Electronic Supplementary Information (ESI)

Synthesis of MnO_2 nanoparticle and its effective utilization as UV protector for outdoor high voltage polymeric insulator used in power transmission line

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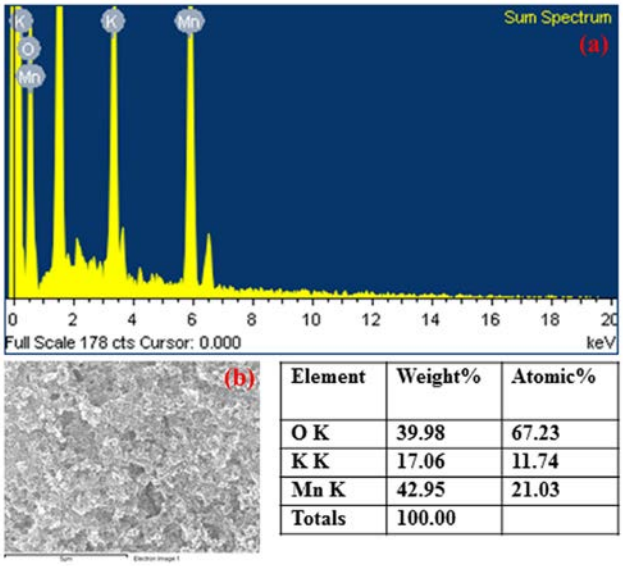
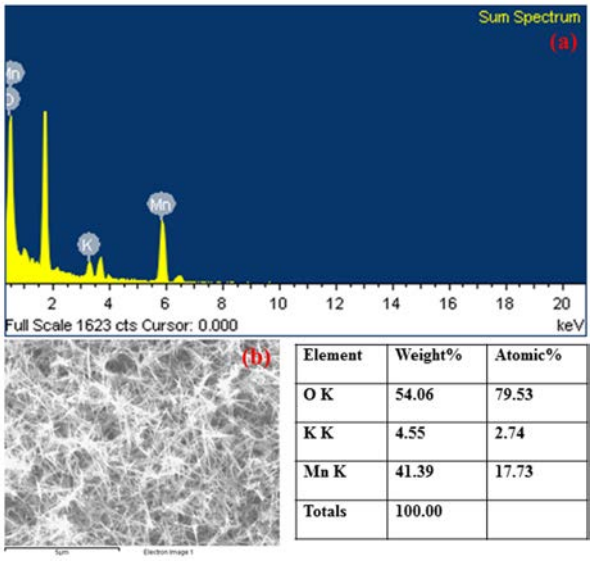
EDX- analysis of synthesized three different nanoparticles



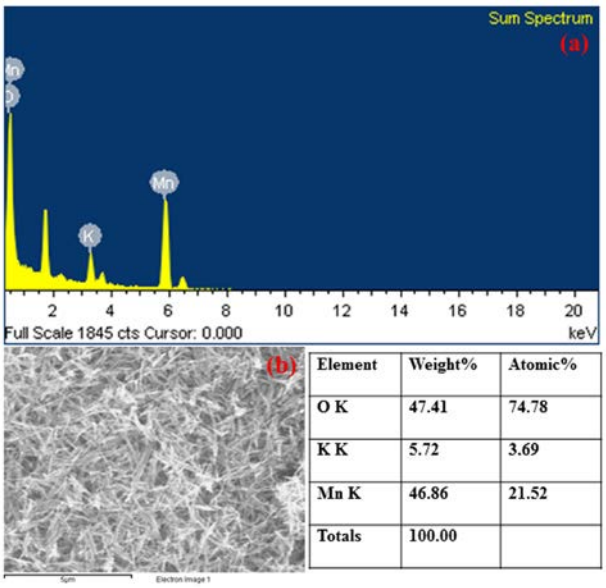
Element	Weight%	Atomic%
O K	39.98	67.23
K K	17.06	11.74
Mn K	42.95	21.03
Totals	100.00	

Fig. S1: EDX spectra (a), scan area (b) and elemental composition of synthesize MnO_2 δ-nanosheet (NS).



Element	Weight%	Atomic%
O K	54.06	79.53
K K	4.55	2.74
Mn K	41.39	17.73
Totals	100.00	

Fig. S2: EDX spectra (a), scan area (b) and elemental composition of synthesize MnO_2 α-nanowire (NW).



Element	Weight%	Atomic%
O K	47.41	74.78
K K	5.72	3.69
Mn K	46.86	21.52
Totals	100.00	

Fig. S3: EDX spectra (a), scan area (b) and elemental composition of synthesize MnO_2 α-nanorod (NR).

TEM analysis of α-nanorod of extended heating

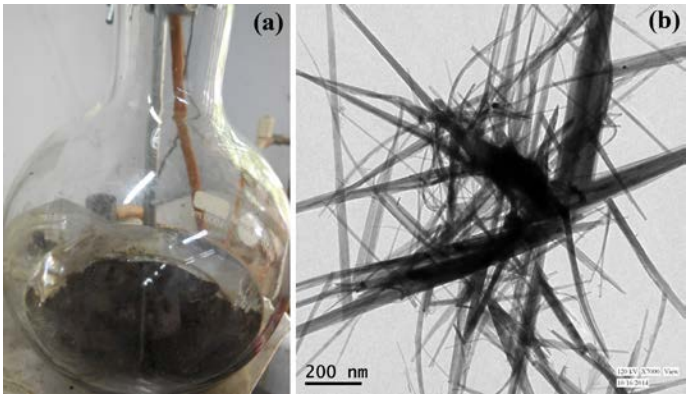


Fig. S4: Digital picture (a) and TEM image (b) of α-MnO_2 nanorod of extended heating sample.

Thermogravimetric analysis

Fig S5 represents the thermogravimetric analysis of synthesized different morphological nanoparticles. It was detected from this analysis that all the particles absorbed traces of moisture (weight loss ~1-2 %) due to weight loss at 100°C. It may be due to present of surface hydroxyl group which can absorb traces of moisture. The loss weight at near about 300-400°C may be due to transformation of phase from MnO_2 to Mn_2O_3[53].

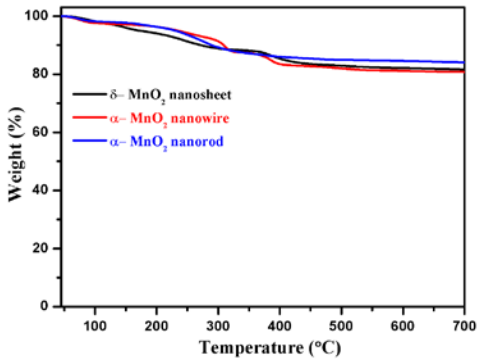


Fig. S5: TGA analysis of δ- MnO_2 nanaosheet (NS), α- MnO_2 nanowire (NW) and α- MnO_2 nanorod (NR).

Nanoindentation analysis

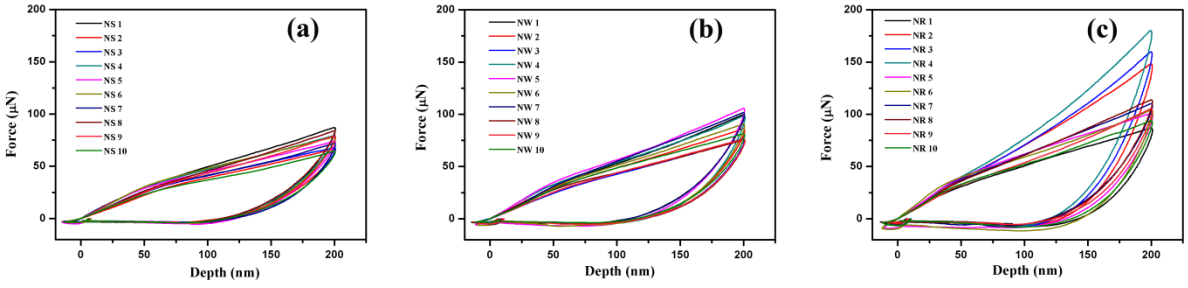


Fig. S6: Force versus depth profile of (a) δ-nanosheet (NS), (b) α- nanowire (NW) and (c) α-nanorod (NR) under nanoindentation at 10 different places of each type of nanomaterial.

Electrical properties of MnO_2

Effect of frequency on electrical impedance

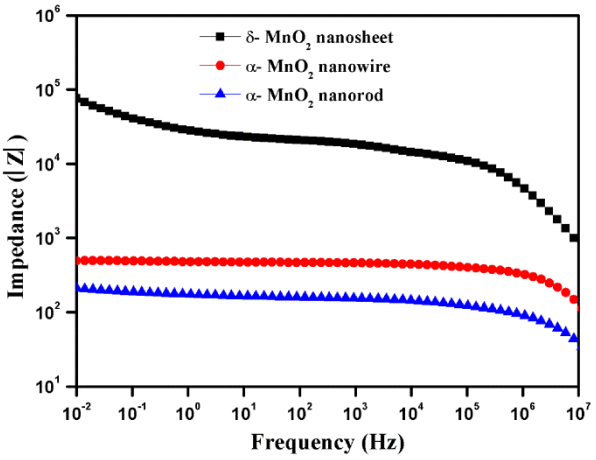


Fig. S7: Variation of impedance of δ- MnO_2 nanaosheet (NS), α- MnO_2 nanowire (NW) and α- MnO_2 nanorod (NR) with respect to frequency at room temperature.

Effect of temperature on electrical impedance

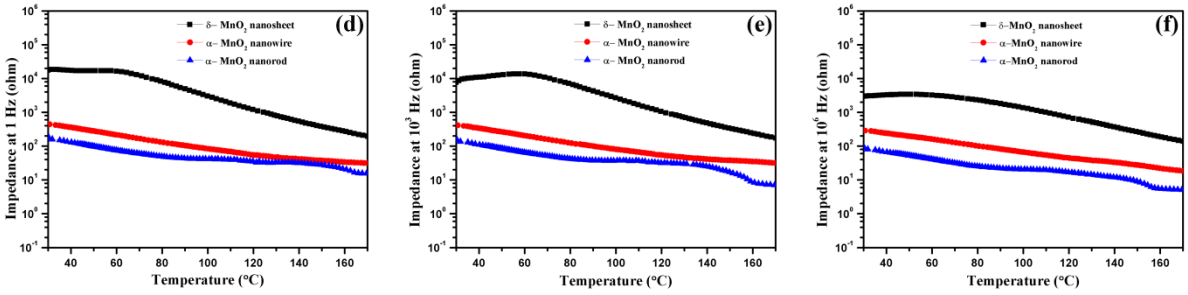


Fig. S8: Variation of impedance of δ- MnO_2 nanaosheet (NS), α- MnO_2 nanowire (NW) and α- MnO_2 nanorod (NR) with respect to temperature at (a) 1 Hz, (b) 10^3 Hz and (c) 10^6 Hz frequency.

Band gap measurement using UV analysis

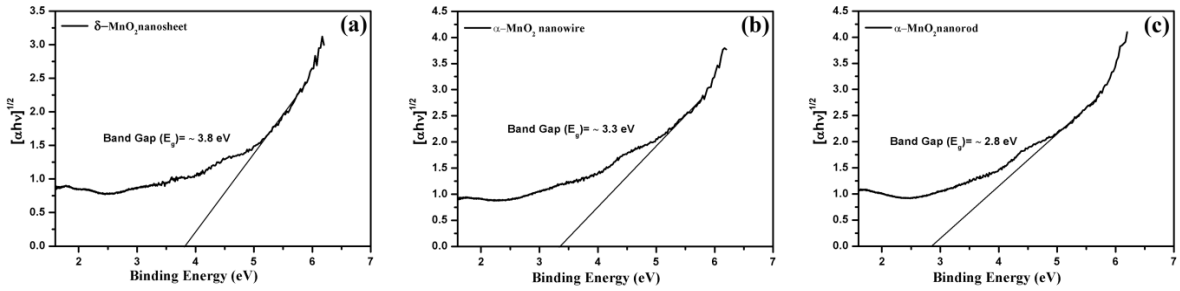


Fig. S9: Band gap analysis of (a) δ- MnO_2 nanaosheet (NS), (b) α- MnO_2 nanowire (NW) and (c) α- MnO_2 nanorod (NR).

Digital picture of synthesized MnO_2 nanoparticle

Fig. S10: Digital picture of synthesized δ- MnO_2 nanosheet for the preparation of high voltage insulator composite as UV retardant.