Supporting Information

Modulating the porosity of N-doped carbon materials for enhanced CO_2 capture and methane uptake

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Table S1. CO_2 uptake capacity of various porous carbons at 25 °C and 0.15 bar or 1 bar (The data in the table is adapted from reference 29 in main manuscript).

	CO_2 uptake (mmol/g)		Reference
	1 bar	0.15 bar	
Sawdust-derived activated carbon	4.8	1.2	1
Petroleum pitch-derived activated carbon	4.55	~1.0	2
Activated carbon spheres	4.55	~1.1	3
Phenolic resin activated carbon spheres	4.5	~1.2	4
Fungi-derived activated carbon	3.5	~1.0	5
Chitosan-derived activated carbon	3.86	~1.1	6
Polypyrrole derived activated carbon	3.9	~1.0	7
Soya bean derived N-doped activated carbon	4.24	1.2	8
N-doped ZTCs	4.4	~1.0	9
Activated templated N-doped carbon	4.5	1.4	10
Polyaniline derived activated carbon	4.3	1.38	11
N-doped activated carbon monoliths	5.14	1.25	12
Activated hierarchical N-doped carbon	4.8	1.4	13
Activated N-doped carbon from algae	4.5	~1.1	14
Compactivated carbons from sawdust	5.8	2.0	15
Fern-derived activated carbon	5.67	~1.7	16
Compactivated carbons from polypyrrole	5.5	2.1	17
Clove-derived activated carbon	5.4	1.4	18
Potassium oxalate-activated carbon from date seed	5.0	1.8	19
Potassium phthalimide derived carbons	5.2	1.7	20

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Table S2. Methane uptake for the best performing N-doped activated carbons compared to selected benchmark MOFs and carbons reported in the literature. Volumetric uptake of powder MOFs is calculated based on crystallographic density rather than packing density.

Sample	Density ($g\ cm^{-3}$)	65 bar ($g\ g^{-1}$)	65 bar ($cm^3\ cm^{-3}$)	80 bar ($g\ g^{-1}$)	80 bar ($cm^3\ cm^{-3}$)	100 bar ($g\ g^{-1}$)	100 bar ($cm^3\ cm^{-3}$)	Reference
DSM2800-1	0.65	0.25	230	0.27	248	0.29	266	This work
DSM4700-1	0.59	0.27	219	0.29	237	0.31	256	This work
DSU4800-1	0.41	0.35	197	0.39	217	0.42	239	This work
PPI-800-2	0.92	0.21	270	0.22	287	0.25	309	1
PPI-900-2	0.87	0.23	283	0.25	303	0.28	331	1
PPI-1000-2	0.83	0.25	288	0.27	311	0.29	338	1
CHCC2800	0.82	0.26	293	0.28	315	0.30	339	2
CHCC4700	0.75	0.27	282	0.29	306	0.32	334	2
CHCC4800	0.58	0.32	258	0.35	279	0.38	309	2
CNL4800	0.67	0.26	241	0.29	269	0.31	291	3
PPYCNL124	0.52	0.30	217	0.33	238	0.36	260	3
PPYCNL214	0.36	0.36	183	0.41	204	0.46	229	3
ACDS4800	0.69	0.25	243	0.27	262	0.29	282	3,4
PPYSD114	0.47	0.32	211	0.35	231	0.39	254	4
AX-21 carbon	0.487	0.30	203	0.33	222	0.35	238	5
HKUST-1	0.881	0.21	263	0.22	272	0.23	281	5
Ni-MOF-74	1.195	0.15	259	0.16	267	0.17	277	5
Al-soc-MOF-1	0.34	0.41	197	0.47	222			6
MOF-210	0.25	0.41	143	0.48	168			7
NU-1500-Al	0.498	0.29	200	0.31	216	0.34	237	8
NU-1501-Fe	0.299	0.40	168	0.46	193	0.52	218	8
NU-1501-Al	0.283	0.41	163	0.48	190	0.54	214	8
$_{mono}$HKUST-1	1.06	0.17	261	0.18	278	0.18	275	9
$_{mono}$UiO-66_D	1.05	0.14	210	0.17	245	0.20	296	10

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Table S3: Methane uptake working capacity for N-doped activated carbons compared to selected benchmark MOFs and carbons reported in the literature.

Sample	65 bar		80 bar		100 bar		Reference
	($g\ g^{-1}$)	($cm^3\ cm^{-3}$)	($g\ g^{-1}$)	($cm^3\ cm^{-3}$)	($g\ g^{-1}$)	($cm^3\ cm^{-3}$)	
DSM2800-1	0.17	159	0.19	177	0.21	195	This work
DSM4700-1	0.20	159	0.22	177	0.24	196	This work
DSU4800-1	0.27	151	0.31	171	0.34	193	This work
PPI-800-2	0.13	174	0.14	190	0.16	212	1
PPI-900-2	0.15	183	0.17	203	0.19	231	1
PPI-1000-2	0.17	199	0.19	222	0.21	249	1
CHCC2800	0.18	200	0.20	222	0.22	246	2
CHCC4700	0.20	210	0.22	234	0.25	262	2
CHCC4800	0.25	197	0.28	218	0.31	248	2
CNL4800	0.19	182	0.22	202	0.24	224	3
PPYCNL124	0.23	167	0.26	188	0.29	209	3
PPYCNL214	0.29	146	0.34	167	0.39	192	4
ACDS4800	0.18	171	0.20	189	0.22	209	3,4
PPYSD114	0.25	162	0.28	182	0.32	205	4
AX-21 carbon	0.23	155	0.26	174	0.28	190	5
HKUST-1	0.15	179	0.16	198	0.17	207	5
Ni-MOF-74	0.08	148	0.09	152	0.10	162	5
Al-soc-MOF-1	0.36	176	0.42	201			6
MOF-210	0.38	134	0.45	157			7
NU-1500-Al	0.24	165	0.26	181	0.29	202	8
NU-1501-Fe	0.36	151	0.42	176	0.48	201	8
NU-1501-Al	0.37	147	0.44	174	0.50	198	8
$_{mono}$HKUST-1	0.12	184	0.13	201	0.13	198	9
$_{mono}$UiO-66_D	0.11	167	0.14	202	0.17	253	10

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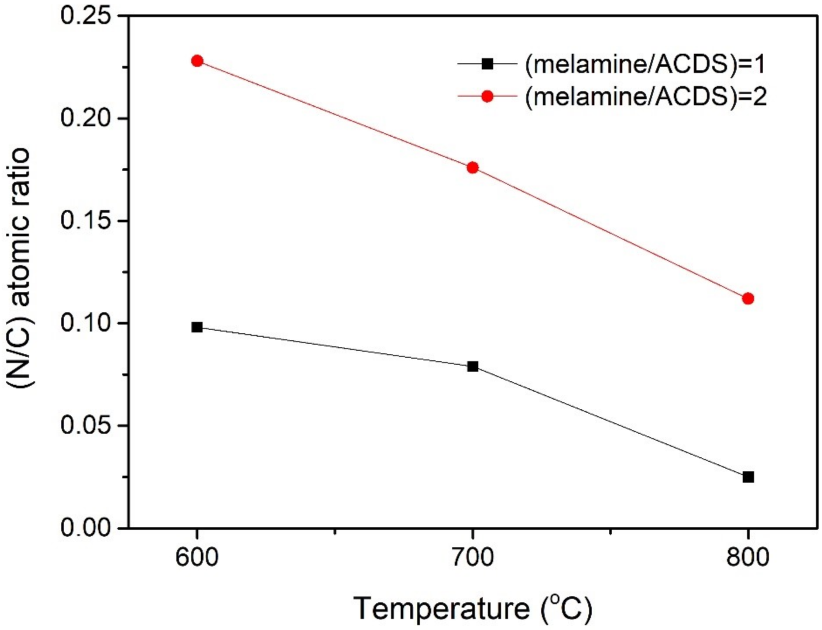
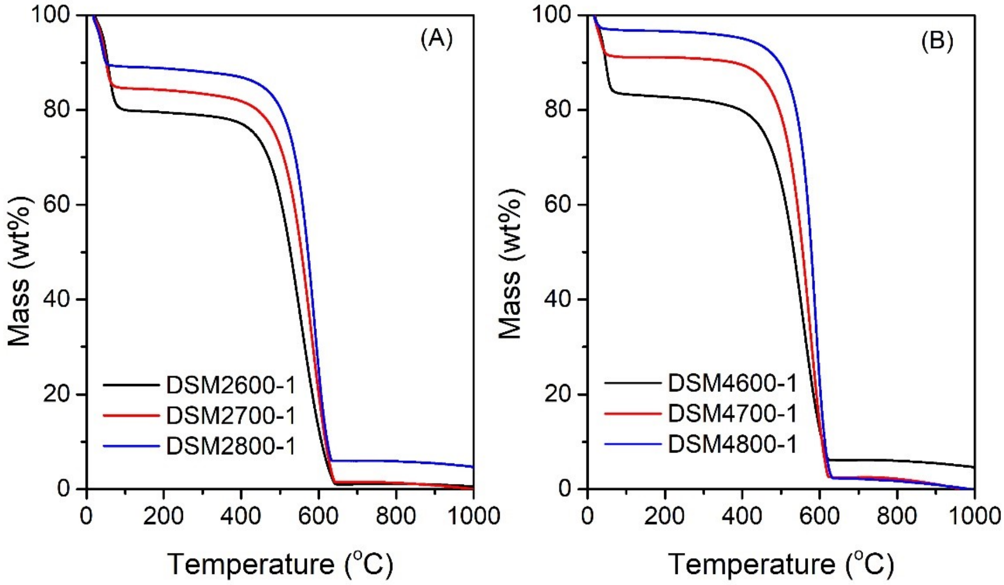
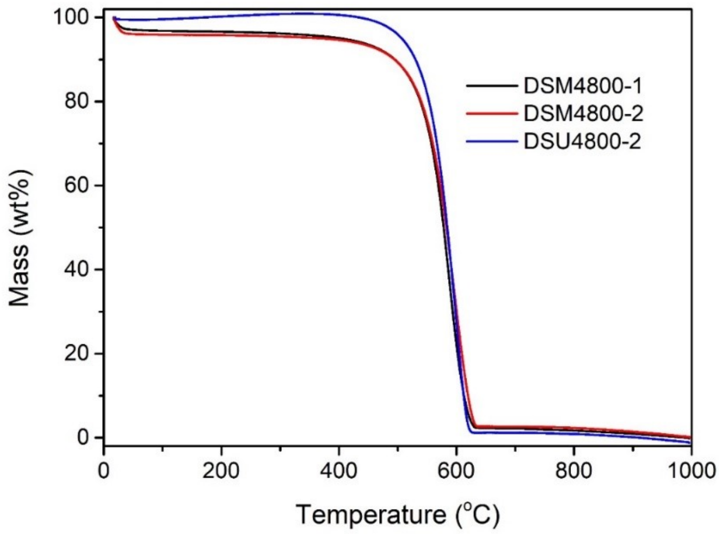
Supporting Figure 1. Photograph of the attempted activation of melamine and urea.



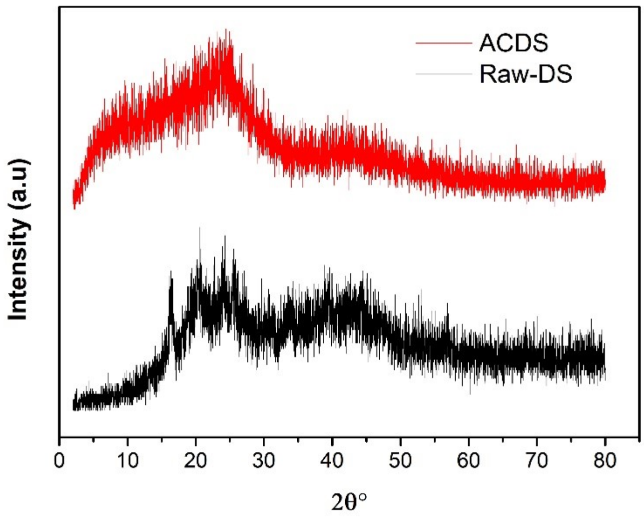
Supporting Figure 2. The N/C atomic ratio of activated carbons as a function of the activation temperature.



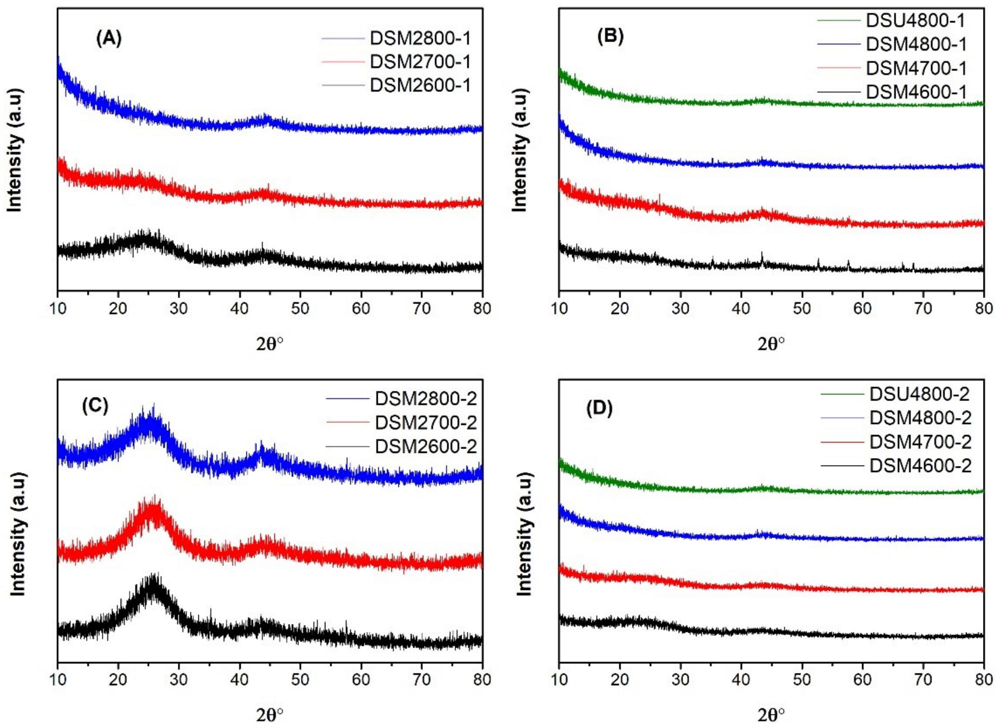
Supporting Figure 3. TGA curves of N-doped activated carbons prepared at KOH/ACDS ratio of 2 or 4 at 600, 700 or 800 °C and melamine/ACDS ratio of 1.



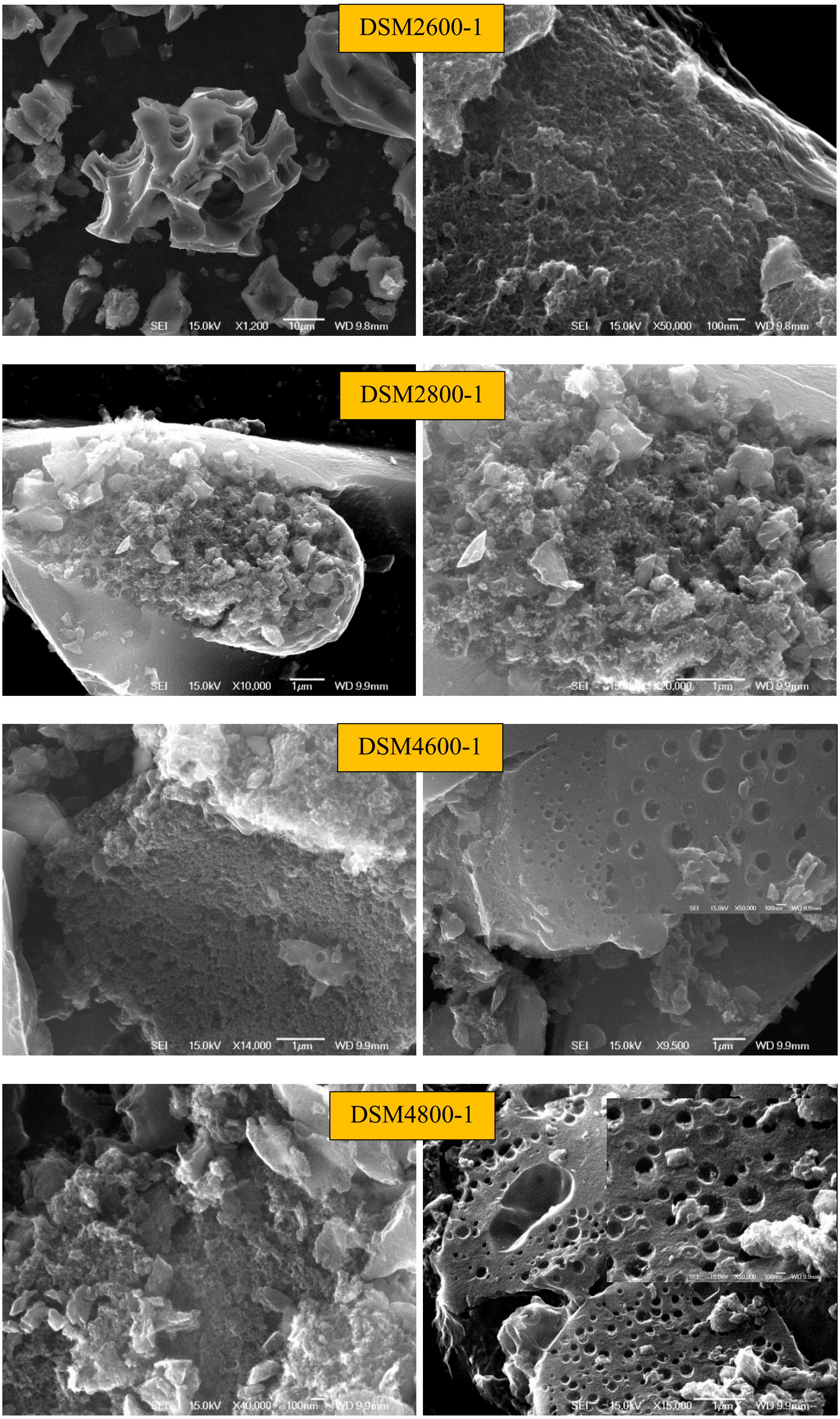
Supporting Figure 4. TGA curves of N-doped activated carbons prepared at 800 °C and KOH/ACDS ratio of 4 and various amounts of melamine or urea.



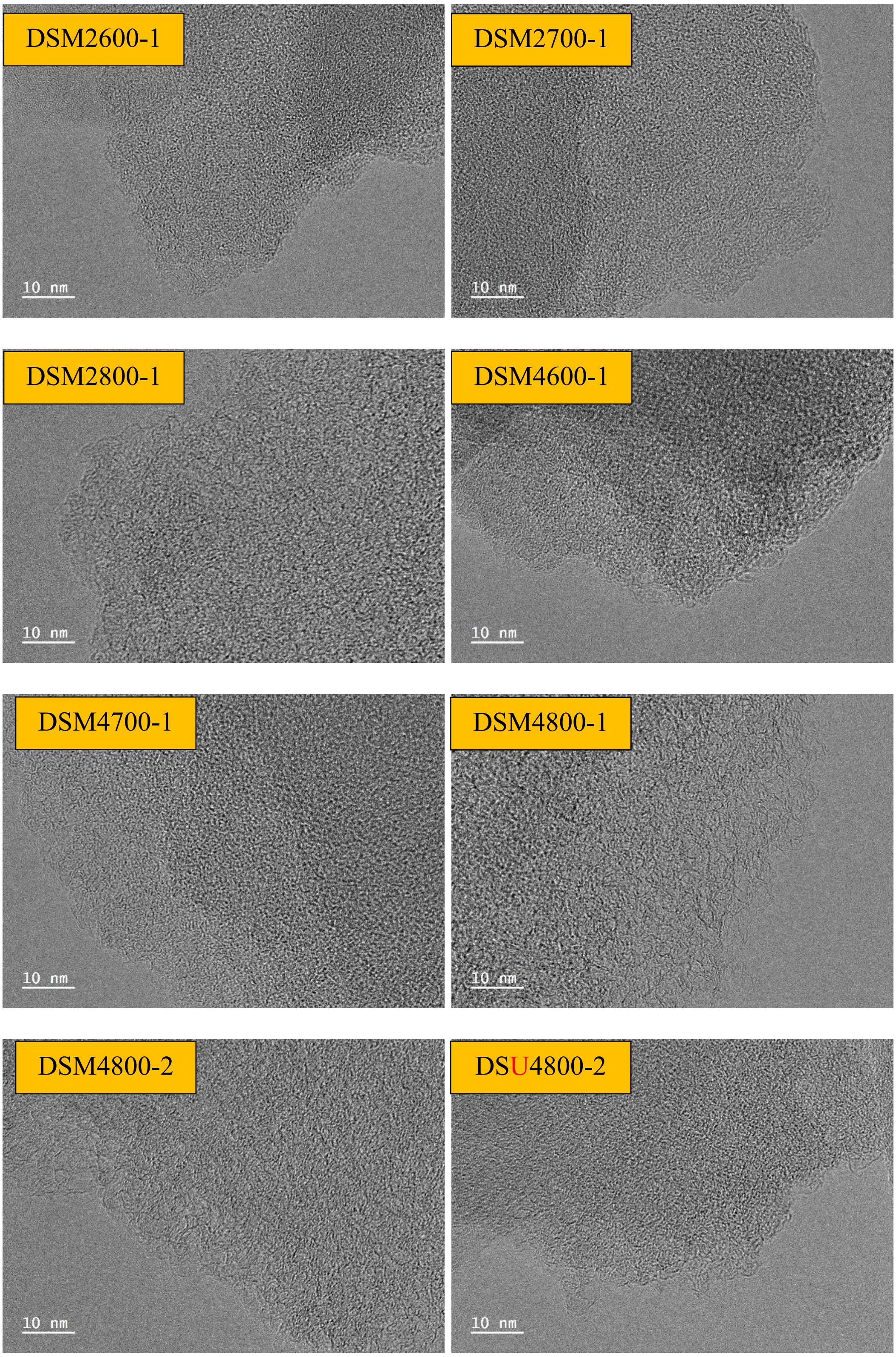
Supporting Figure 5. Powder XRD patterns of raw date seeds (Raw-DS) and air-carbonised dated seeds (ACDS).



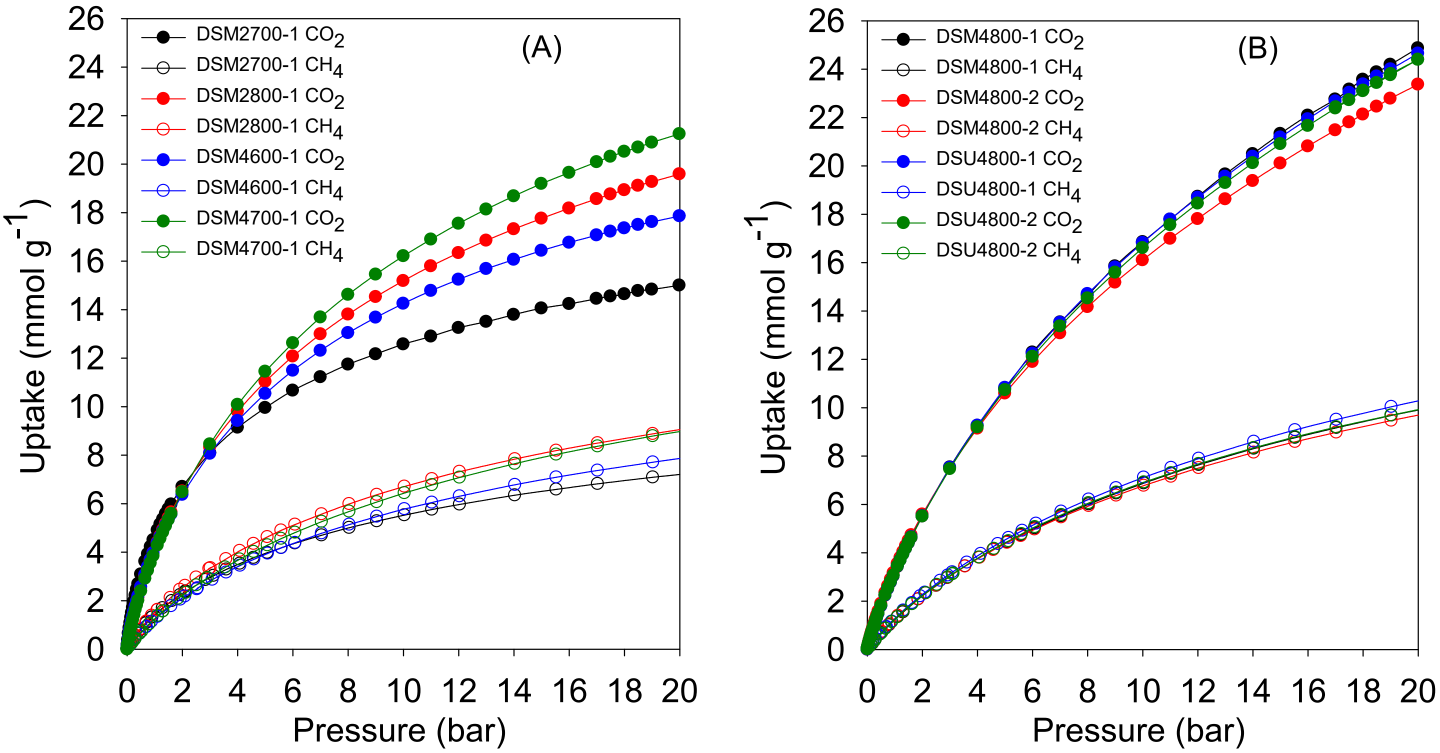
Supporting Figure 6. Powder XRD patterns of N-doped carbons activated at KOH/ACDS ratio 2 or 4 with melamine or urea as dopants.



Supporting Figure 7. SEM images of selected N-doped activated carbons.



Supporting Figure 8. TEM images of selected N-doped activated carbons.



Supporting Figure 9. Excess CO_2 and methane uptake of N-doped carbons.