Supplementary Information (SI) for Journal of Materials Chemistry A.
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Supporting Information

Stabilization of various phases of MnO_2 for affordable supercapacitor

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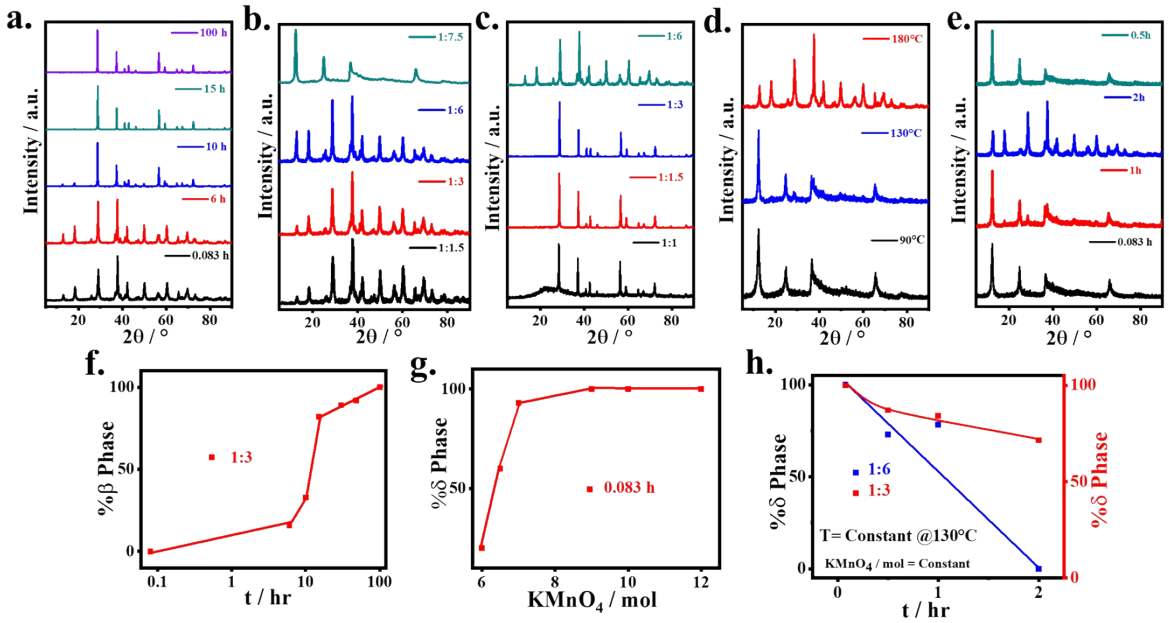

Figure S1. (a) XRD patterns of MnO_2 samples synthesized at 180 °C with increasing reaction time at a $KMnO_4$:APS molar ratio of 1:3. (b) XRD patterns of samples prepared at 180 °C and 0.083 hours with varying precursor concentration ratios. (c) XRD patterns of samples synthesized at 180 °C and 15 h with varying precursor concentration ratios. (d) XRD patterns of samples synthesized at different temperatures while maintaining constant concentration ratio (1:3) and reaction time (1 hour). (e) XRD patterns of samples synthesized at 130 °C with increasing reaction time at 1:6 molar ratio. (f) Variation in the percentage of β-MnO_2 with respect to α-MnO_2 at a constant temperature (180 °C) and concentration ratio (1:3). (g) Variation in the percentage of δ-MnO_2 with respect to α-MnO_2 at a constant temperature (180 °C) and reaction time (0.083 h) (h) Variation in the percentage of δ-MnO_2 with respect to α-MnO_2 at constant temperature (180 °C) and concentration ratio (1:3).

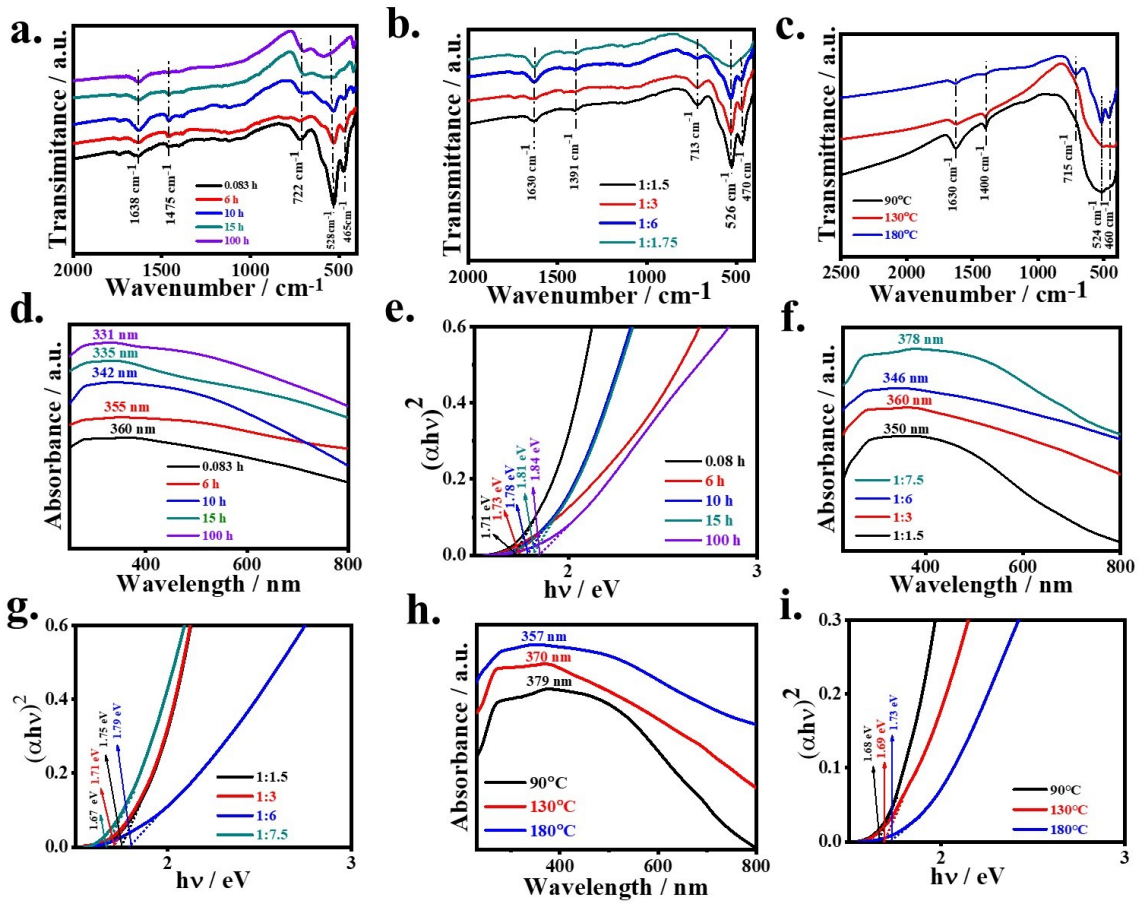

Figure S2: (a) FTIR Spectra of MnO_2 samples synthesized at 180 °C with increasing reaction time at 1:3. (b) FTIR patterns of samples prepared at 180 °C and 0.083 h with varying precursor concentration ratios (c) FTIR Spectra of samples synthesized at different temperatures while maintaining constant concentration ratio (1:3) and reaction time (1 h). (d) UV Spectra of samples prepared at 180 °C and 0.083 h with varying precursor concentration ratios (e) Tauc plots of samples prepared at 180 °C and 0.083 h with varying precursor concentration ratios (f) UV patterns of samples prepared at 180 °C and 0.083 h with varying precursor concentration ratios (g) Tau plot of samples prepared at 180 °C and 0.083 h with varying precursor concentration ratios (h) UV Spectra of samples synthesized at different temperatures while maintaining constant concentration ratio (1:3) and reaction time (1 h) (i) Tau plot of samples synthesized at different temperatures while maintaining constant concentration ratio (1:3) and reaction time (1 h).

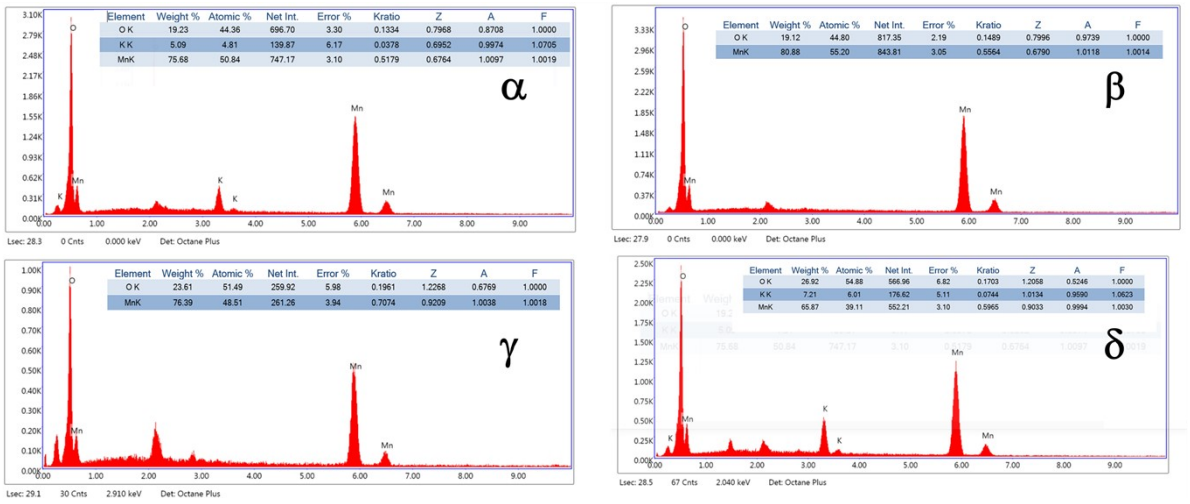

Figure S3: represents the EDS of α-,β-,γ- and δ-MnO_2 respectively.

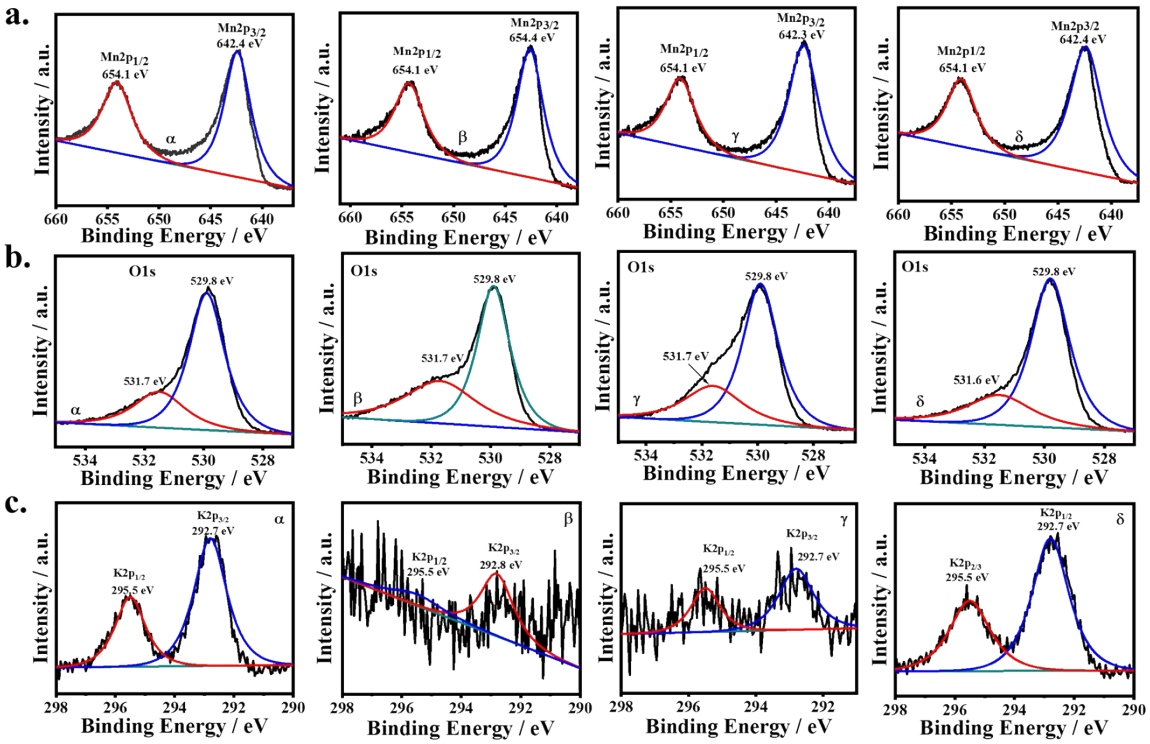

Figure S4: (a) Deconvoluted Mn2p XPS spectra, (b) deconvoluted O1s XPS spectra, and (c) deconvoluted K2p XPS spectra of α-, β-, γ-, and δ-MnO_2 phases.

Table S1.

Element	XPS (%)				EDS (%)			
	α	β	γ	δ	α	β	γ	δ
Mn	6.29	11.62	14.37	10.54	50.84	55.20	51.49	39.11
O	56.42	49.37	56.32	53.60	44.34	44.80	48.51	54.88
K	0.10	<1	<1	0.56	4.81	-	-	6.01

Table S1 shows the atomic percentage of elements from XPS and EDS

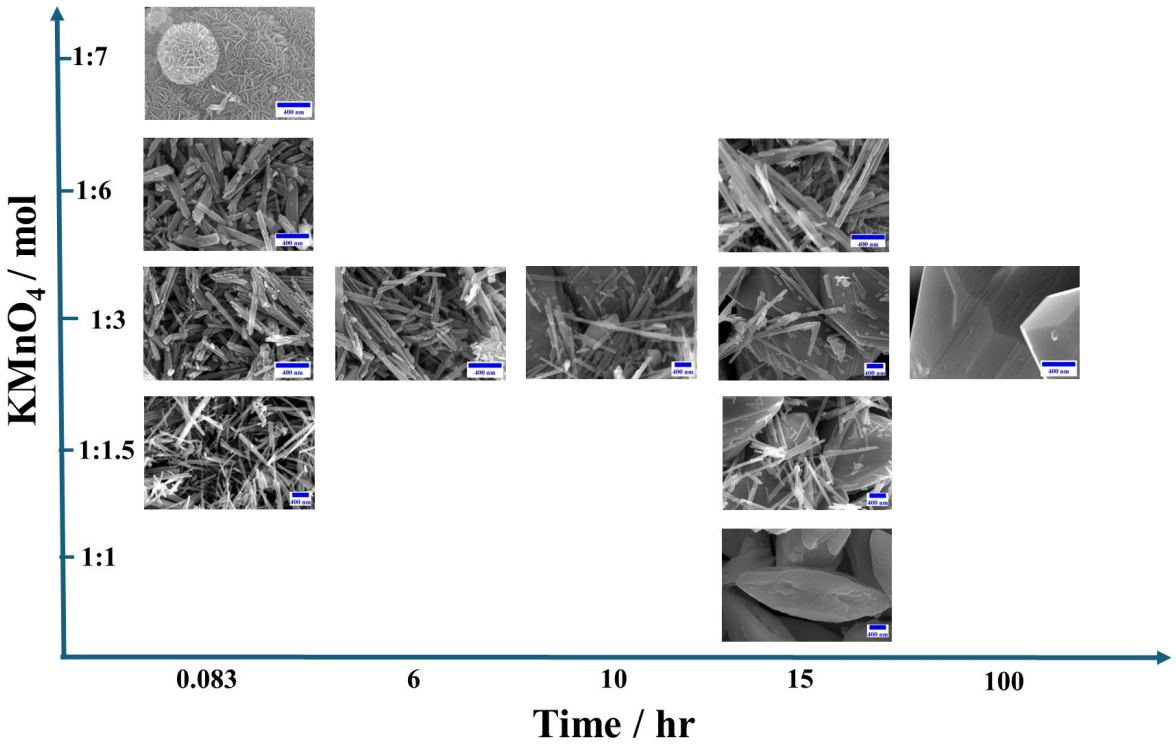

Figure S5 : Represents the variation of morphology with respect to time and concentration.

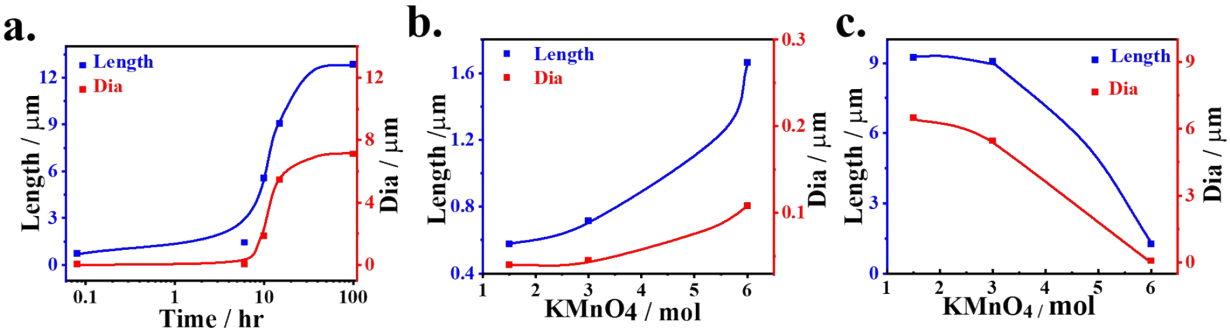

Figure S6 : (a) represents the variation of length and diameter with respect to time at constant temperature (180 °C) and molar ratio (1:3).(b) represents variation length and dia with respect to concentration at constant temperature(180 °C) and time (0.083 h) (c)represents variation length and dia with respect to concentration at constant temperature(180 °C) and time (15hr)

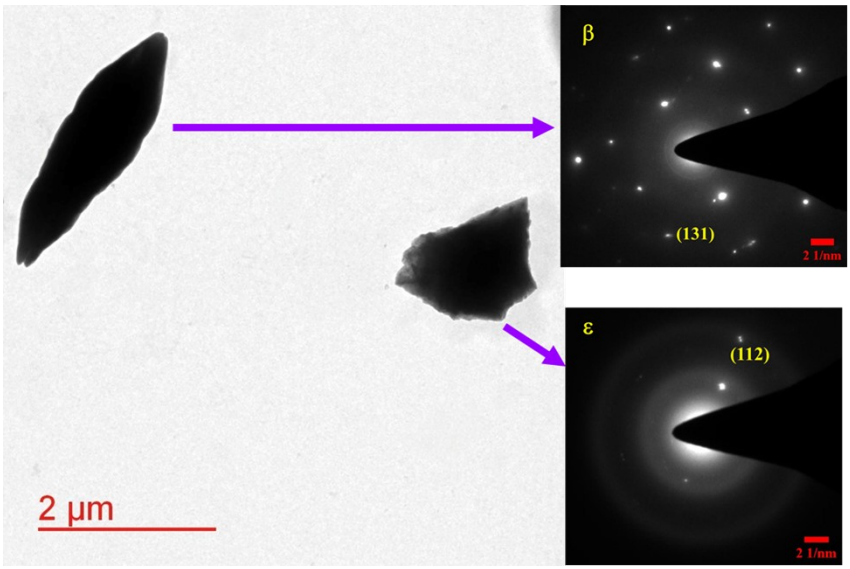

Figure S7: Represent Tem analysis of β-MnO2 with 40% ε-MnO_2.

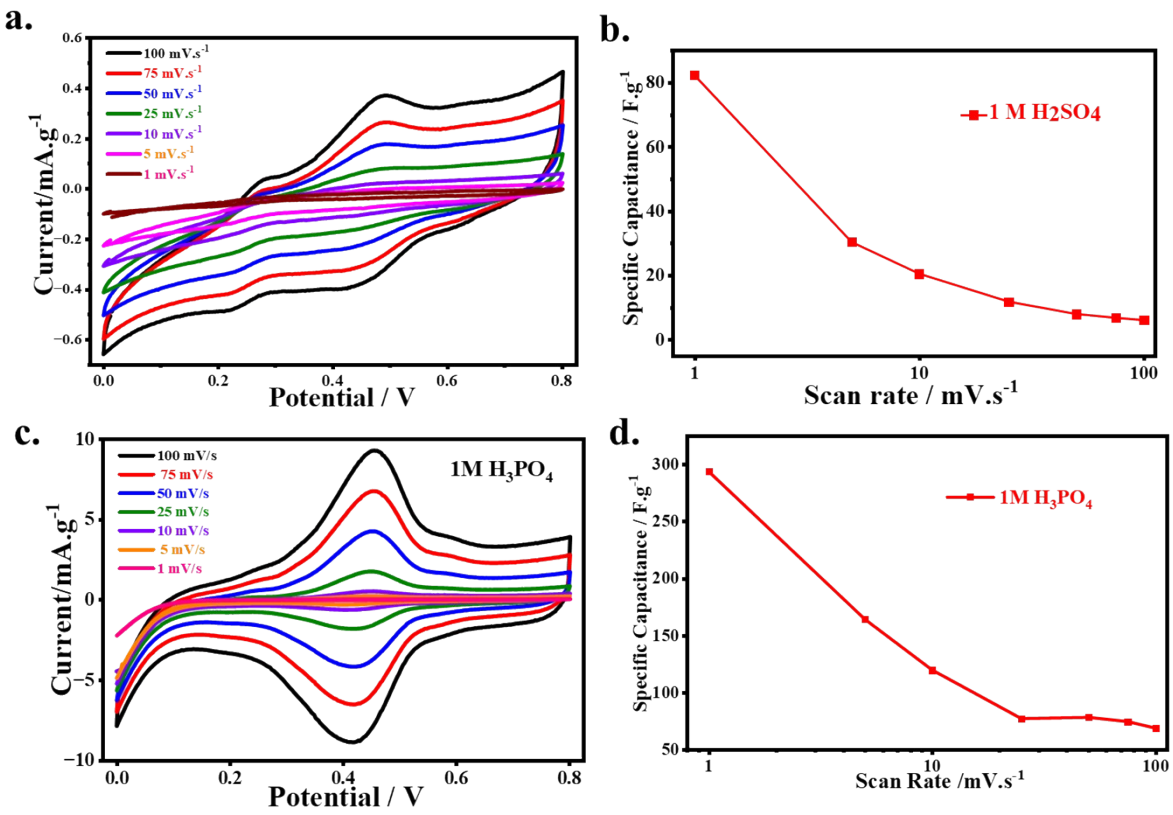

Figure S8: (a) Cyclic voltammetry of γ-MnO_2 electrode in 1M H_2SO_4 (b) Specific capacitance of γ-MnO_2 electrode in 1M H_2SO_4 with respect to scan rate (c) Cyclic voltammetry of γ-MnO_2 electrode in 1M H_3PO_4 (d) Specific capacitance of γ-MnO_2 electrode in 1M H_3PO_4 with respect to scan rate

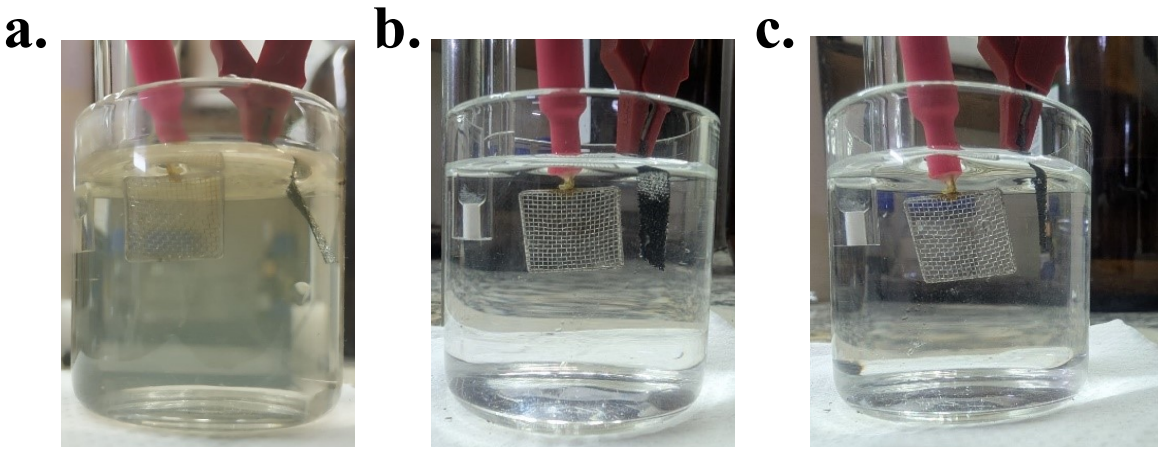

Figure S9: (a) image of solution showing coloration from electrolyte of 1M H_2SO_4 showing light yellow colour; (b) image of solution showing no coloration from electrolyte of 1M H_3PO_4; and (c) image of solution showing no coloration from electrolyte of 1M Na_2SO_4.

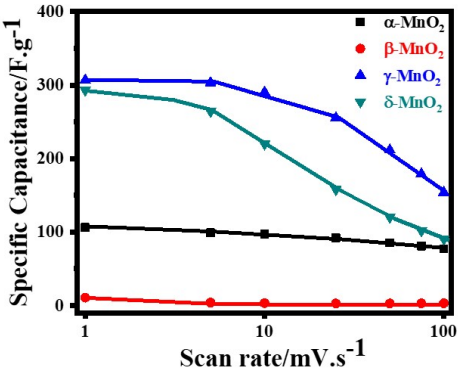

Figure S10: Represent scan rate dependency of polymorphs of MnO_2.

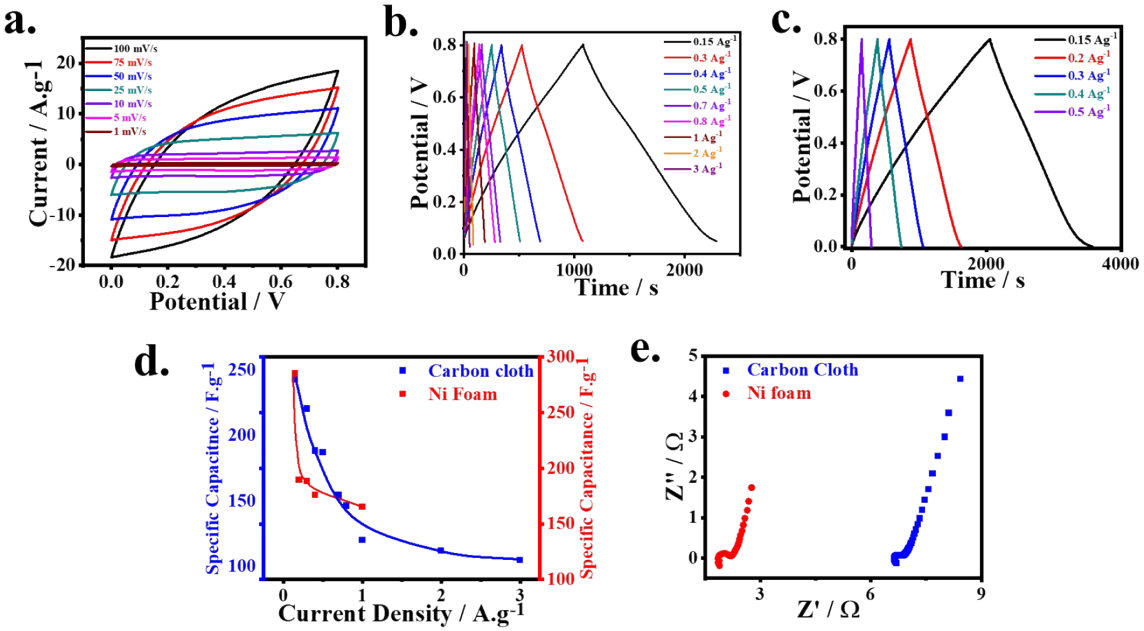

Figure S11: (a) Represents the CV of γ-MnO_2 using Ni foam as the current collector. (b) Represents the GCD of γ-MnO_2 using carbon cloth as the current collector. (c) Represents the GCD of γ-MnO_2 using Ni foam as the current collector. (d) Represents the specific capacitance of γ-MnO_2 as a function of current density using carbon cloth and Ni foam as current collectors. (e) Represents the EIS spectra of γ-MnO_2 using carbon cloth and Ni foam as current collectors.

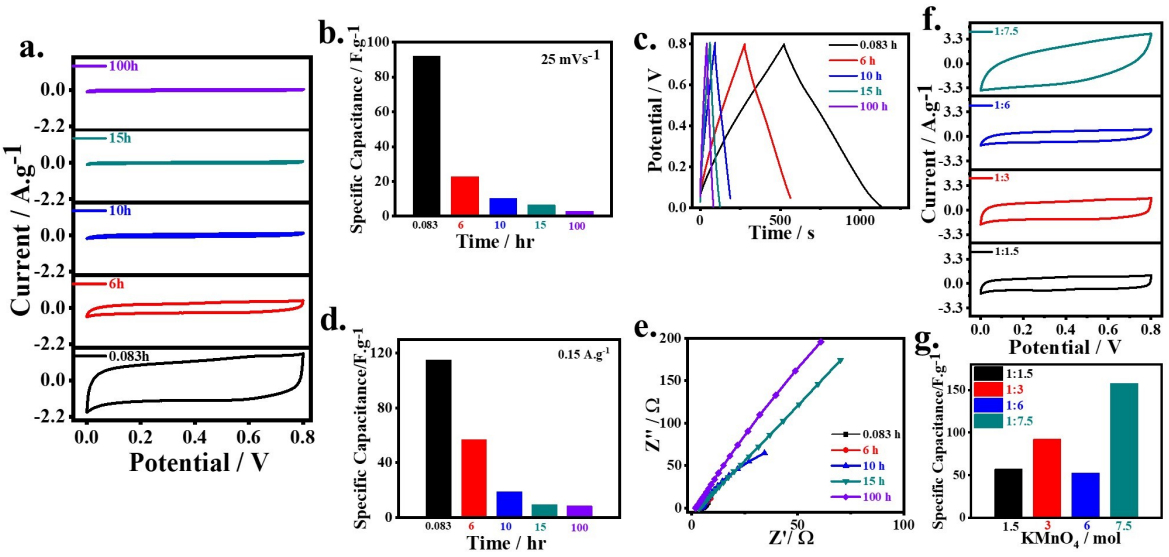

Figure S12: (a) Represents the CV of MnO_2 samples synthesized at 180 °C with increasing reaction time at a molar ratio of 1:3. (b) Represents the specific capacitance with respect to reaction time at a constant temperature (180 °C) and concentration ratio (1:3) at a scan rate of 25 mV s^{-1}. (c) Represents the GCD curves with respect to reaction time at a constant temperature (180 °C) and concentration ratio (1:3). (d) Represents the specific capacitance with respect to reaction time at constant temperature (180 °C) and concentration ratio (1:3) at current density of 0.15 A g^{-1}. (e) Represents the EIS spectra with respect to reaction time at constant temperature (180 °C) and concentration ratio (1:3). (f) Represents the CV of MnO_2 samples at different concentrations at a constant temperature (180 °C) and reaction time (0.083 h). (g) Represents the specific capacitance of MnO_2 samples at a constant temperature (180 °C) and reaction time (0.083 h).

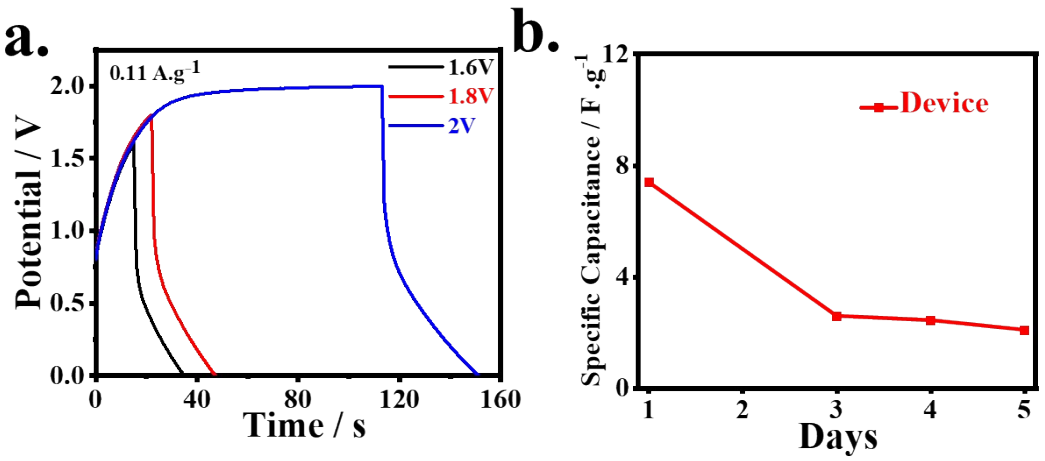

Figure S13: (a) GCD of Device at 0.11A.g^{-1}. (b) Specific capacitance of the device using PVA/H_3PO_4 electrolyte with respect to the time (days).

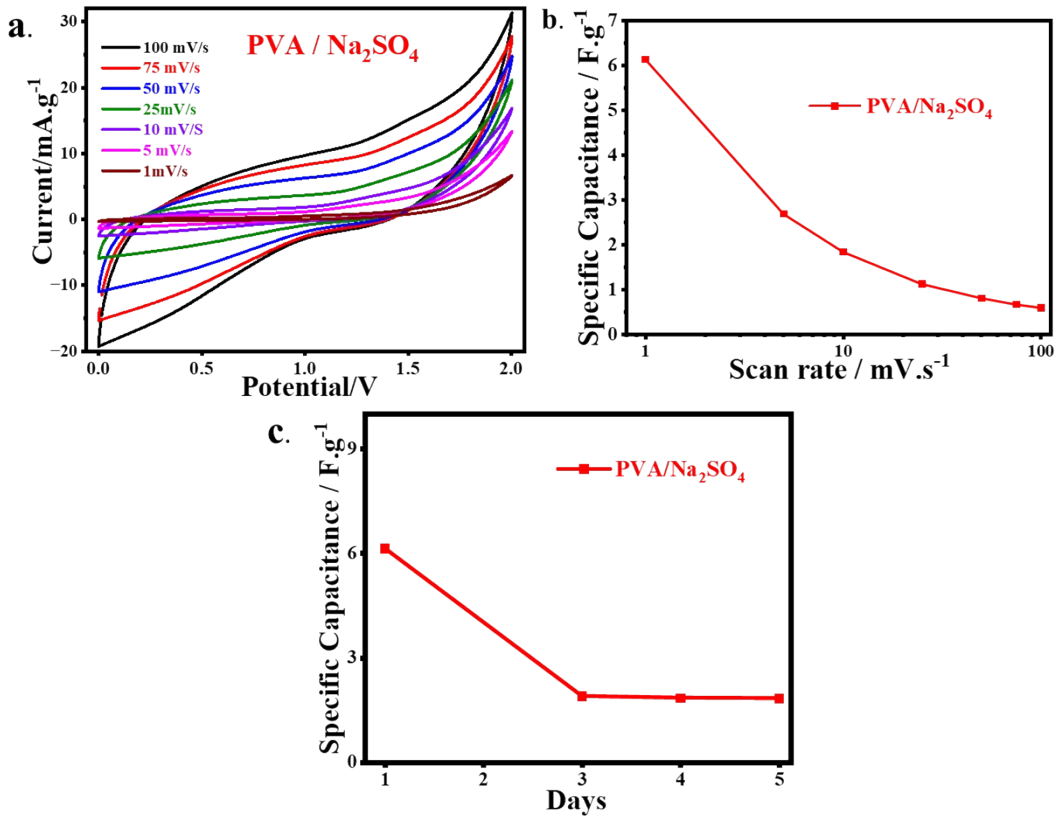

Figure S14: (a) Represent the Cyclic voltammetry of device using electrolyte of PVA/Na_2SO_4, (b) represent the specific capacitance of device using PVA/Na_2SO_4 and (c) represent the specific capacitance of the device with respect to time (days).

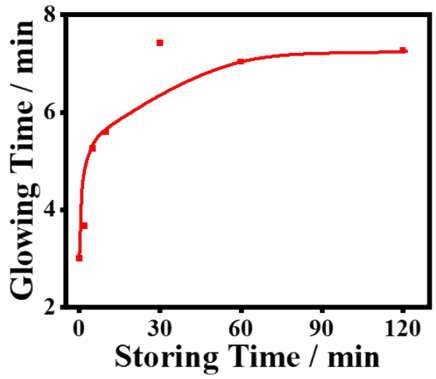

Figure. S15: represent the glowing time of LED light with respect to storing time.