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Electronic Supplementary Information

Size-controlled nitrogen-containing mesoporous carbon nanospheres

by one-step aqueous self-assembly strategy†

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Table S1 Synthesis parameters, particle size of spherical nitrogen-containing resols-F127 composites (APS)

Sample	Ammonia (M)	F127 (mM)	H ₂ O (ml)	HMT (mmol)	MAP (mmol)	TMB (mmol)	Particle Size (nm)
APS-1	0.37	0	52	5	10	-	-
APS-2	0.37	1.5	52	5	10	-	-
APS-3	0.37	3.8	52	5	10	-	-
APS-4	0.37	4.6	52	5	10	-	324±45
APS-5	0.37	5.3	52	5	10	-	136±14
APS-6	0.37	6.1	52	5	10	-	-
APS-7	0	4.6	52	5	10	-	-
APS-8	0.14	4.6	52	5	10	-	-
APS-9	0.57	4.6	52	5	10	-	302±31
APS-10	0.71	4.6	52	5	10	-	221±28
APS-11	0.86	4.6	52	5	10	-	202±16
APS-12	0.37	4.6	52	5	10	3.3	-

Table S2 Texture properties of NMCS with different particle sizes.

Sample	Particle size (nm)	Pore Size (nm)	V_{micro} ($\text{cm}^3 \text{g}^{-1}$)	S_{BET} ($\text{m}^2 \text{g}^{-1}$)	V_{t} ($\text{cm}^3 \text{g}^{-1}$)
NMCS-1-600	-	-	0.15	403	0.19
NMCS-7-600	-	4.7	0.14	497	0.32
NMCS-8-600	-	4.7	0.14	517	0.33
NMCS-4-600	225 ± 23	4.2	0.14	497	0.36
NMCS-9-600	163 ± 23	4.0	0.14	469	0.38
NMCS-10-600	143 ± 17	4.0	0.15	532	0.41
NMCS-11-600	119 ± 14	4.0	0.17	595	0.50
NMCS-5-600	97 ± 13	4.0	0.18	629	0.57
NMCS-4-800	164 ± 23	4.2	0.24	793	0.54
NMCS-12-600	~100	5.1	0.13	492	0.52

Table S3 Elemental composition of the typical samples from Elemental analysis and XPS spectra.

Sample	XPS				Elemental analysis				
	C (at%)	N (at%)	O (at%)	N/C	C (wt%)	N (wt%)	O (wt%)	H (wt%)	C/N/H/O
APS-4	74.3	5.1	20.6	0.069	65.9	3.8	23	7.3	100/5.8/11.1/24.9
NMCS-1-600	87.2	5.3	7.4	0.061	82.4	7.4	8.5	1.7	100/9.0/2.1/10.3
NMCS-4-600	88.0	4.5	7.4	0.051	81.5	7.3	9.3	1.9	100/8.9/2.3/11.4
NMCS-4-800	91.2	3.1	5.7	0.033	86.0	4.4	8.4	1.2	100/5.11/9.8/1.4
CMK-3	95.4	-	4.2	0	-	-	-	-	-
N-CMK-3 ^a	93.9	1.3	4.8	0.014	-	-	-	-	-

a: N-CMK-3 represents the nitrogen-containing CMK-3, which is synthesized through two-step method: CMK-3 is firstly oxidized by concentrated HNO₃ at 60 °C for 3 h and then treated by ammonia at 800 °C for 3 h.

Table S4 Sample denotations and comparison of the fit parameters from the peaks fitted in the Raman spectra of NMCS before and after reaction.

	Sample	Description	Position (cm^{-1})	Area (a.u.)	FWHM (cm^{-1})	I_D/I_G
Before Reaction	NMCS-1-600	D4	1195.1	70793	191	2.18
		D	1348.8	186100	183	
		D3	1507.2	102760	64	
		G	1591.8	85169	94	
	NMCS-4-600	D4	1173.5	55857	2216	2.08
		D	1341.5	189190	200	
		D3	1503.5	76090	60	
		G	1586.7	90929	97	
	NMCS-4-800	D4	1180.3	147440	243	1.98
		D	1334.5	408810	183	
		D3	1493.7	184850	58	
		G	2582.6	206130	95	
After Reaction	NMCS-1-600	D4	1198.6	98243	183	2.36
		D	1348.6	215070	173	
		D3	1509.6	155950	70	
		G	1593.1	91093.9	84	
	NMCS-4-600	D4	1183.4	110840	210	2.45
		D	1340.9	191380	189	
		D3	1520.2	142730	79	
		G	1593.7	78079	80	
	NMCS-4-800	D4	1169.3	121450	90	2.13
		D	1330.6	259930	181	
		D3	1509.2	164220	76	
		G	1589.6	121640	76	

Table S5 C, N, O content of typical samples from XPS spectra after reaction.

Sample	C (at %)	N (at %)	O (at %)	N/C
NMCS-1-600	89.1	4.6	6.4	0.052
NMCS-4-600	90.1	4.2	5.7	0.047
NMCS-4-800	93.4	2.4	4.2	0.026

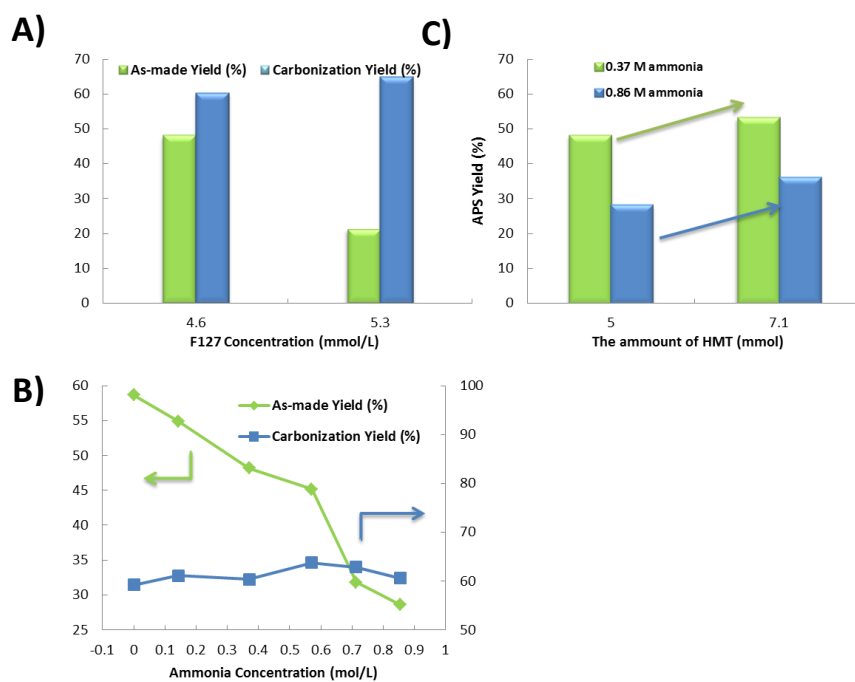


Fig. S1 Yield variation of APS and NMCS-600 with the change of F127 concentration (A) and ammonia concentration (B); Yield variation of APS with the change of HMT amount (C).



Fig. S2 The upper solution after centrifugation. The synthesis condition: F127: 3.8 mM. 3-Aminophenol, 10 mmol; HMT, 5 mmol; ammonia concentrations: 0.37 M.

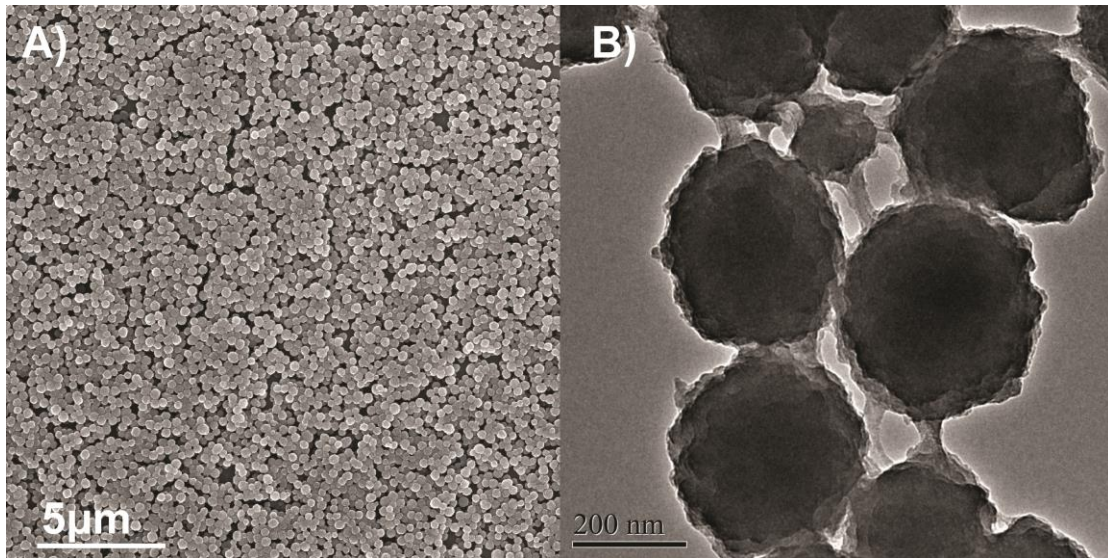


Fig. S3 Typical SEM image (A) and TEM image (B) of APS-4.

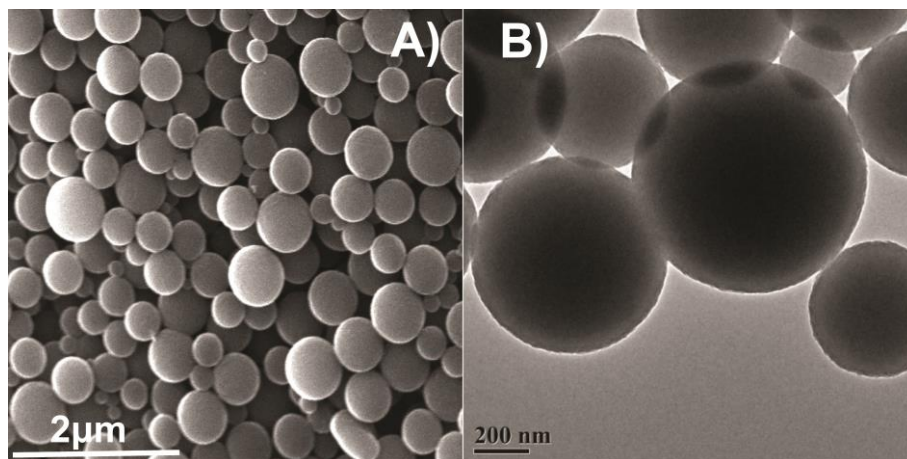


Fig. S4 Typical SEM image (A) and TEM image (B) of NMCS-1-600.

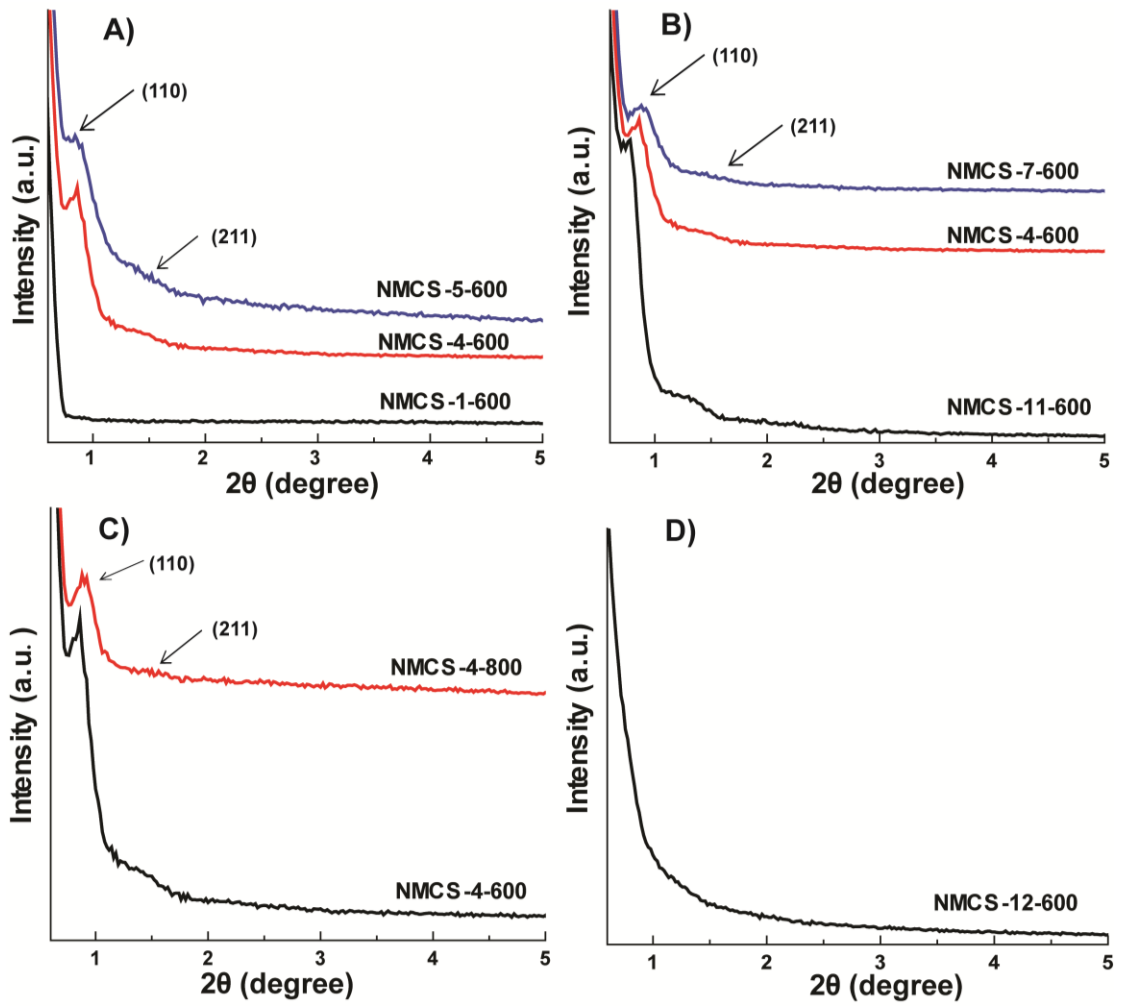


Fig. S5 Small-angle XRD patterns of the prepared NMCS with different synthesis conditions: A) different F127 concentration; B) different ammonia concentration; C) different carbonization temperature; D) adding TMB.

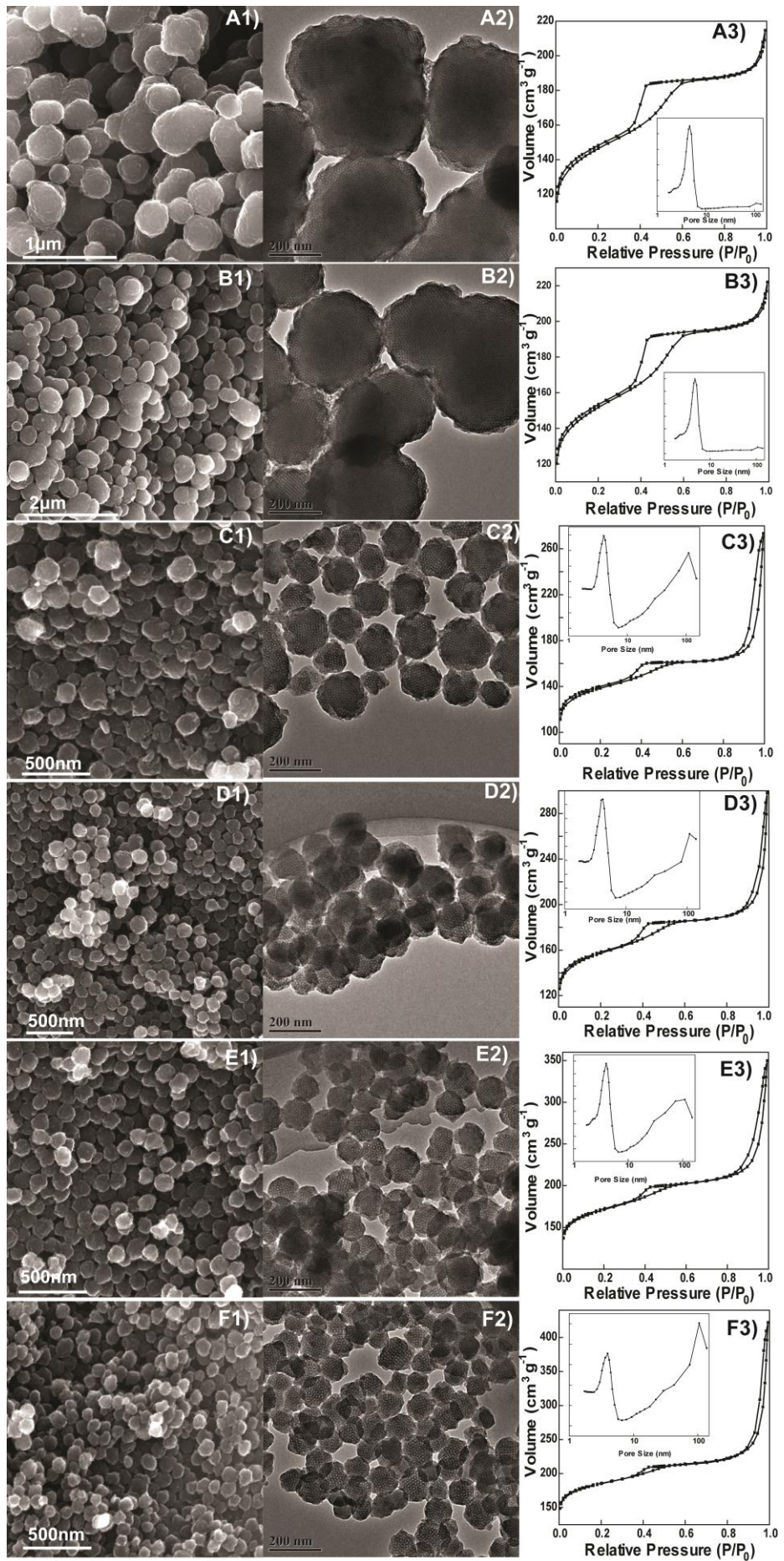


Fig. S6 Typical SEM images (A1-F1), TEM images (A2-F2) and N₂ adsorption-desorption isotherms (A3-F3) of NMCS-7-600 (A1-A3), NMCS-8-600 (B1-B3), NMCS-9-600 (C1-C3), NMCS-10-600 (D1-D3), NMCS-11-600 (E1-E3) and NMCS-5-600 (F1-F3). The insets show the corresponding pore size distributions.

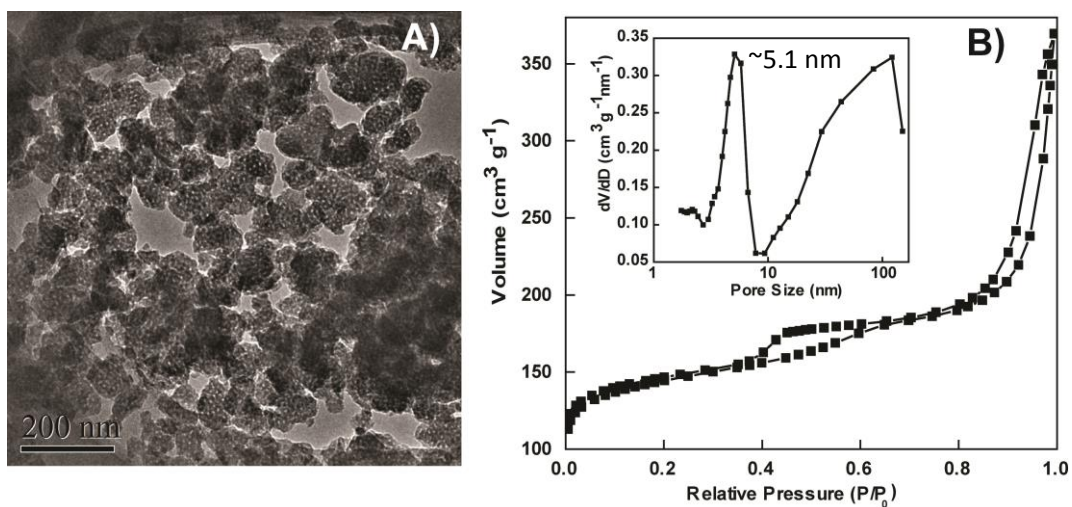


Fig. S7 TEM image (A) and N₂ adsorption-desorption isotherms (B) of NMCS-12-600. The inset shows the corresponding pore size distributions.

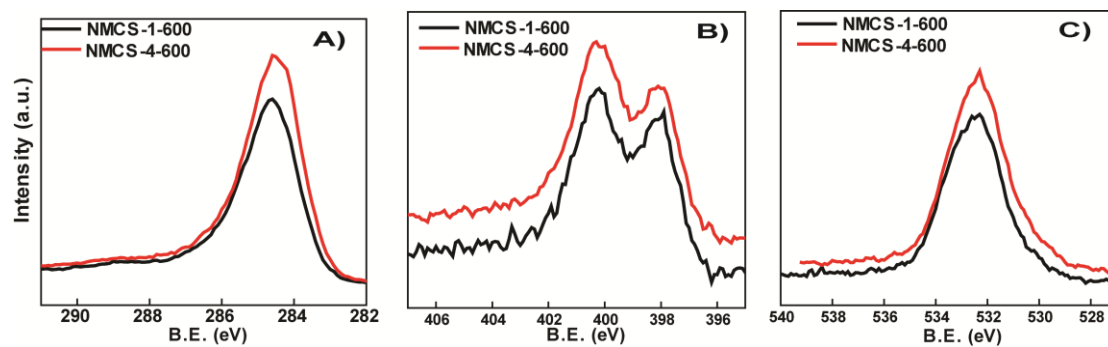


Fig. S8 XPS spectra of C1s (A), N1s (B), and O1s (C) in NMCS-1-600 and NMCS-4-600.

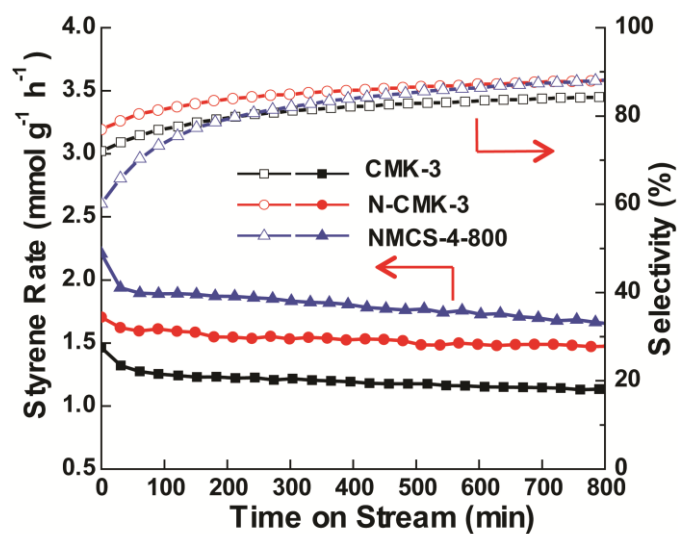


Fig. S9 Catalytic performance of N-CMK-3 for direct dehydrogenation of ethylbenzene to styrene. Reaction conditions: 550 °C, 2.8 % of Ethylbenzene in He, 10 mL min⁻¹, 100 mg catalyst. For comparison, we also plot the results of CMK-3 and NMCS-4-800.

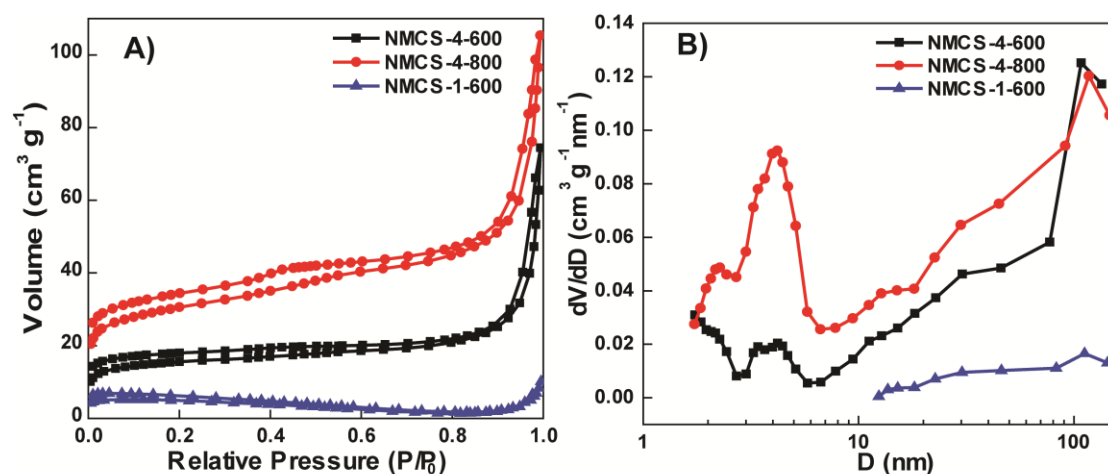


Fig. S10 N₂ adsorption-desorption isotherms (A) and corresponding pore size distributions (B) of NMCS-1-600, NMCS-4-600, and NMCS-4-800 after reaction.

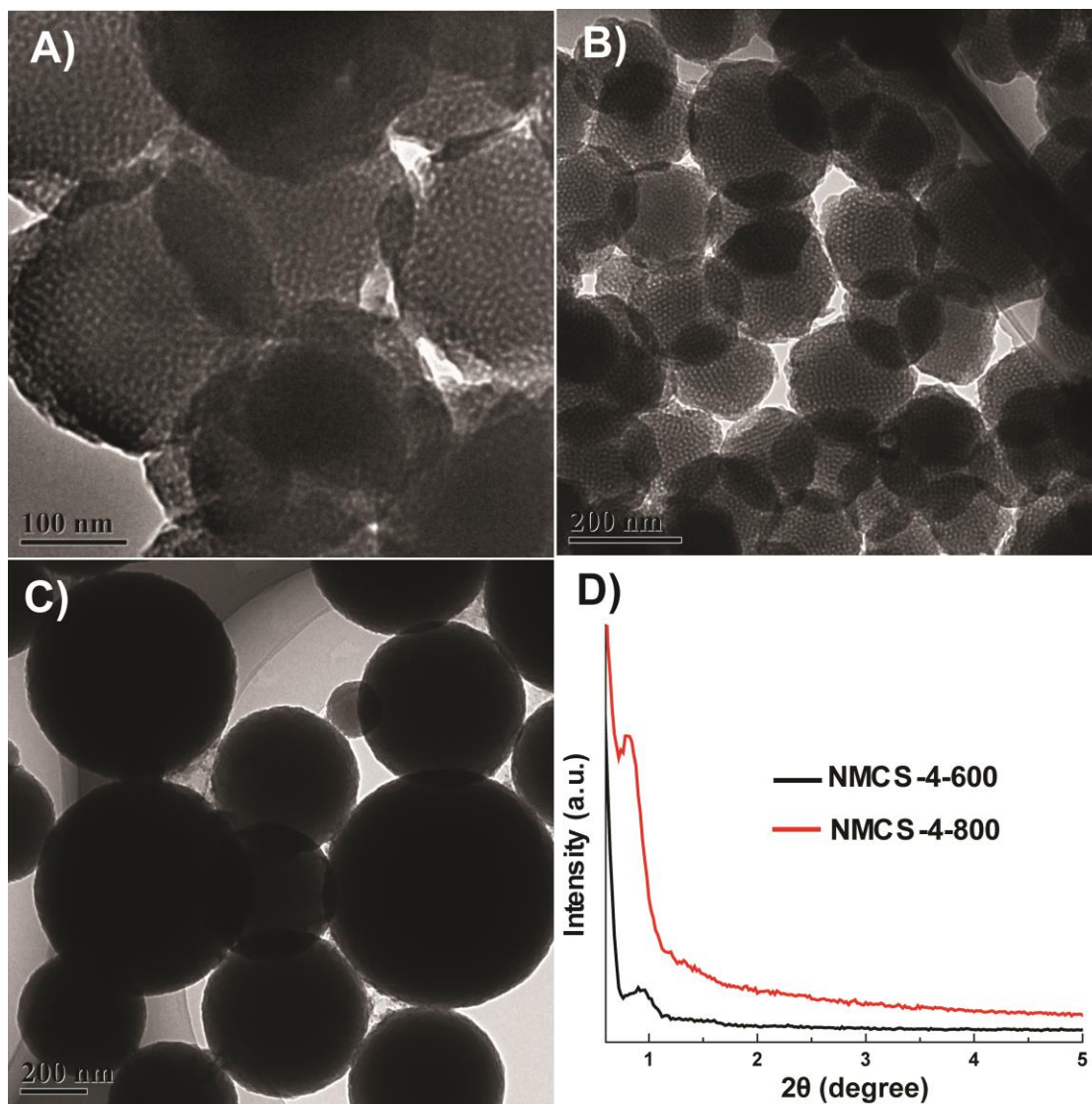


Fig. S11 TEM images of NMCS-4-600 (A), NMCS-4-800 (B), and NMCS-1-600 (C) after reaction and small-angle XRD patterns of the catalysts after reaction (D).

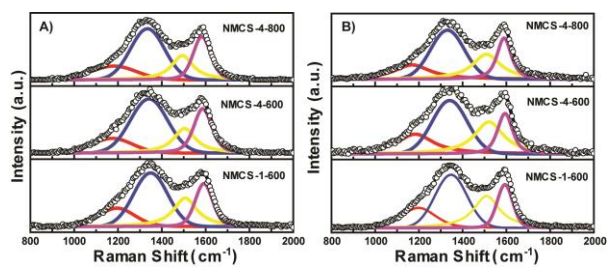


Fig. S12 Raman spectra of NMCS samples after reaction.