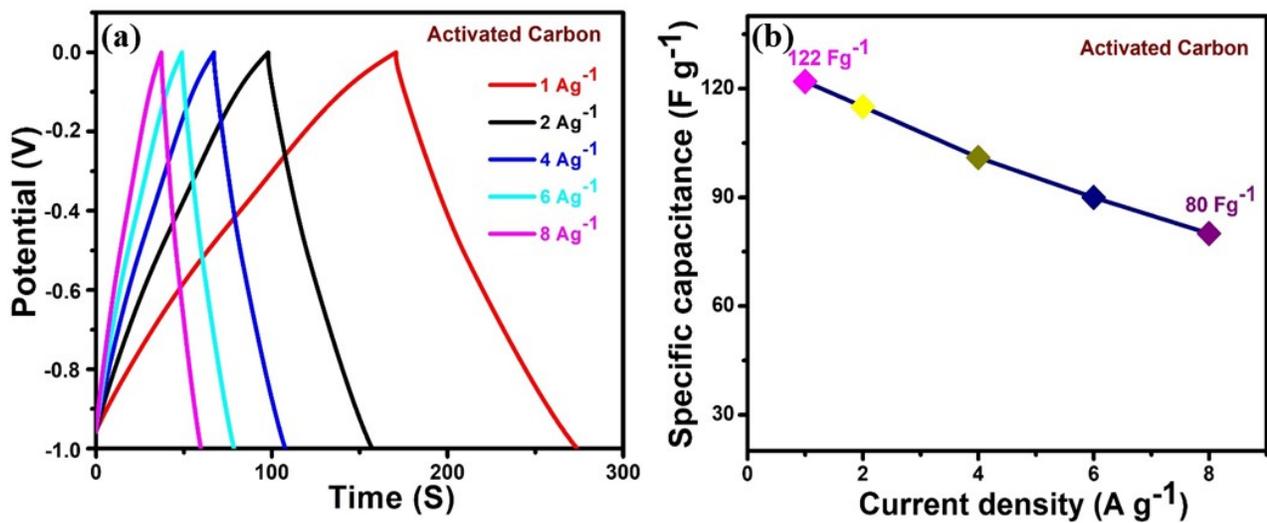


Fig. S9. (a) GCD response of AC electrode at current density of 1, 2, 4, 6 and 8 A g<sup>-1</sup> (b) corresponding specific capacitance of AC electrode.

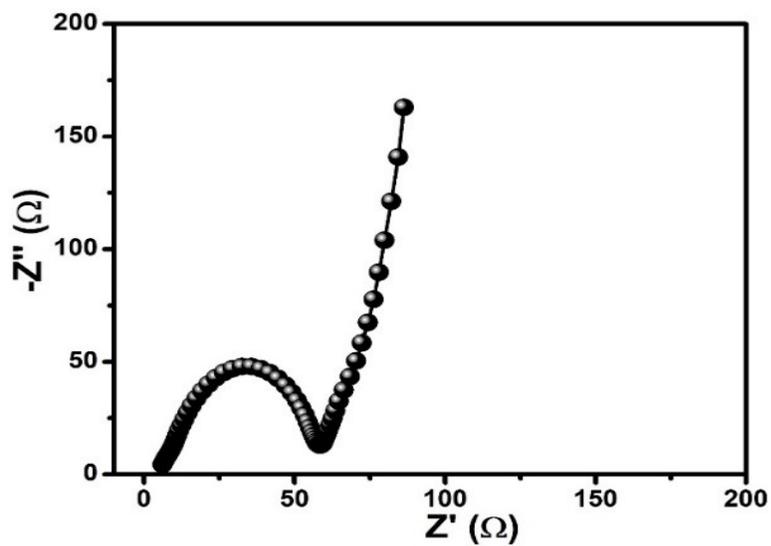


Fig. S10. Nyquist plot of the fabricated device

**Table. S3.** Comparative analysis of kinetic parameters of  $\alpha$ -MnO<sub>2</sub> and  $\alpha$ -MnO<sub>2</sub>/ZnO electrodes.

<b>Material</b>	<b>R<sub>s</sub> (<math>\Omega</math>)</b>	<b>R<sub>ct</sub> (<math>\Omega</math>)</b>
$\alpha$ -MnO <sub>2</sub> /ZnO	0.8	92.5
$\alpha$ -MnO <sub>2</sub>	1.6	140.5