Supporting information

Facile hydrothermal synthesis of tri-metallic Cu-Mn-Ni oxides based electrochemical pseudocapacitor

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Electrometrical test and fabrication of working electrode

CV, EIS, and GCD of the NO, MNO and CMNO based nanocomposites were carried out using a three-electrode arrangement on Metrohm Auto lab (PGSTAT 204) workstation. The platinum (Pt) was used as a counter electrode, whereas the Ag/AgCl was utilized as the reference electrode, the synthesized materials as a working electrode, and 1 KOH as an electrolyte. The homogenous slurry of each sample was obtained by grinding the prepared materials and dissolved in distilled water and deposited on Ni-foams (1 cm × 1 cm) via drop cast technique to fabricate the working electrode and was dried at 45 ◦C for 24 h. The amount of loaded material was about 0.004 g. The CV curves were traced at a potential window of 0–0.6 V at varying scan rates (5, 10, 15, 20, 25, 30, mVs^{-1}). A 0.5 V AC voltage with frequency 0.1 Hz to 1×10^5 Hz was employed for EIS. The GCD tests were carried out at 1, 2, 3, 5 and 7 A/g current density.

2.6. Characterization

The phase investigation of the fabricated materials (NO, MNO, and CMNO) was carried out using an X-ray advance diffractometer (Model: Bruker-D8, CuKα: λ = 1.5407 Å: Range 2θ = 20-80◦, the scanning rate of 1.5◦/min, run at 40 kV/35 mA). X-ray photoelectron spectroscopy (XPS) was carried out using a PHI Quantera SXM (ULVAC-PH) with mono-chromated AlKα(1486.7eV) radiation under a pressure of 4×10^{-8} Pa. The Metrohm Autolab (PGSTAT-204) was used for electrochemical measurements. The surface morphology and elemental analysis were performed using Field Emission Scanning Electron Microscope (FE-SEM) (modeled Nova Nano 45).

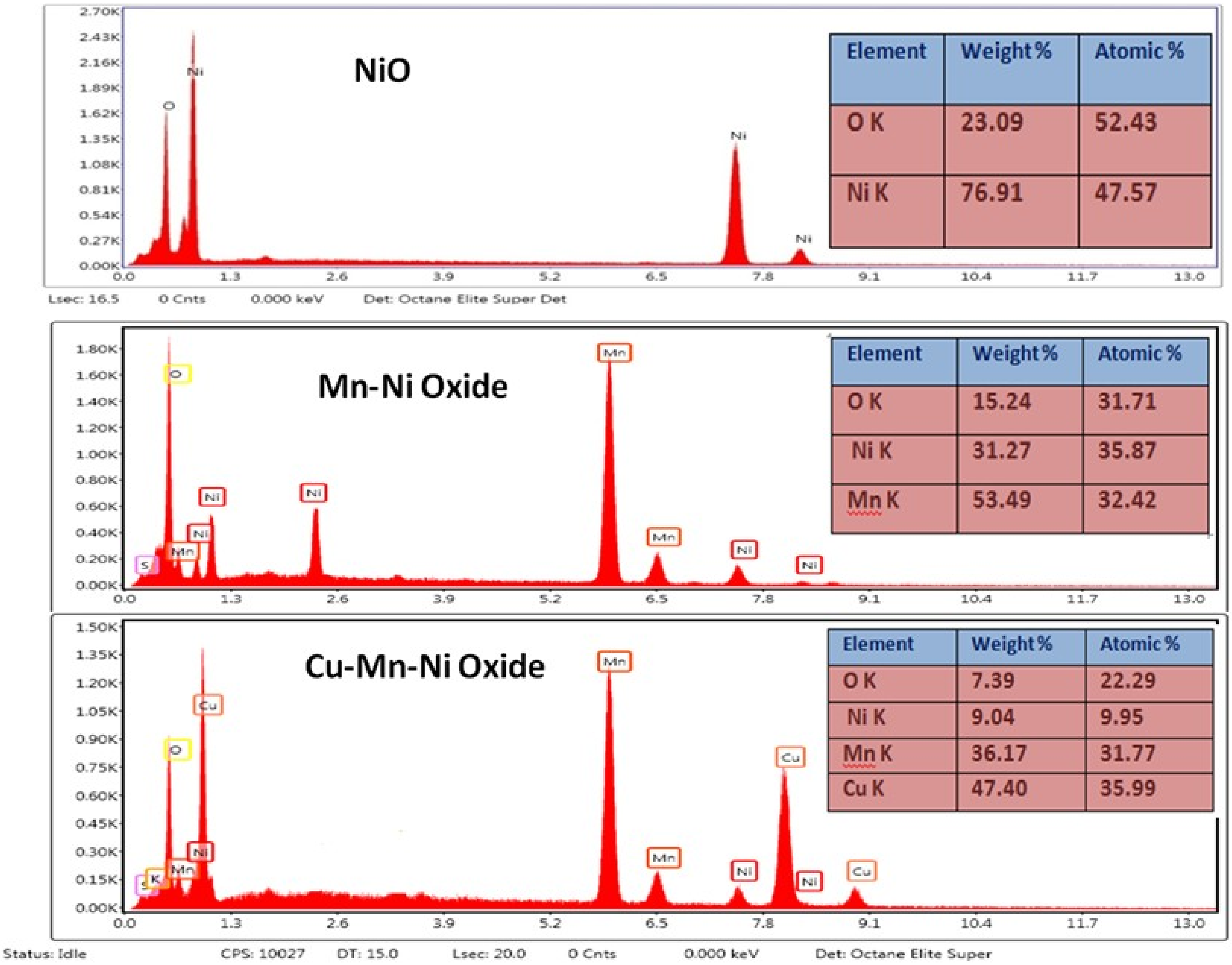

Figure S1 represents the EDX of NO, MNO, CMNO.

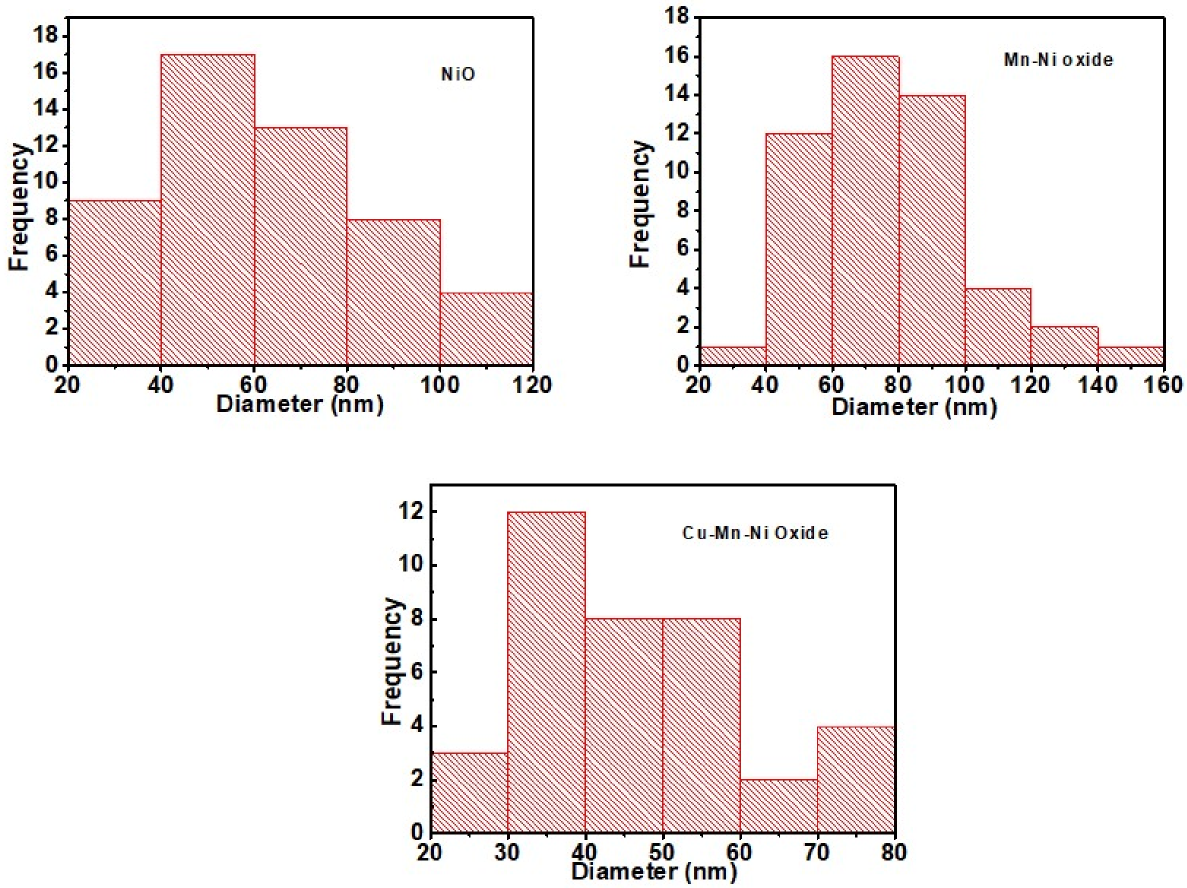

Figure S2 showing diameter of NO, MNO and CMNO.

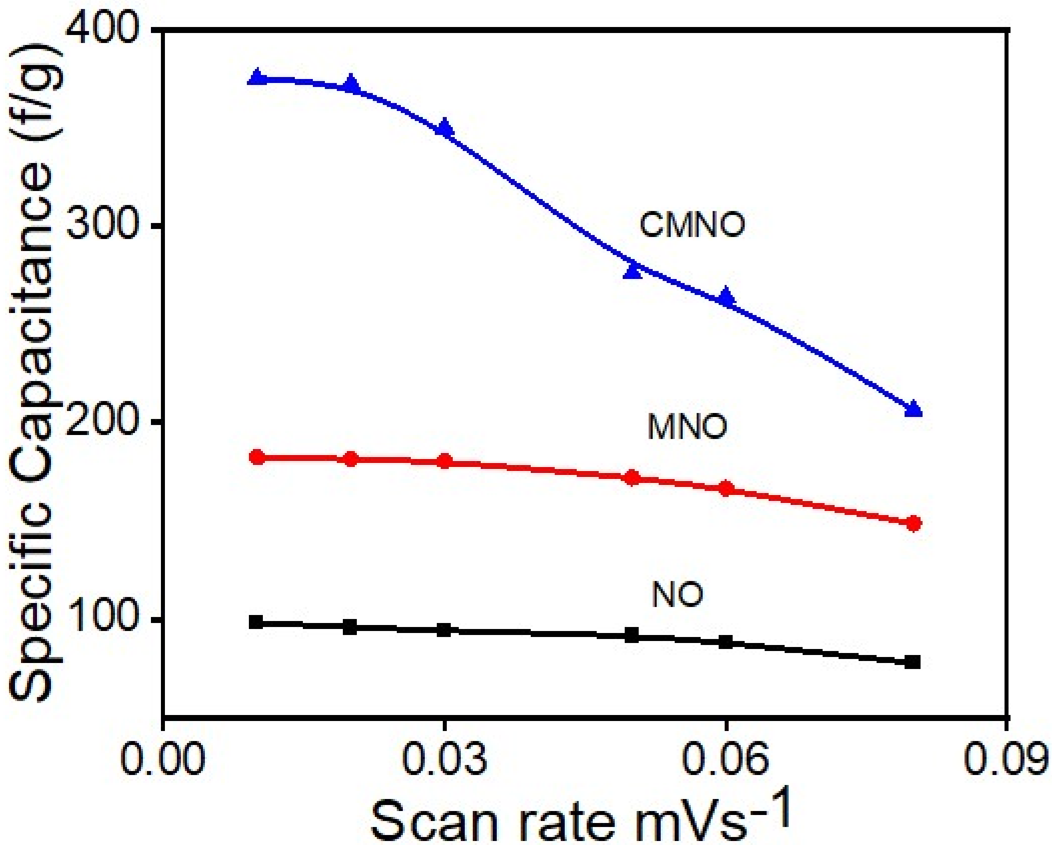

Figure S3 Specific capacitance of NO, MNO, and CMNO calculated from CV.

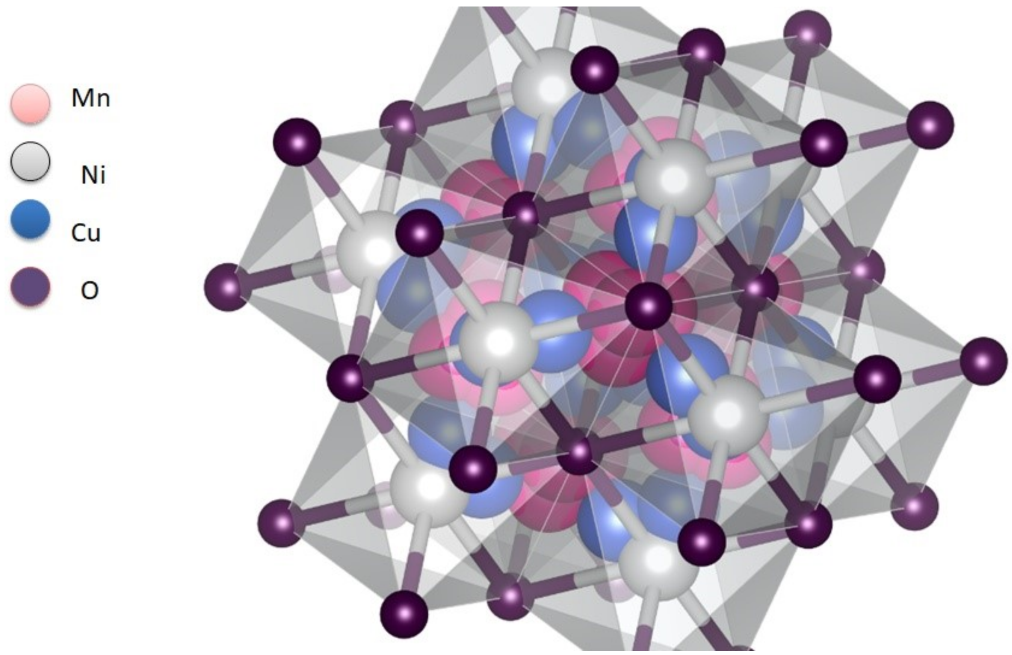

Fig S4 Structural formula representing the compositions of CMNO

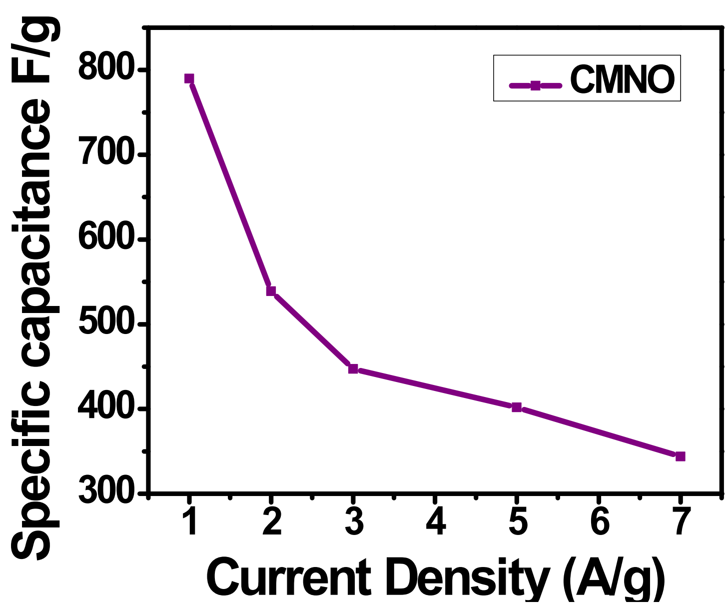

Fig S5 Variation of specific capacitance as a function of current density of CMNO

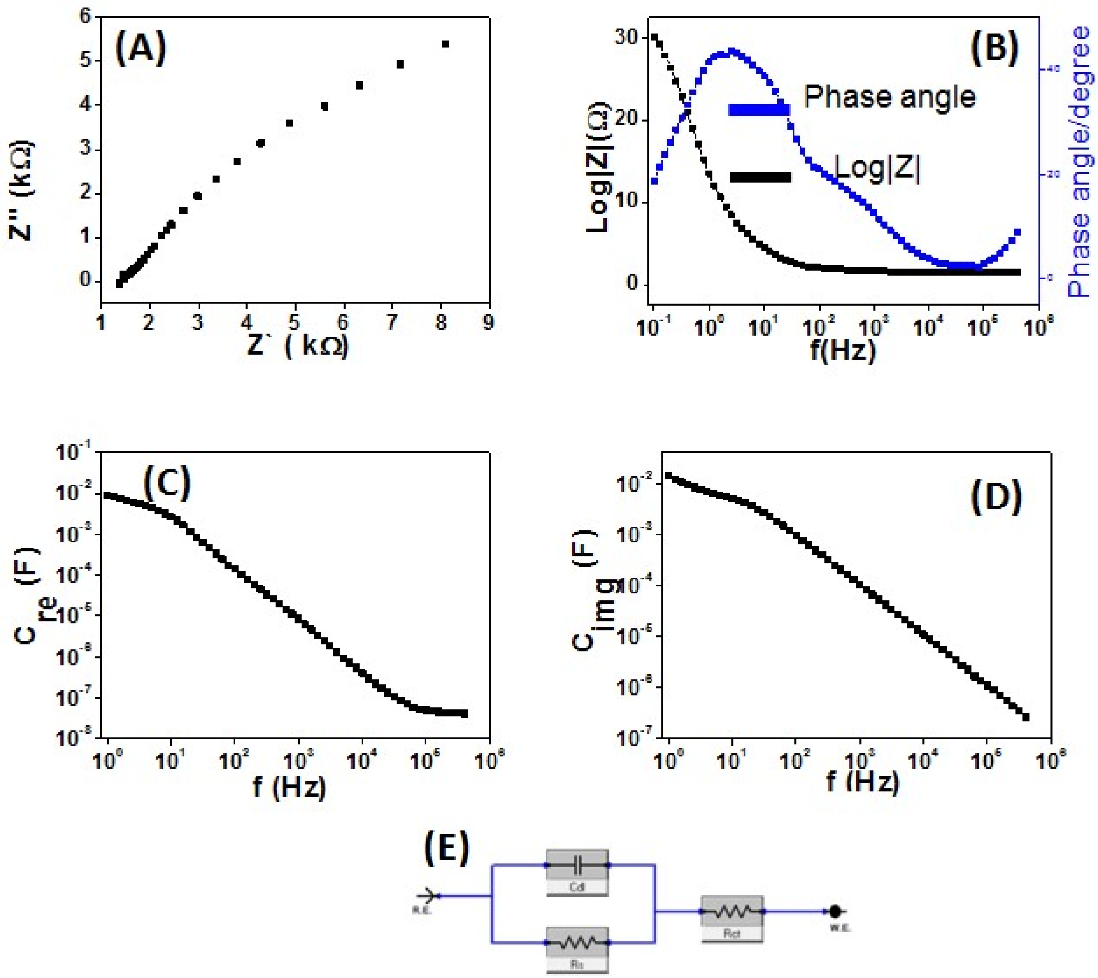

Fig S6 Nyquist plot of CMNO electrode (A), Bode plot (B), plot of Imaginary and real capacitance versus frequency (C&D), Equivalent Circuits (E)

Table S1: Specific Capacitance of NO, MNO and CMNO calculated from CV at different scan rate.

Scan rate (mV/s)	NO Specific capacitance(F/g)	MNO Specific capacitance(F/g)	CMNO Specific capacitance(F/g)
10	182.49	98.0833	375.68
20	181.52	95.75	372.91
30	180.55	94.42	350.50
50	172.12	91.70	276.34
60	166.62	88.05	264.40
80	148.60	77.60	206.72

Table S2: Electrochemical Parameters of different Material Compositions from GCD curves at different current densities

Current density	NO Specific capacitance(F/g)	MNO Specific capacitance(F/g)	CMNO Specific capacitance (F/g)
1 A/g	290.84	438.47	790.0
2 A/g	220.3	359.3	538.98
3 A/g	213.5	330.50	447.4
5 A/g	228.81	288.13	401.8
7 A/g	261.01	272.8	344.0

Table S3: Comparison of electrochemical performance of synthesized CMNO in this work and recent reported work.

Sr.No	**Materials**	**Synthesis Method**	**Morphology**	**Specific Capacitance**	**Cyclic stability**	**References**
1	Ni doped $CuO/Cu/Cu_2O$	Hydrothermal	Nano-flakes	338.98F/g at 1A/g	98% after 5000 cycles	[1]
2	NiO/Ni_6MnO_8	Hydrothermal	Porous flower like	433 F/g at 1A/g	91.9% after1000 cycles	[2]
3	$MnNiO_3/Ni_6MnO_8$	Hydrothermal	3D flower like	423.3F/g at 1A/g	100% after 6000 cycles	[3]
4	MnO_2	Hydrothermal	Nano rods	577.6 F/g at 1A/g	98.1% after 10000 cycles	[4]
5	Mn_2O_3/CuO	Hydrothermal	Spherical nanoparticles	342.85F/g at 1A/g	89.97% after 5000 cycles	[5]
6	MnO_2/CuO	Hydrothermal	Sphere shaped nanoparticles	279.12F/g at 0.5A/g	91% after 10000 cycles	[6]
7	Cu doped $NiMnO_3$	Hydrothermal	Ir-regular nano sphere	659.50F/g at 10mV/s	--------	[7]
8	Cu-Mn-NiO_4	Hydrothermal	Nano rods	790.63F/g at 1A/g	96 % after 8000 cycles	This work

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