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Supporting Information

In-situ Coupled Nickel-based Layered Double Hydroxides with MXene to Enhance the Supercapacitor Performance

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Results and Discussion

1. Composition, Structures and Morphologies Characterization

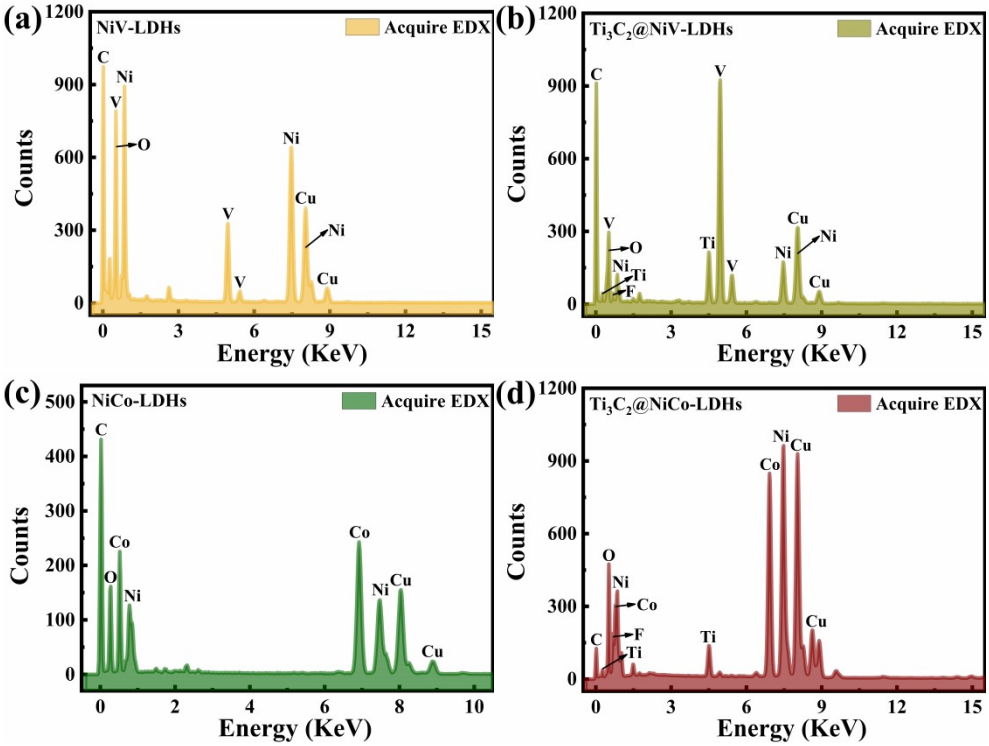


Fig. S1. The EDX spectrum of **(a)** NiV-LDHs, **(b)** Ti_3C_2@NiV-LDHs, **(c)** NiCo-LDHs and **(d)** Ti_3C_2@NiCo-LDHs.

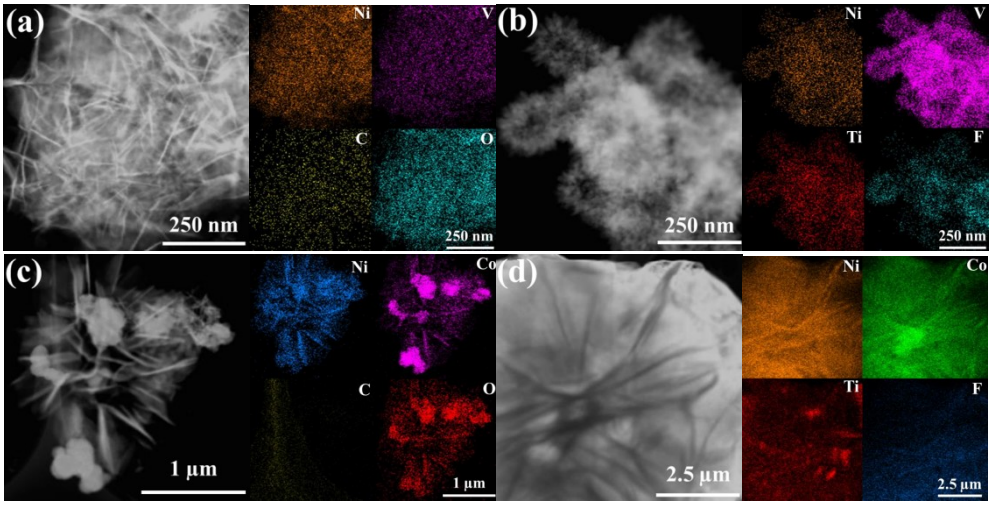
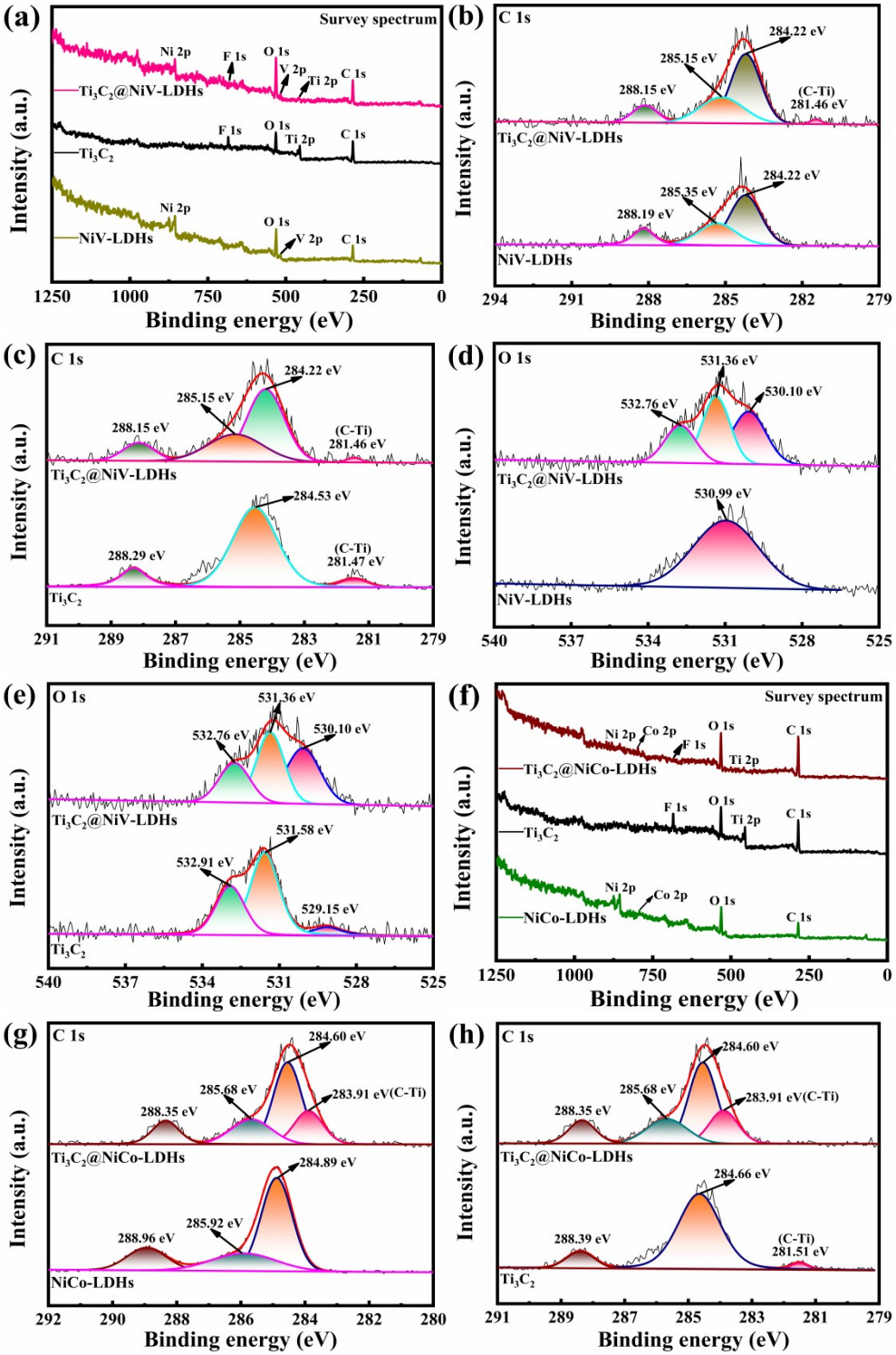


Fig. S2. Elements mapping of **(a)** NiV-LDHs, **(b)** Ti_3C_2@NiV-LDHs, **(c)** NiCo-LDHs and **(d)** Ti_3C_2@ NiCo-LDHs.


(a)
Survey spectrum
Ni 2p
F 1s
O 1s
V 2p
Ti 2p
C 1s
Ti3C2@NiV-LDHs
Ti3C2
NiV-LDHs
Intensity (a.u.)
Binding energy (eV)
(b)
C 1s
284.22 eV
285.15 eV
288.15 eV
(C-Ti)
281.46 eV
Ti3C2@NiV-LDHs
285.35 eV
284.22 eV
288.19 eV
NiV-LDHs
(c)
C 1s
284.22 eV
285.15 eV
288.15 eV
(C-Ti)
281.46 eV
Ti3C2@NiV-LDHs
284.53 eV
288.29 eV
(C-Ti)
281.47 eV
Ti3C2
(d)
O 1s
531.36 eV
532.76 eV
530.10 eV
Ti3C2@NiV-LDHs
530.99 eV
NiV-LDHs
(e)
O 1s
531.36 eV
532.76 eV
530.10 eV
Ti3C2@NiV-LDHs
531.58 eV
532.91 eV
529.15 eV
Ti3C2
(f)
Survey spectrum
Ni 2p
Co 2p
O 1s
C 1s
F 1s
Ti 2p
Ti3C2@NiCo-LDHs
Ti3C2
NiCo-LDHs
(g)
C 1s
284.60 eV
285.68 eV
283.91 eV(C-Ti)
288.35 eV
Ti3C2@NiCo-LDHs
284.89 eV
285.92 eV
288.96 eV
NiCo-LDHs
(h)
C 1s
284.60 eV
285.68 eV
283.91 eV(C-Ti)
288.35 eV
Ti3C2@NiCo-LDHs
284.66 eV
288.39 eV
(C-Ti)
281.51 eV
Ti3C2

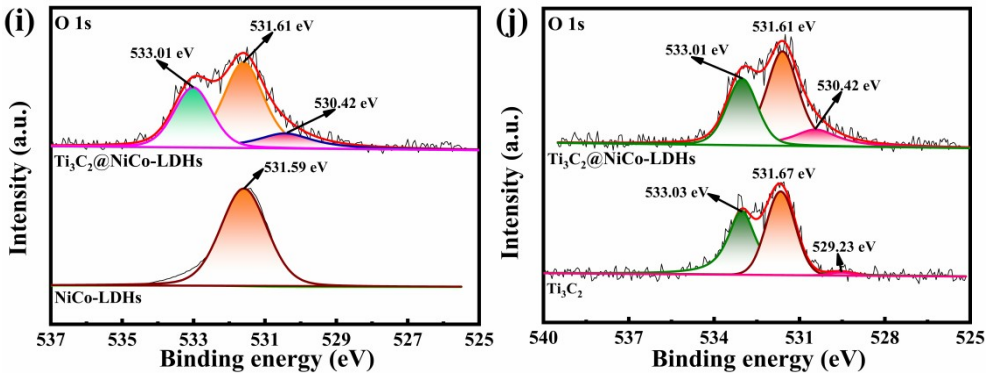


Fig. S3. The XPS spectra of the NiV-LDHs, Ti_3C_2 and the Ti_3C_2@NiV-LDHs: **(a)** Survey spectrum, **(b)** C 1s, **(c)** C 1s, **(d)** O 1s, **(e)** O 1s, respectively. **(f)** Survey spectrum of NiCo-LDHs, Ti_3C_2 and Ti_3C_2@NiCo-LDHs. **(g)** C 1s XPS spectrum of NiCo-LDHs and Ti_3C_2@NiCo-LDHs. **(h)** C 1s XPS spectrum of Ti_3C_2 and Ti_3C_2@NiCo-LDHs. **(i)** O 1s XPS spectrum of NiCo-LDHs and Ti_3C_2@NiCo-LDHs. **(j)** O 1s XPS spectrum of Ti_3C_2 and Ti_3C_2@NiCo-LDHs.

2. Three-Electrode System

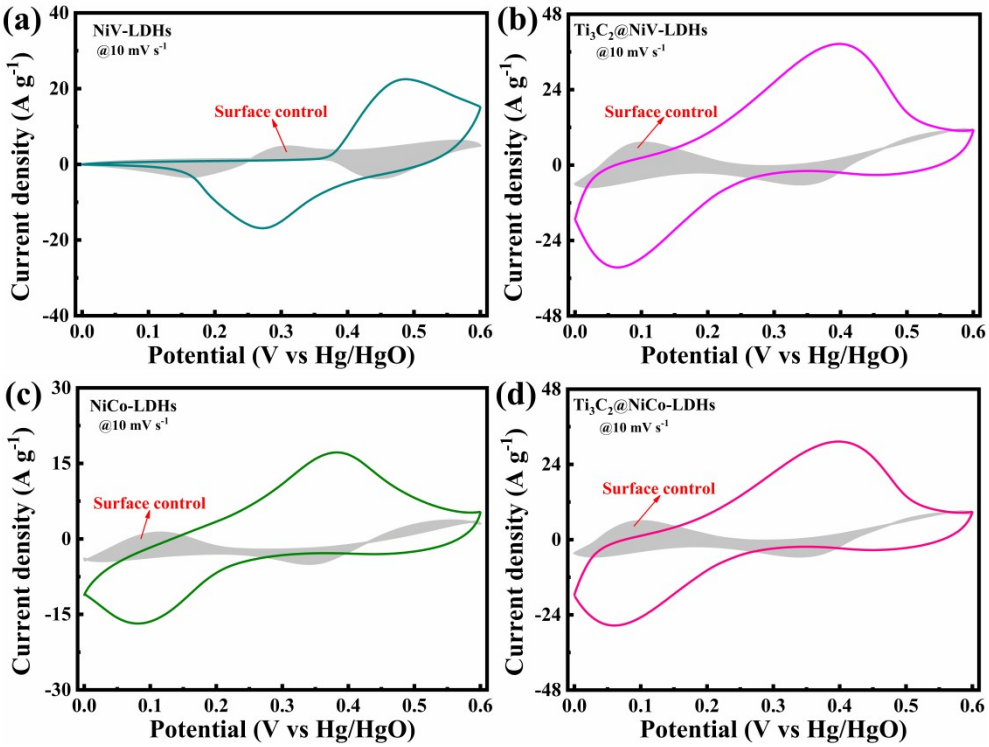


Fig. S4. **(a)** The shaded area represents the capacitance contribution of NiV-LDHs at 10 mV s^{-1}. **(b)** The shaded area indicates the capacitive contribution of Ti_3C_2@NiV-LDHs at 10 mV s^{-1}. **(c)** The gray area represents the portion of the NiCo-LDHs surface control contribution. **(d)** The gray area represents the portion of the Ti_3C_2@NiCo-LDHs surface control contribution.

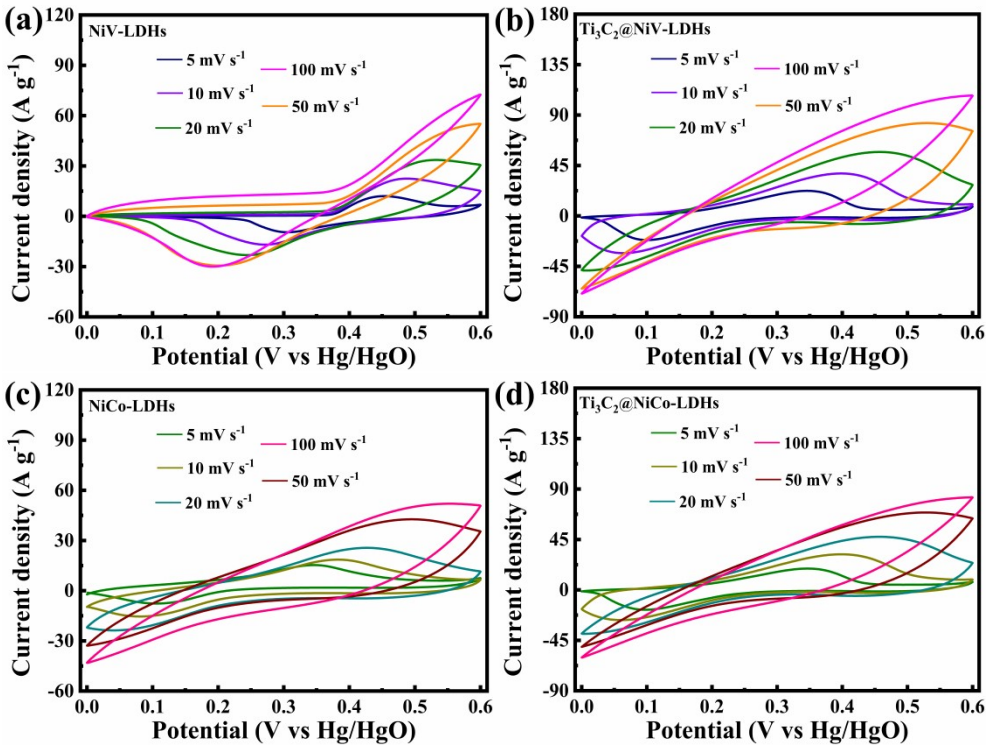


Fig. S5. **(a)** The cyclic voltammetry characteristic curve of NiV-LDHs at 5 to 100 mV s^{-1}. **(b)** The CV curve of Ti_3C_2@NiV-LDHs at 5 to 100 mV s^{-1}. **(c)** Cyclic characteristics curve of the NiCo-LDHs tested. **(d)** Cyclic characteristics curve of the Ti_3C_2@NiCo-LDHs tested.

3. Two-Electrode System

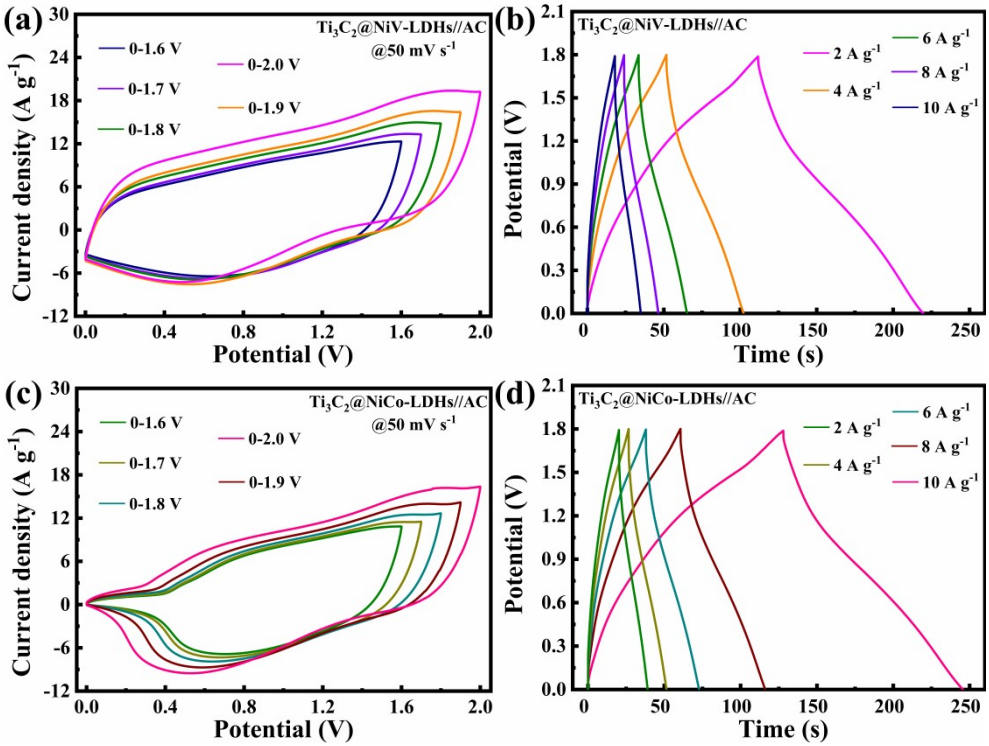


Fig. S6. (a) Cyclic voltammetry characteristic curves of Ti_3C_2@NiV-LDHs//AC ASC at 50 mV s^{-1} of different voltage windows. **(b)** Constant current charge-discharge curves of Ti_3C_2@NiV-LDHs//AC ASC at 2 A g^{-1} to 10 A

g^{-1}. **(c)** Cyclic voltammetry curves of self-assembled Ti_3C_2@NiCo-LDHs//AC soft package devices under different voltage windows. **(d)** Constant current charge-discharge curve of the Ti_3C_2@NiCo-LDHs//AC device.

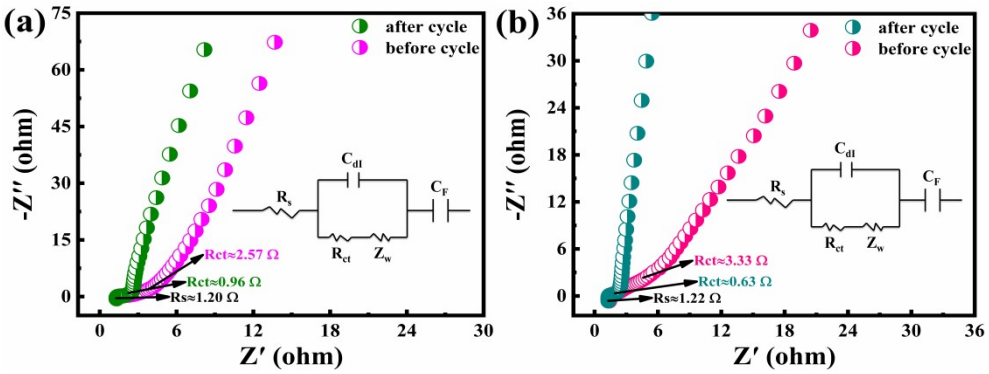


Fig. S7. (a) Charge transfer internal resistance curve of Ti_3C_2@NiV-LDHs//AC ASC. **(b)** EIS curves of the Ti_3C_2@NiCo-LDHs//AC device before and after long-term charge-discharge cycle test.