Supporting Information

Three-Dimensional Multilevel Porous Thin Graphite Nanosuperstructures for $Ni(OH)_2$-based Energy Storage Devices

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Measurements and calculations of the specific surface area:

The volumetric specific surface areas of Ni foam and porous Cu-Ni foam were characterized by multi-point BET Surface Area Analysis (Pacific Surface Science Inc.) The volume specific surface areas of Ni foam and porous Cu-Ni were determined as 0.0532 m^2/cm^3 and 0.096 m^2/cm^3, respectively.

Then, the volumetric specific surface area of non-porous graphite and porous graphite can be estimated from Ni foam and porous Cu-Ni foam, respectively. Considering the Ni or Cu-Ni etching process resulted double sided (inner/outer) graphite, the volume specific surface area of porous and non-porous graphite became 0.192 m^2/cm^3 and 0.103 m^2/cm^3, respectively.

Of the same volume of 1 cm × 1 cm × 0.02 cm, the masses of porous and non-porous graphite/$Ni(OH)_2$ were measured as 0.2 mg and 0.5 mg, respectively. As a result, the specific surface area normalized by weight could be estimated as 19.2 m^2/g for porous graphite/$Ni(OH)_2$, and 4.12 m^2/g for non-porous one graphite/$Ni(OH)_2$. Note that the estimations shown above didn't take account of the surface area contribution from $Ni(OH)_2$ for either porous or non-

porous graphite/$Ni(OH)_2$.

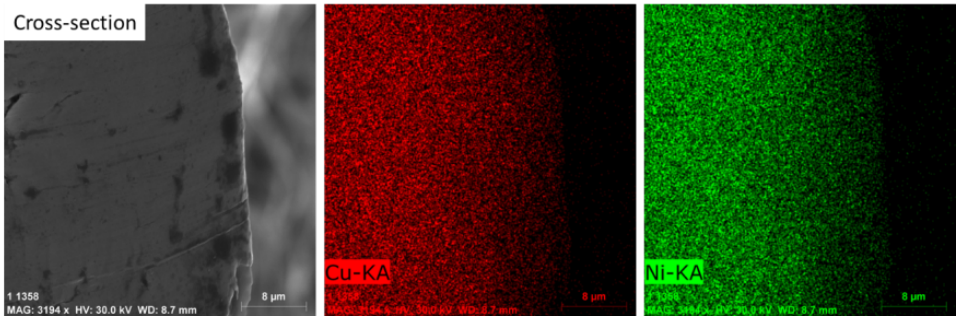

Figure S1. SEM image and EDS mappings of the cross-section of Cu-Ni foam after annealing at 1000° C.

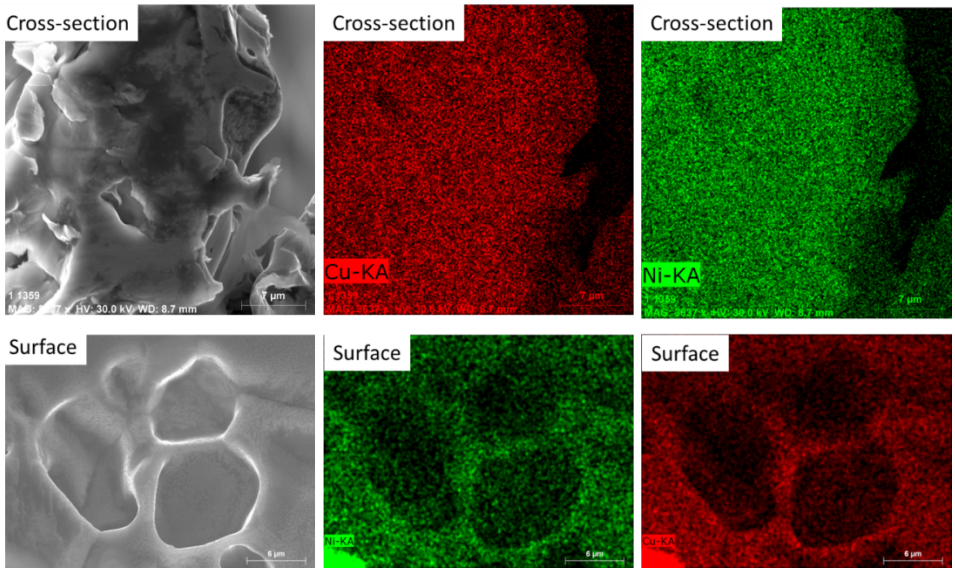

Figure S2. SEM images and EDS mappings of the cross-sections and surfaces of porous Cu-Ni catalysts after electrochemical etching.

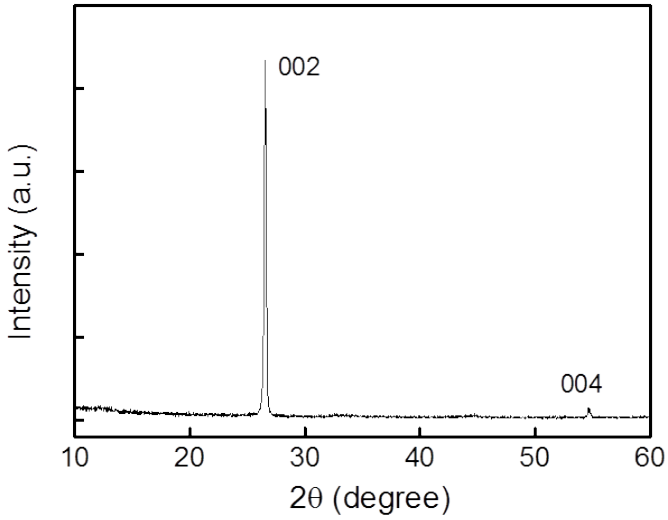

Figure S3. XRD measurement of the freestanding multi-level porous graphite.

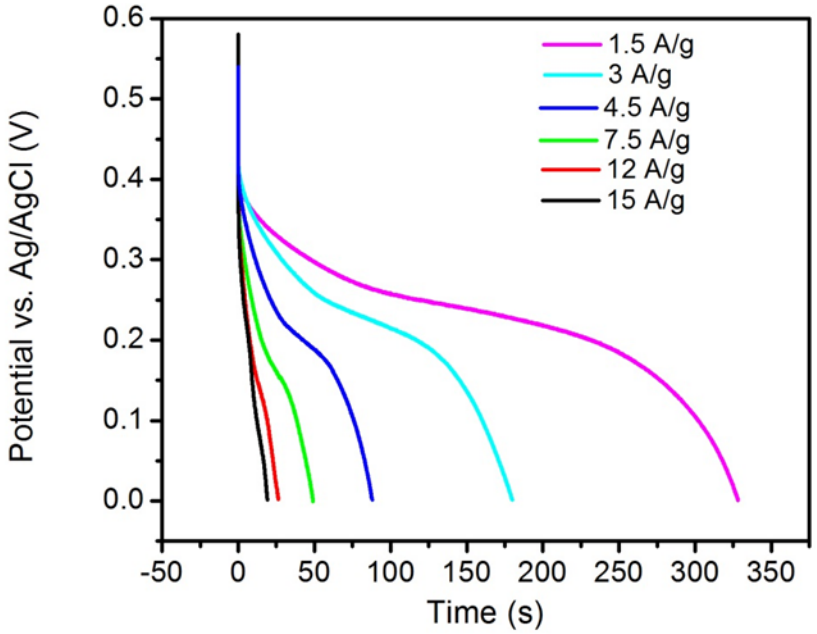

Figure S4. galvanostatic discharging curves of $Ni(OH)_2$ on the porous 3-D graphite.

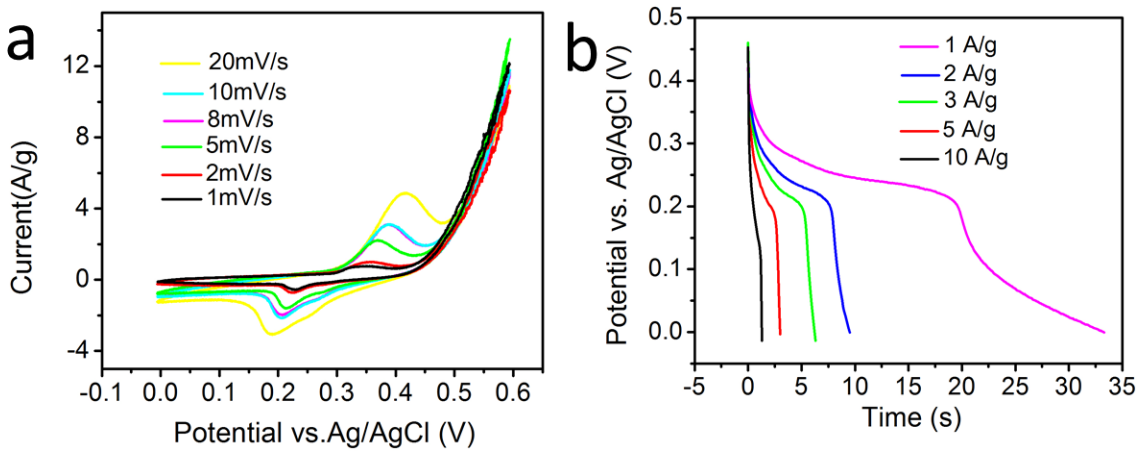

Figure S5. (a, b) Cyclic voltammogram and galvanostatic discharging curves of $Ni(OH)_2$ on the non-porous 3-D graphite.

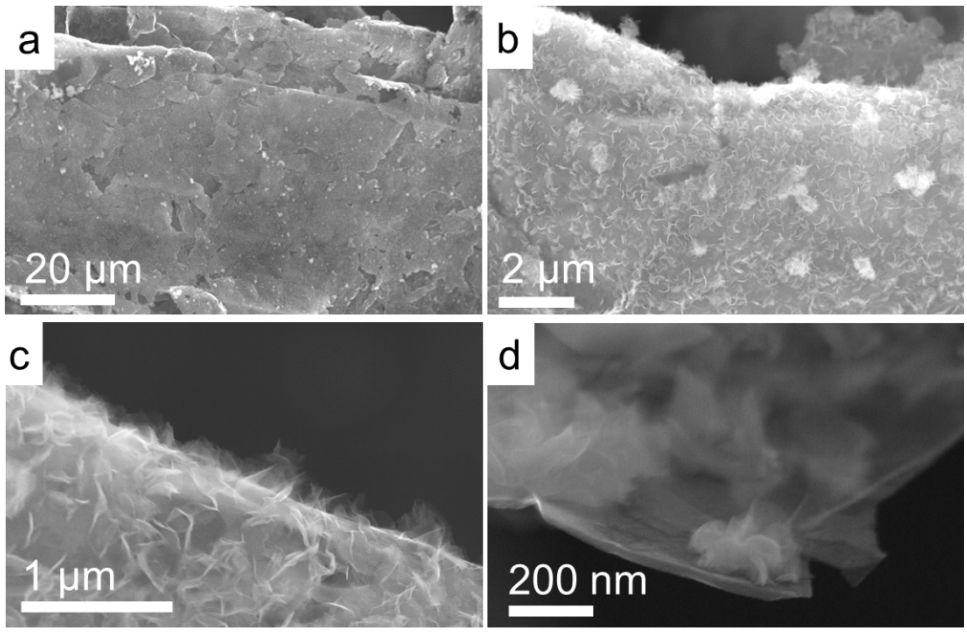

Figure S6. SEM images of $Ni(OH)_2$ nanostructures on the non-porous 3-D graphite.

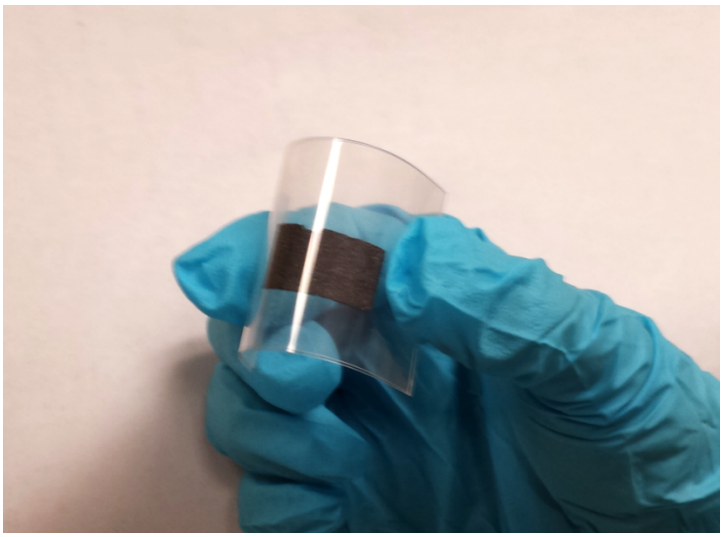

Figure S7. Photo of flexible porous graphite/$Ni(OH)_2$.

Table S1. Summary of electrochemical measurements in recent $Ni(OH)_2$ energy storage devices

Year	Materials	Additives	Supporting Materials and testing conditions	Specific capacitance: $Ni(OH)_2$/*with graphene/**total electrode (current density /scan rate)	Cyclic performance	Specific capacity (calculated from the provided data): $Ni(OH)_2$/*with graphene/**total electrode (mAh/g) (Discharging rate)
2014[1]	**G**raphite $Ni(OH)_2$ nanosheet	HPMC-10 wt%	Ni Foam 6 M KOH 0–1V (Hg/HgO)	1956 F/g * N/A ** ~49/F/g (1 A/g)	70% 1000 cycles (10 A/g)	~278 *N/A ** N/A (1 A/g)
2013[2]	graphite $Ni(OH)_2$ Film	N/A	Ni Foam 6 M KOH 0–0.5 V (Ag/AgCl)	~1560 F/g *N/A **~166 F/g (0.5 A/g)	65% 1000 cycles (10 A/g)	~207 *N/A **~22 (1 A/g)
2013[3]	graphite $Ni(OH)_2$ film	AC-80wt% PVDF-10wt% AB-10wt%	Ni Foam 1 M KOH 0–0.5 V (Ag/AgCl)	~2188 F/g *N/A ** ~16F/g (1 mV/s)	97% 1000 cycles 76% 10000 cycles (100 mV/s)	N/A *N/A **N/A
2013[4]	GrapheneNi(OH)$_2$ flim	PTFE-60wt% hydrogel	Platinum foil 6 M KOH 0–0.5V (Ag/AgCl)	N/A *1327F/g **N/A (2A/g)	~95% 2000 cycles (16 A/g)	~ N/A *~156 **N/A (2 A/g)
2012[5]	graphite $Ni(OH)_2$ film	AM-75% PTFE-5% AB-20%	Ni Foam 6 M KOH 0–0.5V (Hg/HgO)	1735F/g * N/A ** ~43 F/g (1 mV/s)	N/A	N/A *N/A **N/A
2012[6]	graphite $Ni(OH)_2$ nanosheet	AM-75% PTFE-5% AB-20%	Ni Foam 6 M KOH -0.1–0.45V (SCE)	2194 F/g * N/A ** 55 F/g (2 mV/s)	95.7% 2000 cycles (100 mV/s)	N/A *N/A **N/A
2011[7]	Ni foam $Ni(OH)_2$ nanowoall	No additive	Ni Foam 1 M NaOH 0–0.55V (SCE)	2675F/g * No graphite **~7 F/g (5mV/cm^2)	>96% 500 cycles (30mV/cm^2)	N/A *No graphite **~24 (5mV/cm^2)

2010[8]	graphene $Ni(OH)_2$ nanosheet	PTFE-1%	Ni Foam 3% KOH 0–0.5 V (Ag/AgCl)	1335 F/g *~935 F/g ** ~33F/g (2.8 A/g)	~100% 2000 cycles (28.6 A/g)	~250 *~170 ** N/A (2.8 A/g)
2008[9]	Ni foam $Ni(OH)_2$ nanosheet	No additive	Ni Foam 1 M NaOH -0.05–0.55V (SCE)	3125 F/g * No graphite **~39 F/g (4 A/g)	~48% 300 cycles (4 A/g)	~444 *No graphite **~6 (4 A/g)
This work	Porous graphite / $Ni(OH)_2$ sheet	No additive	Self supported 1 M KOH 0–0.6 V (Ag/AgCl)	3125 F/g (2 mV/s) *1149 F/g **1149 F/g (1.5 A/g)	97.5% 4,000 cycles (20A/g)	480 *137 **137 (1.5 A/g)

1. Footnotes: *Since most references didn't include the mass information of the substrates, i.e. Ni foams, Ti foils, or carbon papers. Here, we assume commercial available substrates were used. The density of commercially available 1.6 mm thick Ni foams and 0.1 mm Ti foil s are ~ 40 mg/cm^2 and ~45 mg/cm^2, respectively. All the parameters in the table have been given on the base of the three-electrode systems.*

   (PTFE: poly(tetrafluoroethylene;AM: active materials; AB: acetylene black or carbon black; PVDF: polyvinylidene difuoride.)

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