Supporting Information:

Pine Needle-Derived Microporous Nitrogen-doped Carbon Frameworks with High Performances for Electrocatalytic Hydrogen Evolution and Supercapacitors

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Table S1. Electrocatalytic HER performance of PNC material in this work compared with those of other materials in the literature.

Ref.	HER catalyst	Onset overpotential (V)	Tafel slope (mV/dec)	η (mV) at J = −10 mA/cm^2
This work	**PNC-800**	**-0.004**	**45.9**	**-62**
[23]	Root nodules-800	-0.027	67.8	--
[27]	Ggraphitic carbon nitride nanoribbon-graphene	-0.08	54	-207
[28]	Ggraphitic carbon nitride@ nitrogen-doped graphene	-0.12	51.1	-240
[29]	N, P-graphene-1	-0.289	91	-422
[30]	N and S co-doped nanoporous graphene	-0.13	81	-276
[31]	monolayer MoS_2 supported by nanoporous gold	-0.12	46	-226
[32]	MoS_2 Nanosheets	–0.12	50	-180
[33]	CoS_2 Nanowires	--	51.6	~145

Table S2. Supercapacitive performance of PNC material in this work compared with those of other materials in the literature.

Ref.	Biomass Precursor	Specific capacitance (C_s, F/g)	Measurement Condition	Electrolyte
This work	**PNC-900**	**236** **212** **183**	**0.1 A/g** **1.0 A/g** **20.0 A/g**	**6.0 M KOH**
[26]	human hairs	340	1.0 A/g	6.0 M KOH
[34]	microalgae	200	0.1 A/g	6.0 M LiCl
[35]	broad bean shells	202	0.5 A/g	6.0 M KOH
[36]	fungi	158	0.1 A/g	1.0 M $TEABF_4$
[37]	seaweed biopolymer	198	2 mV/s	1.0 M H_2SO_4
[38]	silk proteins	264	0.1 A/g	1.0 M H_2SO_4
[39]	corn cob	221	1.0 A/g	0.5 M H_2SO_4
[40]	rice husks	112	1.0 A/g	1.0 M Na_2SO_4
[41]	eggshell membranes	228	4.0 A/g	1.0 M KOH
[42]	beverages	149	5 mV/s	6.0 M KOH

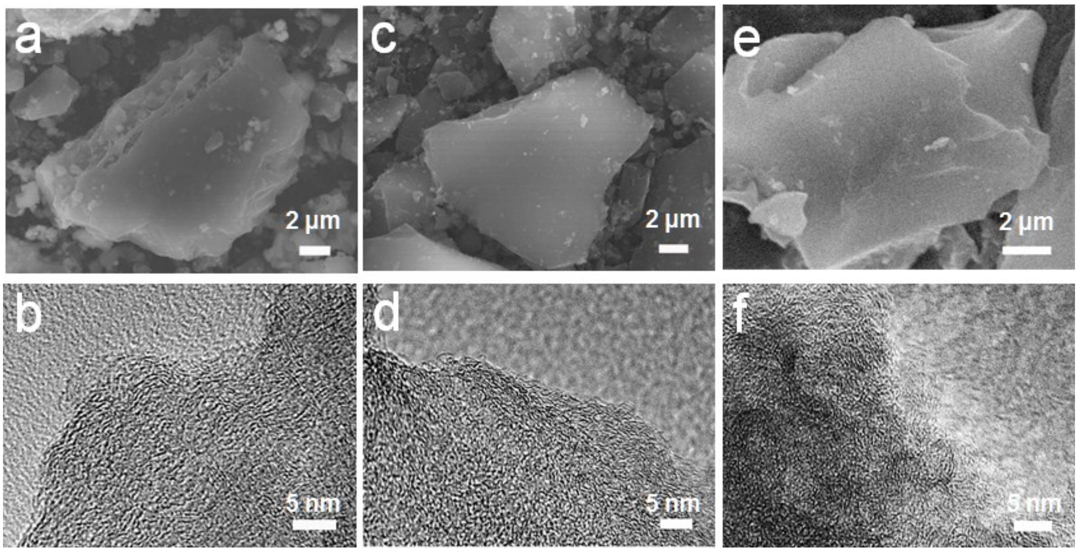

Figure S1. SEM and TEM images of (a,b) PNC-700, (c,d) PNC-800 and (e,f) PNC-1000, respectively, showing similar morphology compared to that of PNC-900.

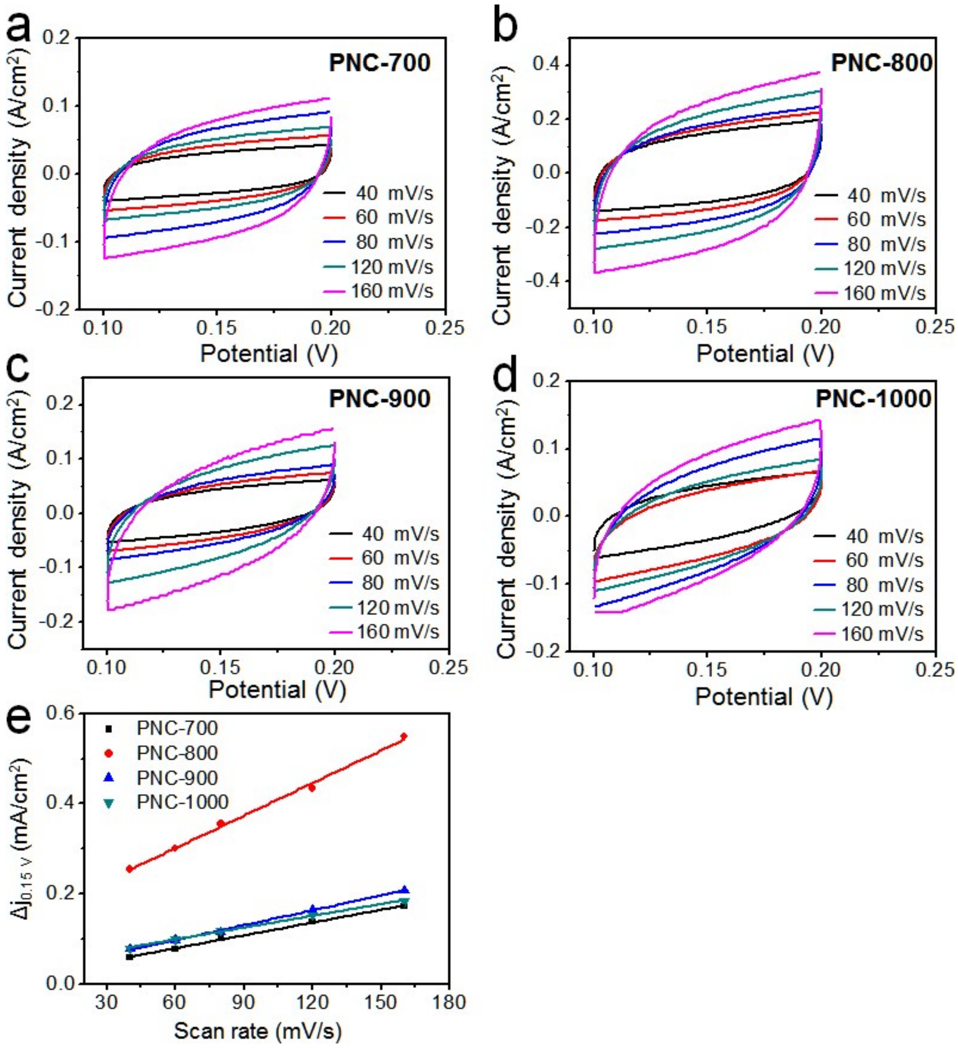

Figure S2. (a-d) CV curves of PNC based electrodes at various scan rates ranged between 40–160 mV/s. (e) Capacitive currents of PNC based electrodes at 0.15 V as a function of scan rate.

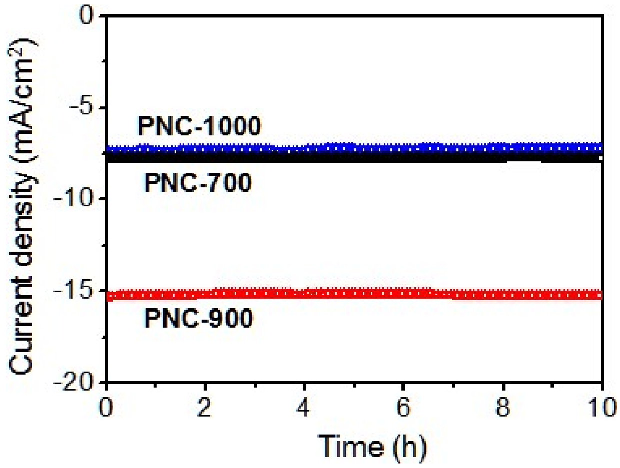

Figure S3. Time-dependent current density curves of PNC-700, PNC-900, and PNC-1000 under a static overpotential of -0.10 V for 10 h.

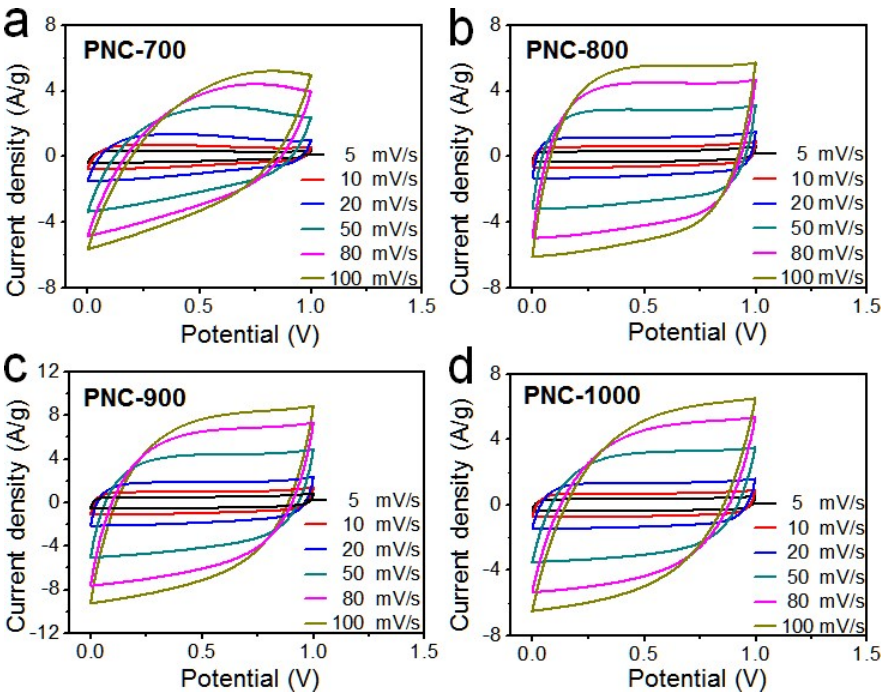

Figure S4. CV curves of (a) PNC-700, (b) PNC-800, (c) PNC-900 and (d) PNC-1000 based supercapacitors at the scan rates between 5−100 mV/s, respectively.

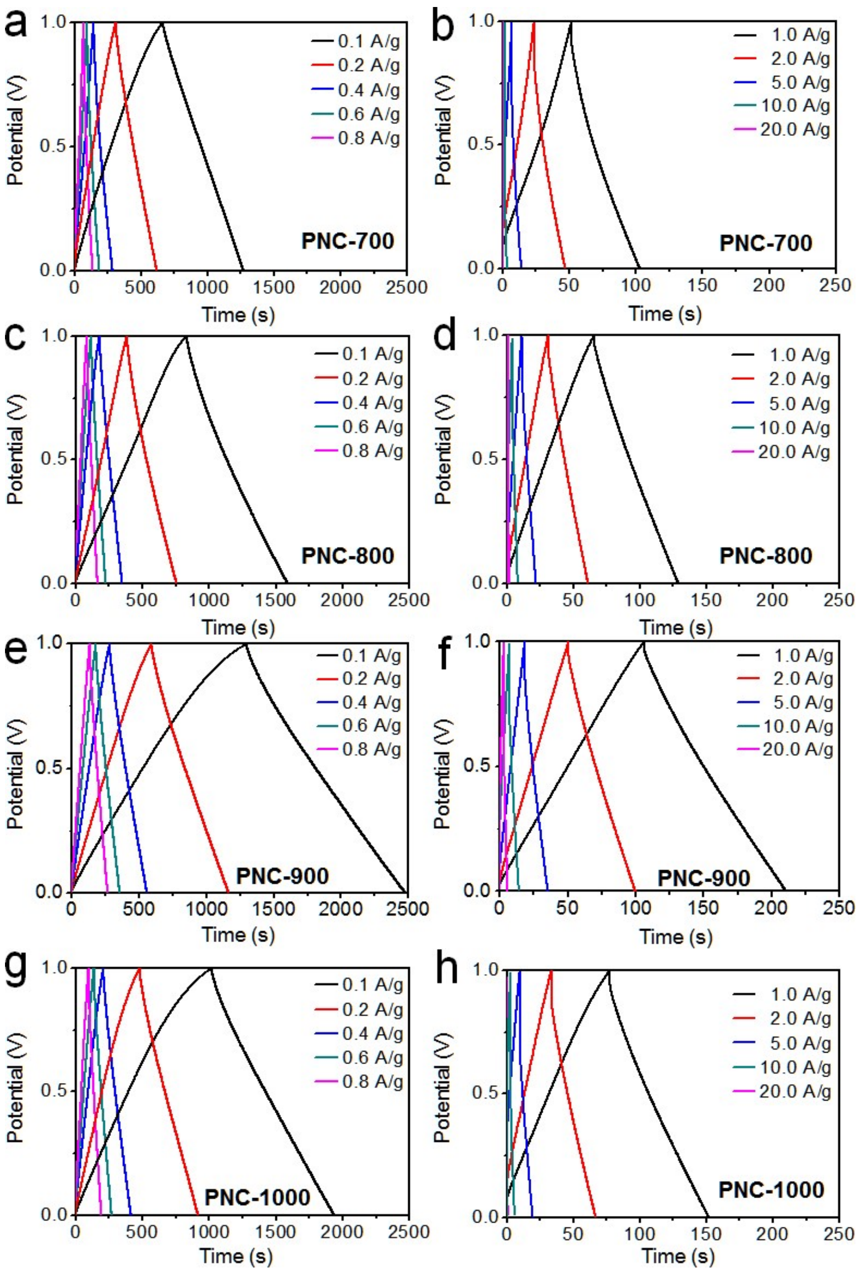

Figure S5. Galvanostatic charge-discharge curves of (a,b) PNC-700, (c,d) PNC-800, (e,f) PNC-900 and (g,h) PNC-1000 based supercapacitors in a range of current densities from 0.1 to 20 A/g.

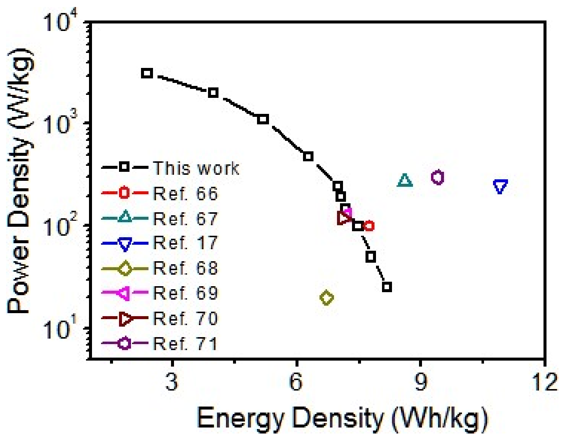

Figure S6. Ragone plots (power density *vs.* energy density) of PNC-based supercapacitors in comparison with other previously-reported N-doped carbon materials.

Table S3. Comparison of the area-normalized capacitances of PNC-900 and other previously-reported N-doped carbon materials.

Ref.	Samples	Area-normalized capacitance (C_A, μF/cm^2)	Measurement Condition
This work	**PNC-900**	**9.7**	**0.1 A/g**
[72]	N-doped carbon capsules (N-CC)	14.8	0.1 A/g
[73]	carbonated PANi (CP)	6	-
[74]	nanoporous carbon-1 (CNX-1)	8	0.25 A/g
[75]	carbon nanosheets-700 (CNS-700)	6.8	1.0 A/g
[17]	hierarchical nitrogen-doped carbon nanocages-800 (hNCNC800)	17.4	1.0 A/g
[76]	polypyrrole-derived activated carbons-700 (AC-P700)	7.6	1.0 mV/s