Supporting Information

Freestanding transparent metallic network based ultrathin, foldable and designable supercapacitors

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Experimental Procedures for freestanding $Co(OH)_2$@Ni network electrode film

Electrochemical deposition of $Co(OH)_2$ nanosheets on Ni network electrode

The $Co(OH)_2$ nanosheets were electrochemical deposited onto the freestanding Ni network electrode by using a three-electrode configuration, consisting of the freestanding Ni network as the working electrode, platinum wire as the counter electrode and Ag/AgCl as the reference electrode at room temperature. The cleaned freestanding Ni network electrode was immersed in a 0.2 M $CoSO_4$ aqueous electrolyte solution. The electrochemical deposition process was conducted at room temperature over a voltage range from -1.2 to -0.8 V with a voltage scan rate of 20 mV/s for continuous 20 cycles. Then, the obtained freestanding $Co(OH)_2$@Ni network electrode film was thoroughly washed by deionized water to remove the residual electrolyte and dried in air ambient.

Electrochemical characterizations of freestanding $Co(OH)_2$@Ni network electrode film

All electrochemical measurements were performed using a CHI 660B electrochemical workstation (Shanghai CH Instrument Company, China). The tests were conducted in a standard three-electrode system with a 3M KOH electrolyte at room temperature. Here, the freestanding $Co(OH)_2$@Ni network electrode, a platinum wire, and an Ag/AgCl electrode were used as the working electrode, counter electrode, and reference electrode, respectively.

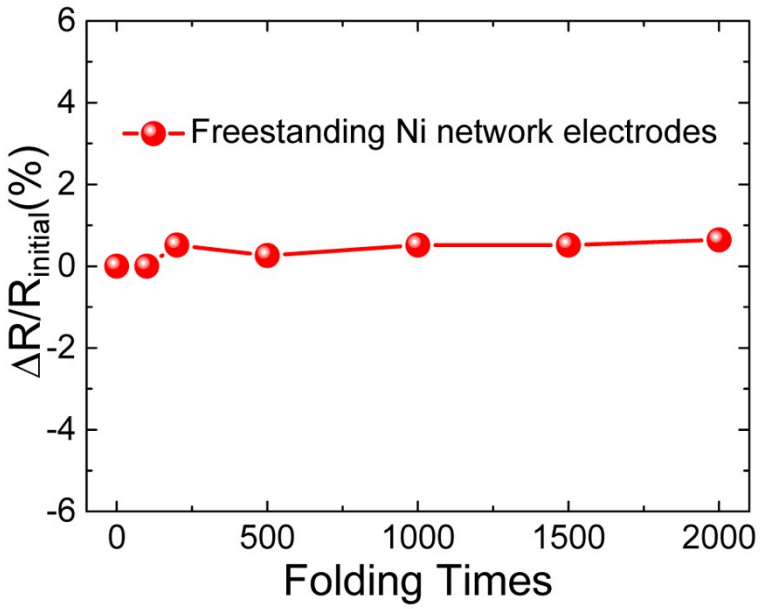

Fig. S1 Normalized variations in sheet resistance of the freestanding Ni network electrode as a function of the repetitive folding cycling times

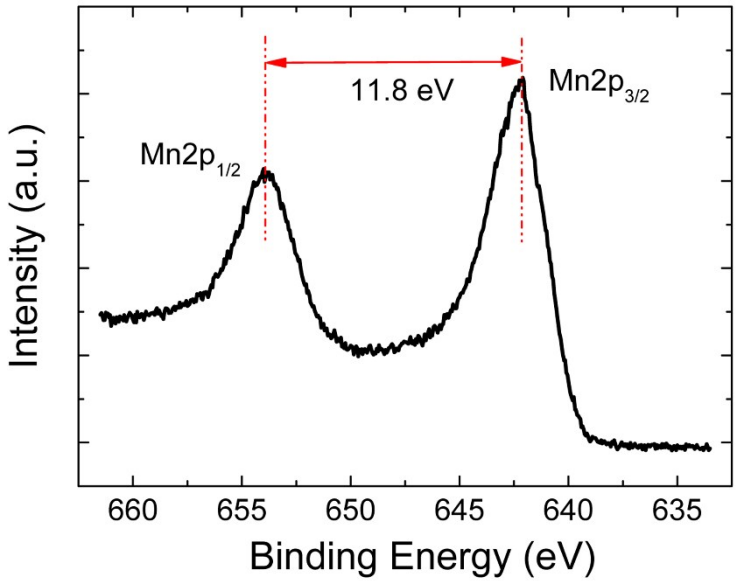

Fig. S2 XPS survey of MnO_2 electrochemical deposited on freestanding Ni network electrode: Mn 2p XPS

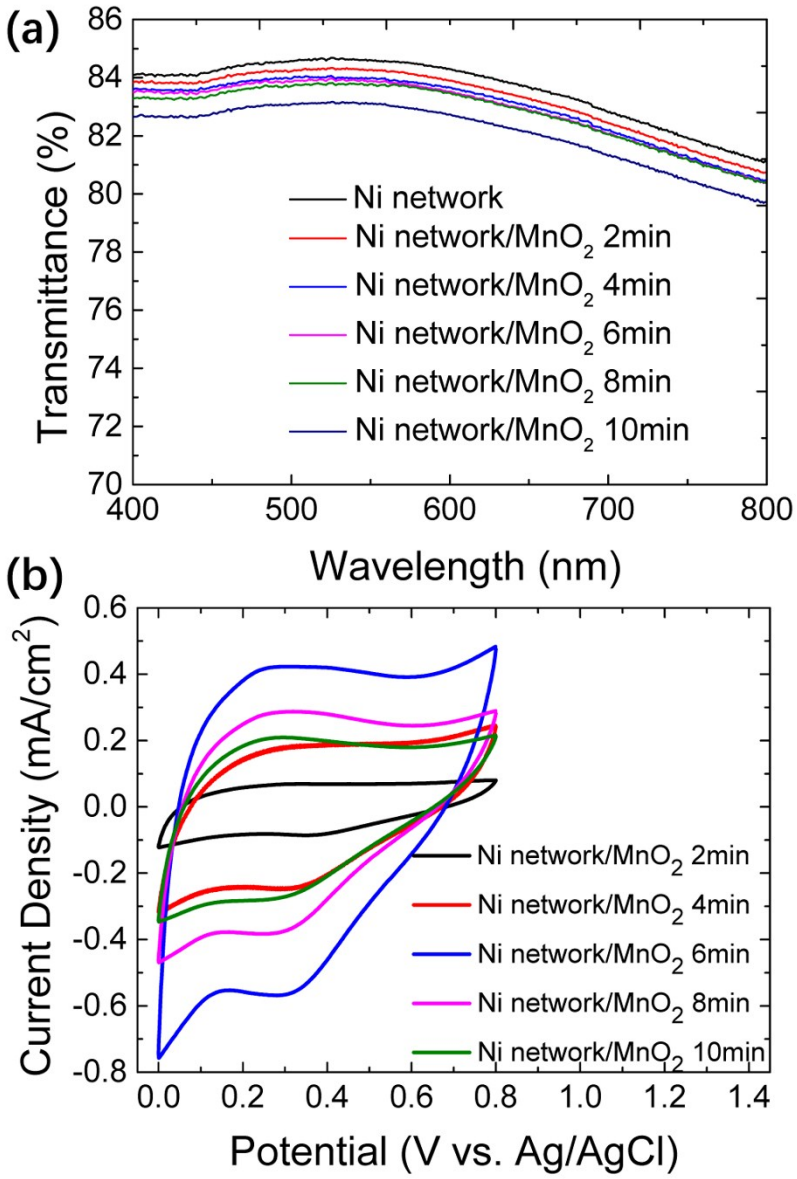

Fig. S3 (a) Transmittance spectra (400-800 nm) of the freestanding Ni network electrode film without MnO_2 and loaded with MnO_2 electrochemical deposition at different deposition time from 2 to 10 min, (b) CV curves of the freestanding Ni network electrode film with MnO_2 electrochemical deposition at different deposition time ranging from 2 to 10 min.

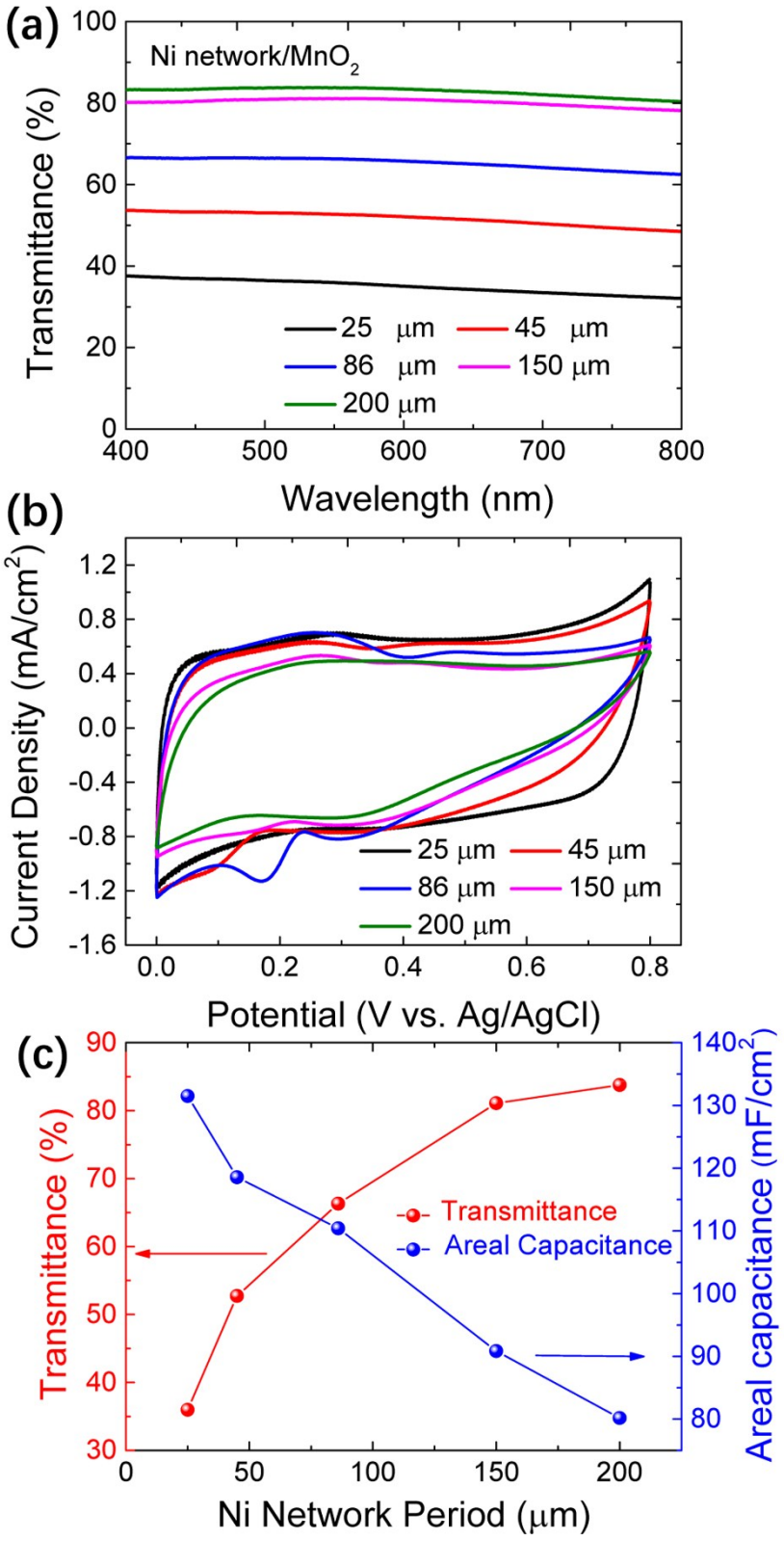

Fig. S4 (a) Transmittance spectra (400-800 nm) and (b) CV curves of the freestanding MnO_2@Ni network electrode film at a different deposition time of 6 min with various network periods ranging from 25 to 200 μm, (c) Extracted optical transmittance value at 550 nm and area capacitance *versus* Ni network period properties.

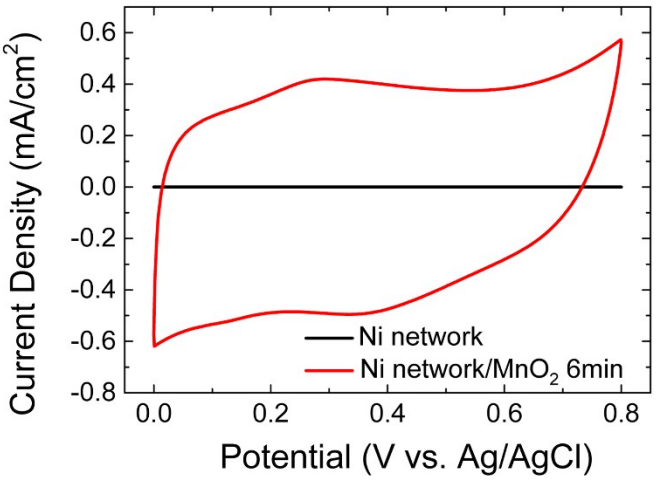

Fig. S5 CV curves of the freestanding Ni network electrode film without MnO_2 and loaded with MnO_2 electrochemical deposition at a deposition time of 6 min in 1M Na_2SO_4 electrolyte

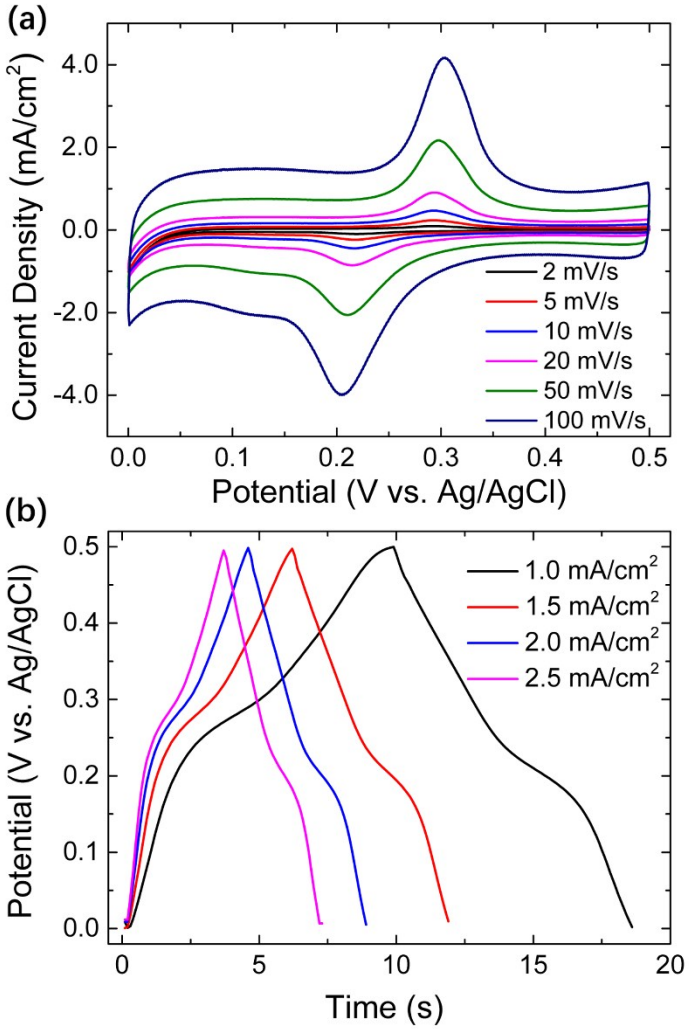

Fig. S6 Electrochemical behaviors of the freestanding $Co(OH)_2$@Ni network electrode film: (a) CV curves in a 3M KOH electrolyte with different scan rates, (b) Galvanostatic charge/discharge curves at various current densities ranging from 1.0 to 2.5 mA/cm^2.

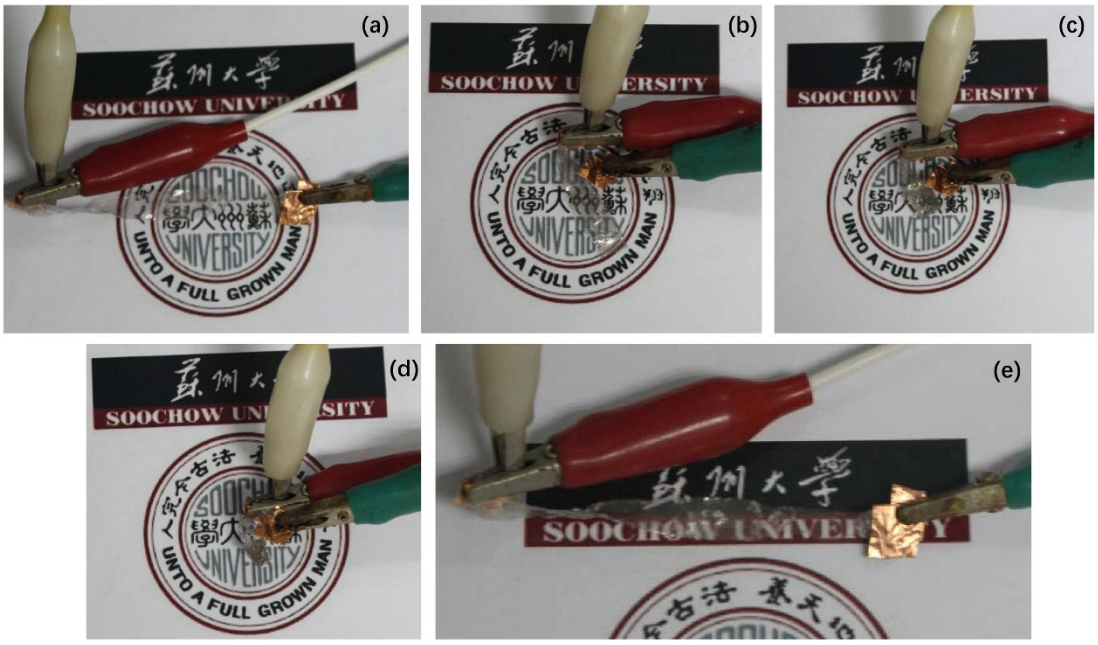

Fig. S7 Photographs of the freestanding ultrathin transparent solid-state supercapacitor device utilizing the freestanding MnO_2@Ni network electrode under different conditions: (a) flat, (b) 2-fold, (c) 4-fold, (d) crumple and (e) after release.

Table S1 A comparative table showing the thickness, transparency, areal capacitance and cycle retention of the flexible transparent supercapacitors utilizing other electrode materials and in this work

Electrode Materials	*Freestanding*	*Thickness (μm)*	*Areal Capacitance (mF/cm²)*	*Transparency* (%)	*Cycle Retention*
graphene-graphene quantum dots[46]	no	>200	0.01	92.97	100% after 10000 cycles
RuO_2/PEDOT:PSS [47]	no	>200	0.84	80.0	93% after 6000 cycles
Graphene paper[39]	yes	--	3.3	59	95.4% after 20000 cycles
Ag–Au core–shell Nanowire[37]	no	--	0.2	--	100% after 500 cycles
PEDOT:PSS/Ag[48]	no	>200	4.52	--	83.7% after 5000 cycles
MnO_2@Ni (This work)	yes	20	10.6	80.7	96.3% after 10000 cycles