Electronic Supporting information (ESI)

Mico-nano NiO-$MnCo_2O_4$ Heterostructure with Optimal Interfacial Electronic Environment for High Performance and Enhanced Lithium Storage Kinetics

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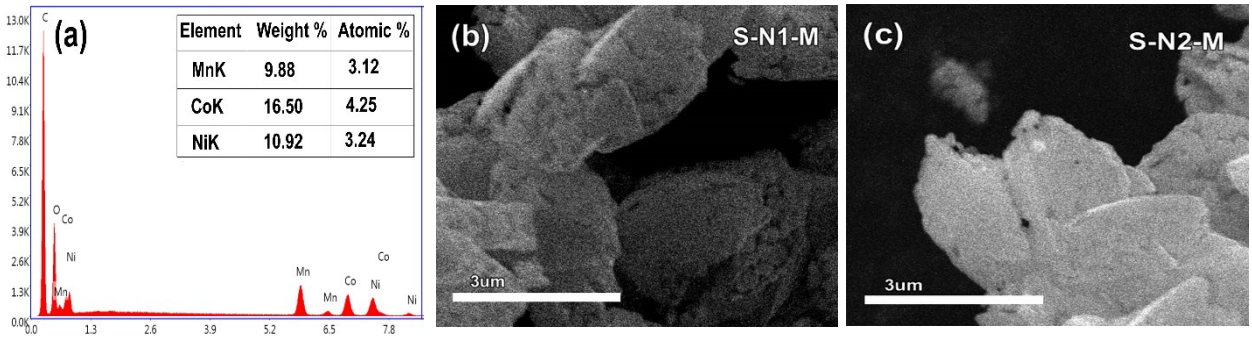

Figure S1. (a) EDS mapping of S-N-MC; (b-c) SEM images of S-N1-MC and S-N2-MC.

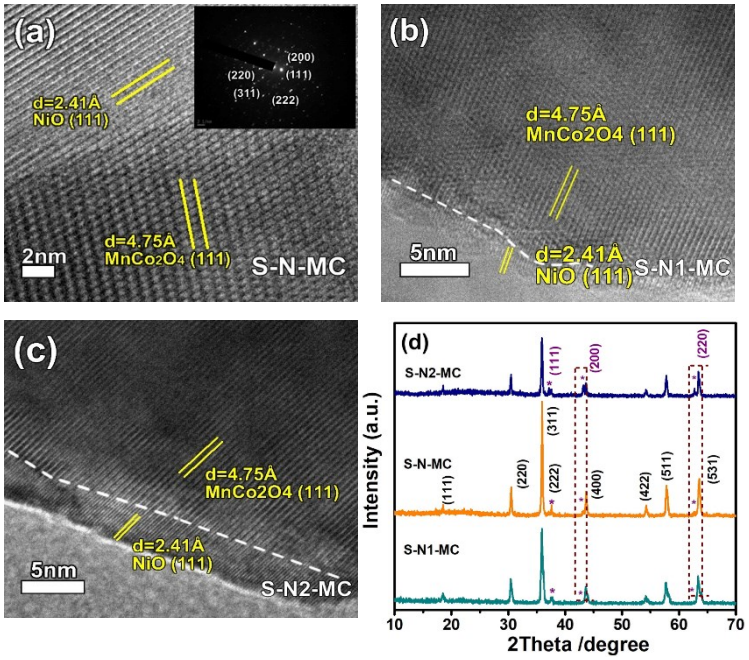

Figure S2. HRTEM images of the (a) S-N-MC heterostructure, (b) S-N1-MC, (c) S-N2-MC and (d) the corresponding XRD patterns.

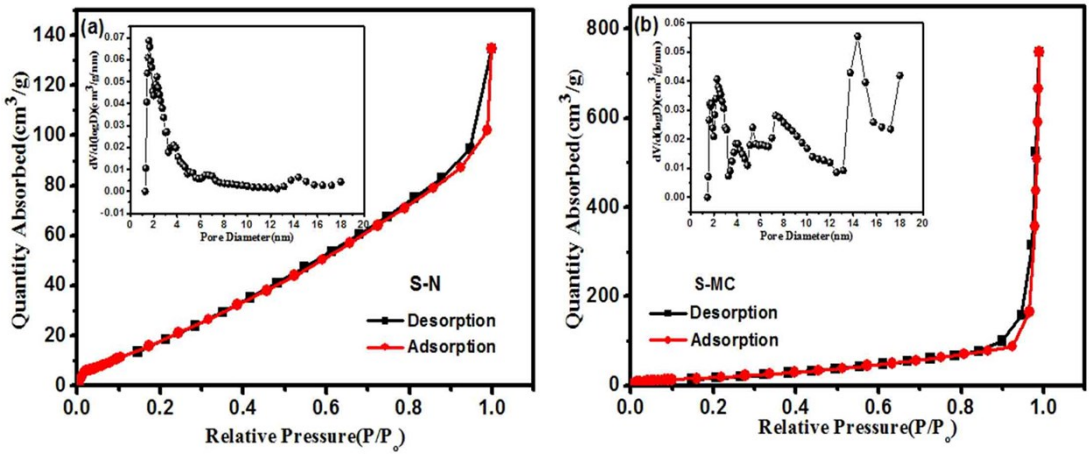

Figure S3. N_2 adsorption/desorption isotherms and the corresponding pore size distribution curves of (a) S-N and (b) S-MC.

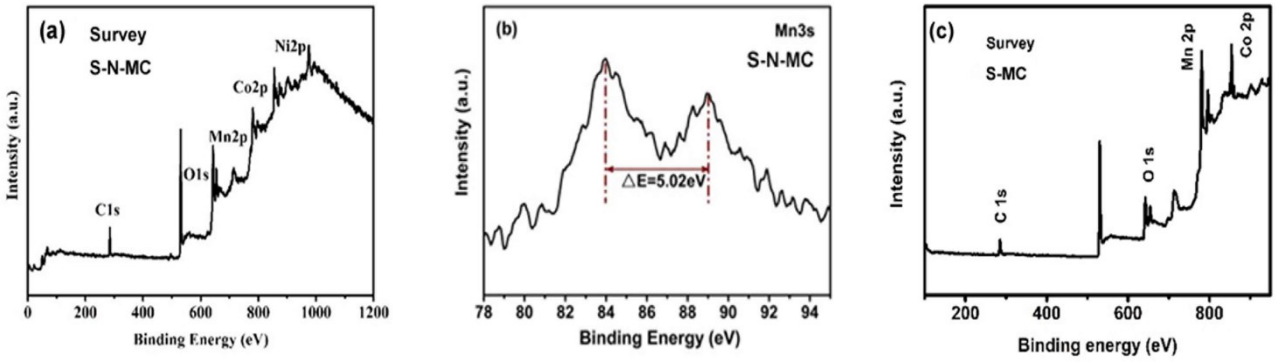

Figure S4. XPS survey spectrum of the sample (a) S-N-MC and (c) S-MC; (b) XPS patterns about Mn 3s of S-N-MC.

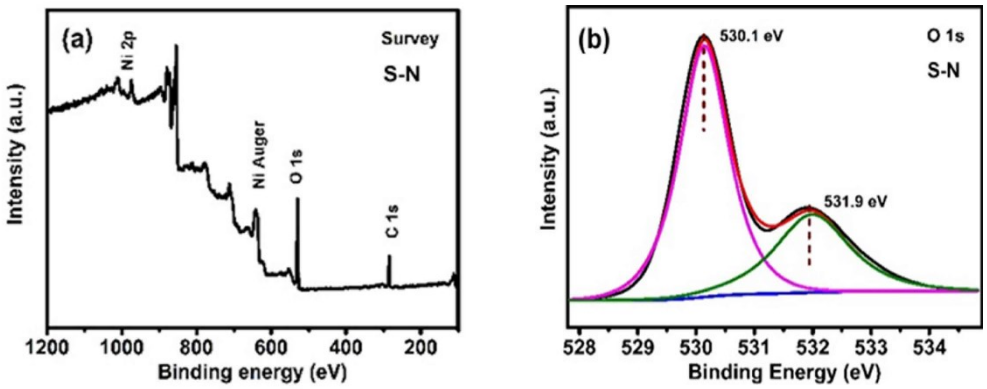

Figure S5. XPS results of S-N: (a) full scan spectra, (b) Ni 2p, (c) O 1s.

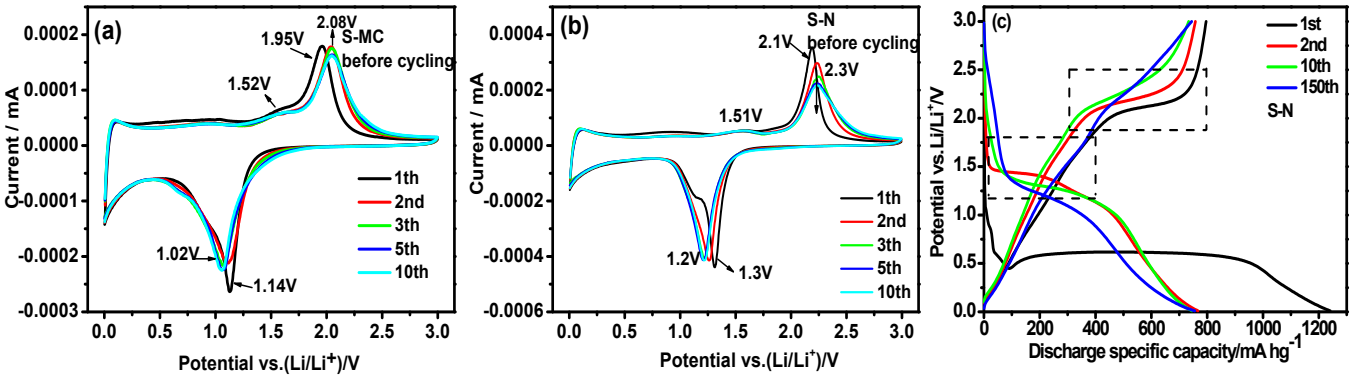

Figure S6. (a-b) CV of S-MC and S-N, (c) GDC of S-N at 500 mA h g^{-1}.

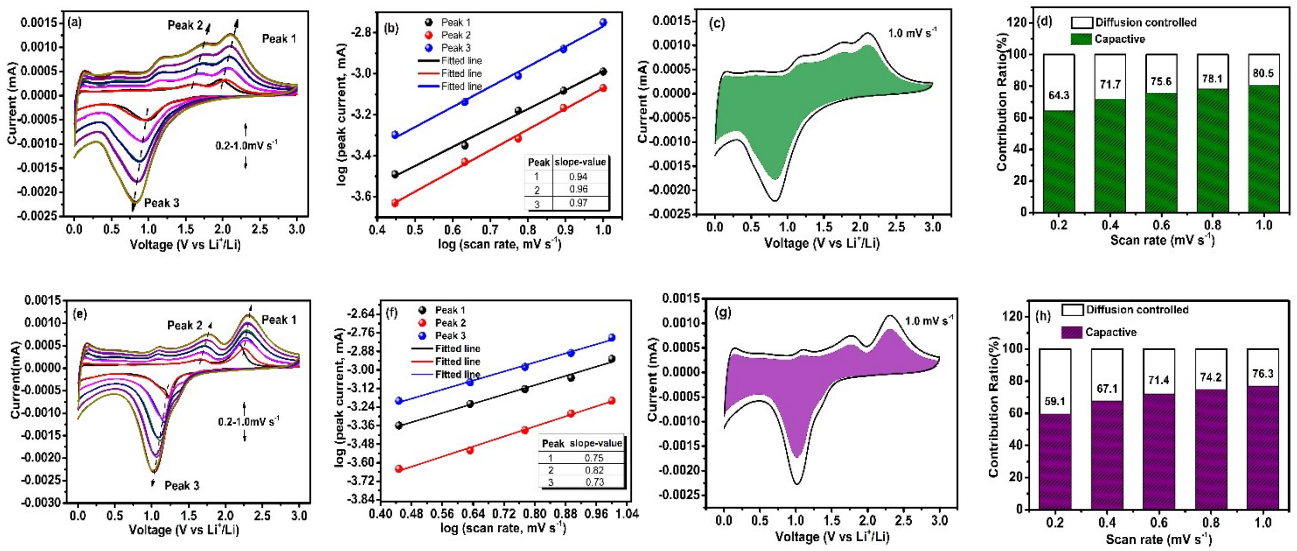

Figure S7. (a, e) CV curves at different scan rates from 0.2 to 1.0 mV s-1, (b, f) Corresponding log(i) vs. log(v) plots at specific peak currents, (c, g) Shaded area of CV curve with the pseudocapacitive fraction at 1.0 mV s^{-1}, and (d, h) bar chart showing the percent of pseudocapacitive contribution at different scan rates of S-MC and (d-f) S-N.

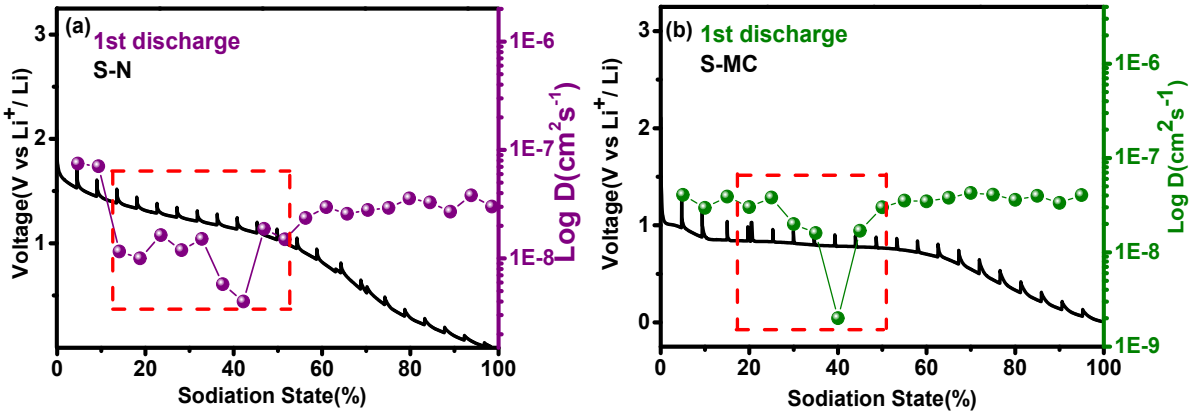

Figure S8. GITT curves and the corresponding Li^+ diffusion coefficient at different discharge/charge state of S-N and S-MC electrodes.

Table S1. Diffraction intensities of (220), (311), (511) and (531) crystal planes of S-MC and S-N-MC.

Selected crystal plane	S-MC	S-N-MC
Diffraction intensity of (220) crystal plane	975	1141
Diffraction intensity of (311) crystal plane	2841	4316
Diffraction intensity of (511) crystal plane	775	1200
Diffraction intensity of (531) crystal plane	1083	1258

Table S2. ICP-OES test on the prepared combination electrodes.

Materials	Ni/ wt%	Mn/ wt%	Co/ wt%
S-N-MC	26.2	21.3	38.1
S-N1-MC	17.3	20.9	39.3
S-N2-MC	44.7	29.6	53.2

Table S3. The crystal analysis results of S-N-MC and S-MC by Rietveld refinements.

Sample	a, b, c / Å	α, β, γ / °	V/ Å^3	R_{wp} / %
S-N-MC	8.24300	90.000	568.548	2.82
S-MC	8.213728	90.000	554.142	3.85

Table S4. BET specific surface areas and pore size distributions of the samples.

Materials	BET surface area/ ($m^2 g^{-1}$)	Pore volume / (nm)
S-N	62.3	6
S-MC	63.5	33
S-N-MC	29.4	16

Table S5. Impedance fitted parameters for the electrode samples before and after cycling

Sample	**S-N**	**S-MC**	**S-N-MC**	**S-N1-MC**	**S-N2-MC**
Rct(ohm) bef. cycling	134.2	127.9	50.3	68.5	85.5
Rct(ohm) aft. cycling	332.8	233.2	82.1	125.1	168.7

Table S6. Reversible specific capacities of $MnCo_2O_4$-based sample reported before and in this work.

Morphology	**Method**	**Current density (mA g^{-1})**	**Cycle number**	**Remaining Density (mA h g^{-1})**	**Ref.**
Ni substituted $MnCo_2O_4$ nanowires	hydrothermal method	500	200	706	[13]
NiO-$MnCo_2O_4$ microspheres	ultrasonic nebulizer	800	300	687	[28]
multiporous $MnCo_2O_4$	solvothermal method	400	100	610	[35]
Core-Shell Ellipsoidal $MnCo_2O_4$	hydrothermal method	400	70	750	[37]
$MnCo_2O_4$ microspheres	calcination-free synthesis	900	200	320	[38]
double-shelled hollow graphene-$MnCo_2O_4$ spheres	solvothermal method	200	100	703	[41]
Sheet or plate type morphology $MnCo_2O_4$	molten salt method	600	70	380	[45]
NiO-$MnCo_2O_4$ microspheres	**self-assembly**	**500** **2000**	**500** **1000**	**1330** **719**	**This work**