Facile growing of Ni-MOFs on Ni foam by self-dissociation strategy for electrochemical energy storage

1. Characterization

Field emission scanning electron microscopy (FE-SEM) was carried out on an FEI NOVA NanoSEM 450 system. Transmission electron microscopy (TEM) and energy dispersive spectroscopy (EDS) were taken on an FEI Tecnai G^2 F30 system. The data of X-ray photoelectron spectroscopy (XPS) were collected on a Thermo ESCALAB 250 photoelectron spectrometer. X-ray diffraction (XRD) was used to examine the crystal structure of the obtained samples with 5-80°. Fourier-transform infrared (FT-IR) spectra of the sample were measured using the KBr disk method on a Nicole Avatar 360 FT-IR spectrometer.

2. Electrochemical tests

The electrochemical nature of the samples was tested by a CHI 760E instrument and LAND CT3002A battery test device in a 6 M KOH electrolyte. In the three-electrode system, the working electrode was directly used Ni-MOF/NF-s and Ni-MOF/NF. Meanwhile, a Pt electrode was chosen as the counter electrode and a Hg/HgO electrode was determined as the reference electrode.

The gravimetric capacitance of a single-electrode Cm (F g-1) was calculated according to the galvanostatic charge–discharge profiles. For the three-electrode test,

$$C_m = \frac{I\Delta t}{m\Delta V}$$

where Cm is the specific capacitance (F g-1), I is the discharge current (A), Δt is the discharge time (s), m is the mass of the active material in a single electrode (g), and ΔV is the change in potential during the discharge process (V), respectively.

In the two-electrode system, the device was assembled by using Ni-MOF/NF-s as the positive electrode and active carbon as the negative electrode.

The mass loadings of positive (m+) and negative (m-) materials were determined by the charge balance $m-/m+=(C+\Delta V+)/(C-\Delta V-)$, where C+ and C- are the capacitances of Ni-MOF/NF-s and active carbon in the three-electrode system.

The C (E, Wh kg-1) and power density (P, W kg-1) were calculated by the total mass of active materials of the two electrodes using the following equations:

$$E = \frac{CV^2}{2 \times 3.6}$$

$$E = \frac{3600E}{t}$$

where C is the specific capacitance of the device, I is the response current (A), t is the discharge time (s), V is the cell voltage, and m is the weight of total active materials on both electrodes (g).

3. Figures

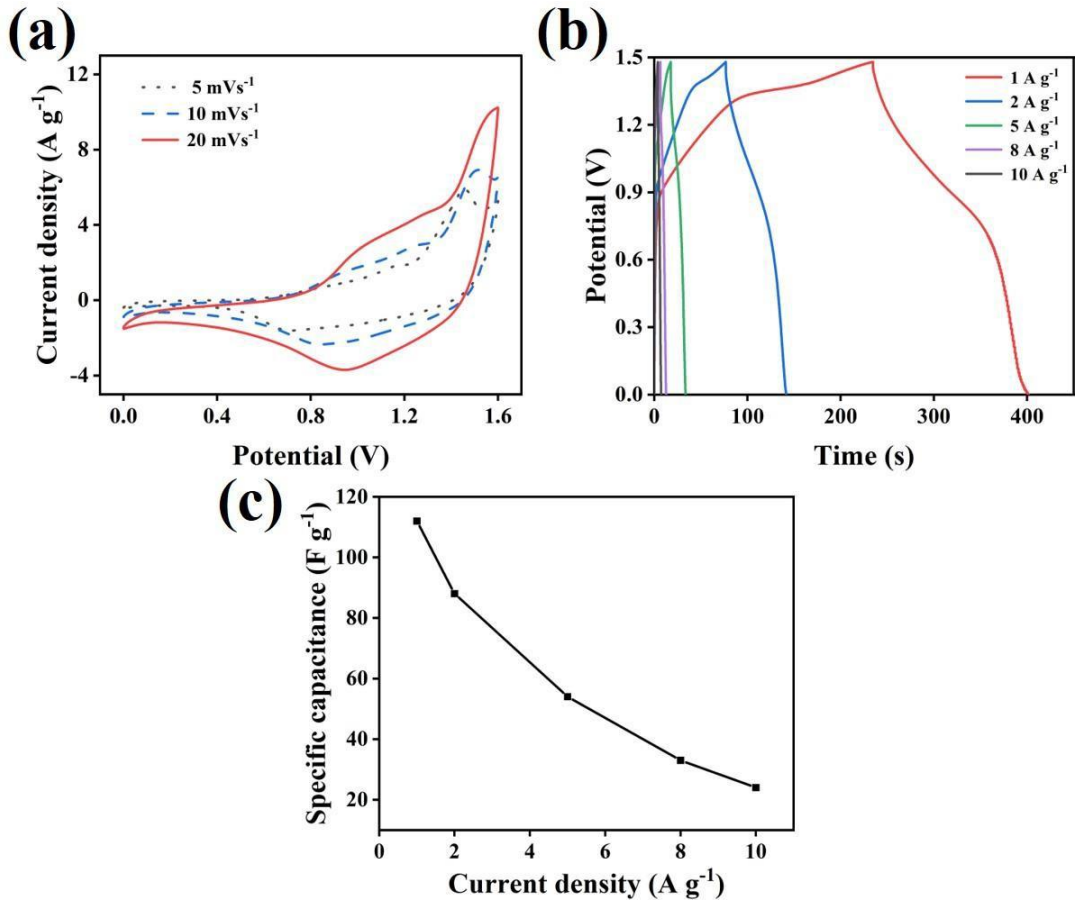


Figure S1. Electrochemical performance Ni-MOF/NF//AC asymmetric supercapacitor: (**a**) CV curves, (**b**) GCD curves, (**c**) specific capacity diagram.

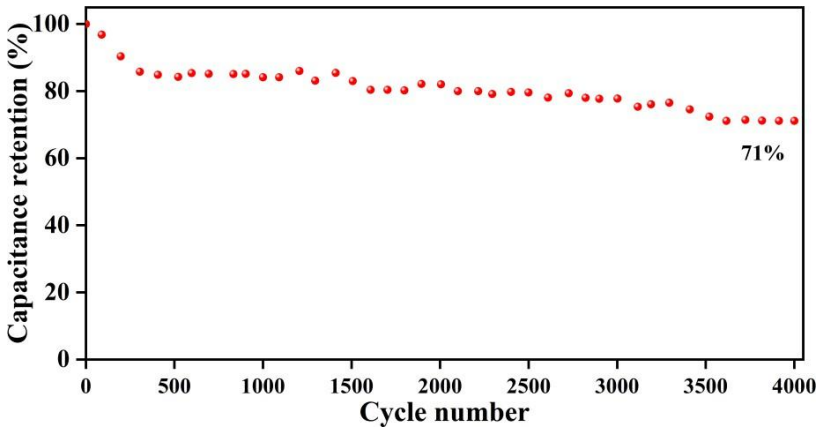


Figure S2. Cyclic performance diagram of Ni-MOF/NF-s//AC.

Table S1. Comparison of the electrochemical properties of Ni-MOF-based asymmetric supercapacitors.

NO.	Sample	Current density (A g^{-1})	Specific capacitance (F g^{-1})	References
1	Ni-MOF/NF-s	1	131	This work
2	3D Ni-MOF	1	66.5	[1]
3	Ni-MOF 1-6	0.5	87	[2]
4	GM-LEG@ Ni-MOF	1	104.5	[3]
5	Ti_3C_2Tx/Ni-MOFs	1	128	[4]
8	NiAl-LDH-0.5/Ni-MOF/S10	1	99.5	[5]
10	Ni-MOF	1	147	[6]
11	Ni-MOF	1	59.4	[7]
12	Co/Ni-MOF-1:15	1	142	[8]

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