Electronic Supplementary Material (ESI) for Inorganic Chemistry Frontiers.

Supporting Information

Strategy for Synthesis of Zeolite Y by Artificial Fish Reef Breeding Negative Crystals

Peng Liu[ab], Tian Xia[a], Suofu Nie[a], Qiaoxia Guo[c], Chunming Xu[a], Baojian Shen*[a]

[a] State Key Laboratory of Heavy Oil Processing; The Key Laboratory of Catalysis of CNPC; College of Chemical Engineering and Environment, China University of Petroleum, Beijing 102249, China

[b] School of Chemistry and Chemical Engineering, Key Laboratory of Green Chemical Media and Reactions, Ministry of Education, Henan Normal University, 453007 Xinxiang, Henan, China

[c] College of Science, China University of Petroleum, Beijing 102249, China

* Corresponding author email: baojian@cup.edu.cn

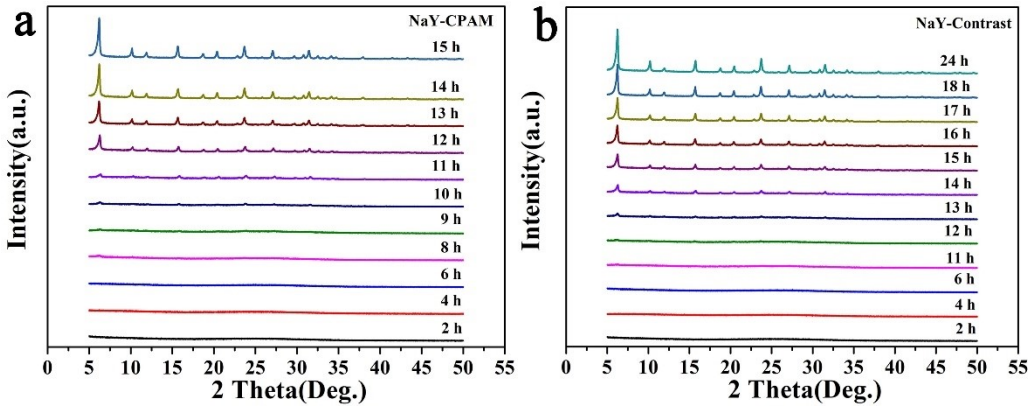

Figure S1 XRD patterns of samples taken from gel at different crystallization time in the synthesis of NaY-CPAM (a) and NaY-contrast (b), respectively.

Table S1 Crystallinity of aliquots taken from gel at different crystallization time in the preparation of NaY-CPAM and NaY-Contrast zeolites.

Samples (With CPAM)	Crastallization time (h)	C/C_0 (%)	Samples (Without CPAM)	Crastallization time (h)	C/C_0 (%)
L-1	2	0	L-1	2	0
L-2	4	0	L-2	4	0
L-3	6	0	L-3	6	0
L-4	8	0	L-4	11	0
L-5	9	16	L-5	12	13
L-6	10	34	L-6	13	20
L-7	11	44	L-7	14	35
L-8	12	49	L-8	15	40
L-9	13	64	L-9	16	57
L-10	14	85	L-10	17	63
L-11	15	95	L-11	20	90
—	—	—	L-12	24	94

Table S2 Relative crystallinity, SiO_2/Al_2O_3 mole ratio and unit cell of NaY-Reference, NaY-Contrast, and NaY-CPAM

Smaple	C/C_0, %	SiO_2/Al_2O_3 mole ratio	Unit cell (a_0), Å
NaY-Reference	93	5.0	24.67
NaY-Contrast	94	5.0	24.67
NaY-CPAM	95	5.2	24.66

Table S3 Textural properties of NaY-Contrast and NaY-CPAM

Sample	S_{BET}[a], $m^2\ g^{-1}$	S_{Micro}[b], $m^2\ g^{-1}$	$S_{External}$[c], $m^2\ g^{-1}$	V_{total}[d], $cm^3\ g^{-1}$	V_{micro}[e], $cm^3\ g^{-1}$	V_{meso}[f], $cm^3\ g^{-1}$
NaY-Contrast	746	713	33	0.381	0.349	0.032
NaY-CPAM	736	686	50	0.447	0.335	0.112

[a] BET method; [b, e] t-plot method; [c] $S_{External} = S_{BET} - S_{Micro}$; [d] Volume absorbed at p/p_0 = 0.9944; [f] $V_{meso} = V_{pore} - V_{micro}$

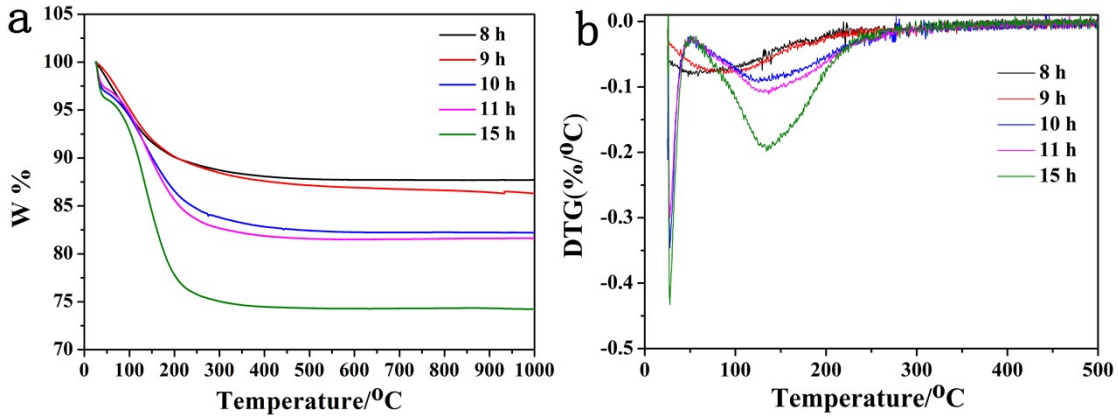

Figure S2 TG (a) and DTG (b) curves of samples from different crystallization time in the synthesis of NaY-CPAM zeolite

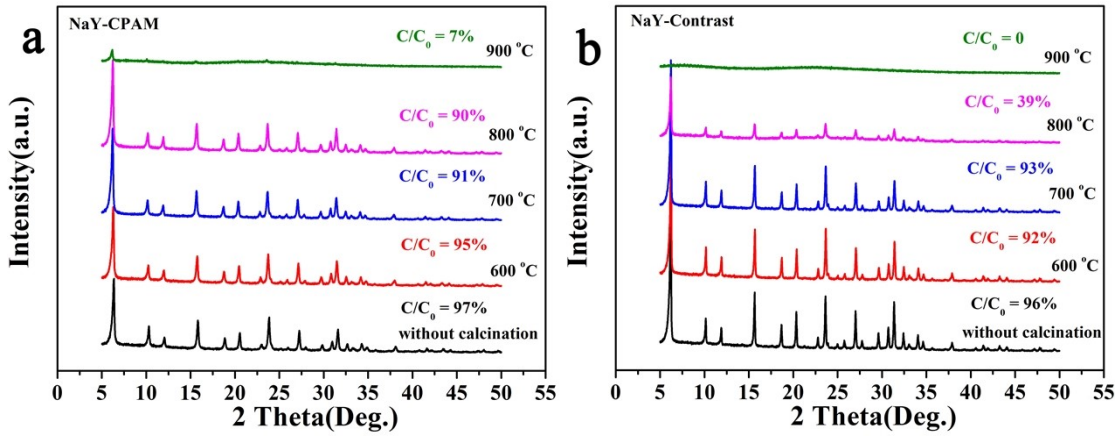

Figure S3 XRD patterns of NaY-CPAM (a) and NaY-Contrast (b) after calcinating at different temperature for 2 h.

Table S4 Relative crystallinity for NaY-CPAM and NaY-Contrast zeolites after calcinating at different temperature for 2 h.

Samples	Relative crystallinity corresponding to different calcination temperature, C/C_0/ %				
	Without calcination	600 °C	700 °C	800 °C	900 °C
NaY-Contrast	96	92	93	39	0
NaY-CPAM	97	95	91	90	7

Table S5 SiO_2/Al_2O_3 mole ratio and Na content of NaY-Contrast and NaY-CPAM determined by XRF and XPS.

Samples	XRF[a]		XPS[b]	
	Na_2O wt%[a]	SiO_2/Al_2O_3[a]	Na %[b]	SiO_2/Al_2O_3[b]
NaY-Contrast	14.97	5.2	15.00	3.0
NaY-CPAM	14.07	5.2	14.02	4.8

[a] Bulk Na_2O wt% and SiO_2/Al_2O_3 mole ratio determined by XRF. [b] Na content and SiO_2/Al_2O_3 mole ratio on the external determined by XPS.

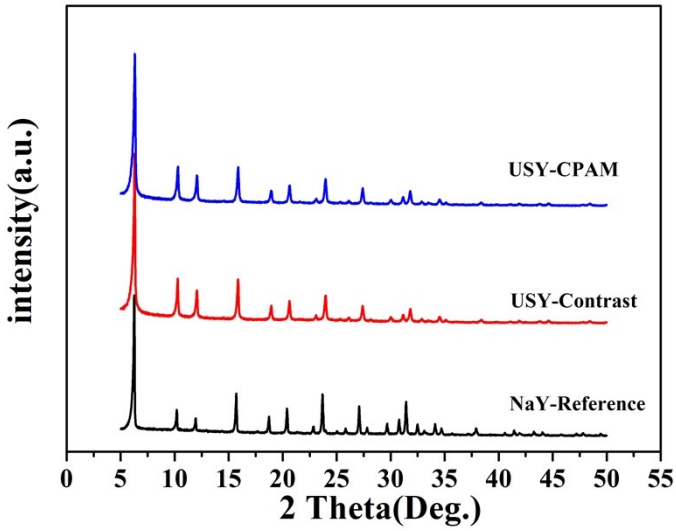

Figure S4 XRD patterns of USY-Contrast and USY-CPAM zeolites.

Table S6 Crystallinity, unit cell constant, framework SiO_2/Al_2O_3 mole ratio (obtained by XRD) and content of Na_2O, bulk SiO_2/Al_2O_3 mole ratio (obtained by XRF) on USY-Contrast and USY-CPAM zeolites

Sample	C/C$_0$ /%	a_0 (Å)	SiO_2/Al_2O_3		Na_2O wt%
			XRD	XRF	
USY-Contrast	73	24.40	13.8	6.6	0.61
USY-CPAM	76	24.37	16.4	7.0	0.54

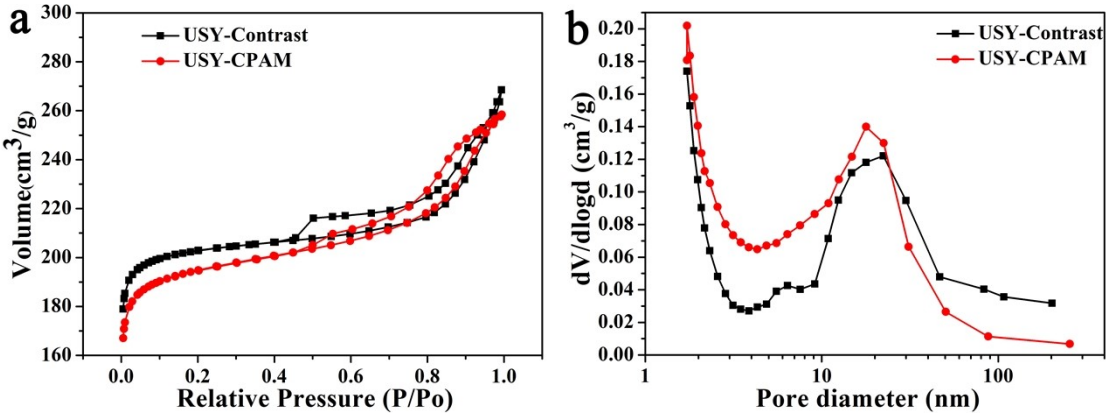

Figure S5 Isotherms curves (a) and pore distribution curves (adsorption branch) (b) on USY-Contrast and USY-CPAM zeolites.

Table S7 Texture properties of USY-Contrast and USY-CPAM zeolites.

Samples	S_{BET}[a] $m^2 \cdot g^{-1}$	S_{Micro}[b] $m^2 \cdot g^{-1}$	$S_{External}$[c] $m^2 \cdot g^{-1}$	V_{total}[d] $cm^3 \cdot g^{-1}$	V_{micro}[e] $cm^3 \cdot g^{-1}$	V_{meso}[f] $cm^3 \cdot g^{-1}$
USY-Contrast	649	578	71	0.415	0.282	0.133
USY-CPAM	628	527	101	0.400	0.257	0.143

[a] BET method; [b, e] t-plot method; [c] $S_{External} = S_{BET} - S_{Micro}$; [d] Volume absorbed at p/p_0 = 0.9944; [f] $V_{meso} = V_{pore} - V_{micro}$

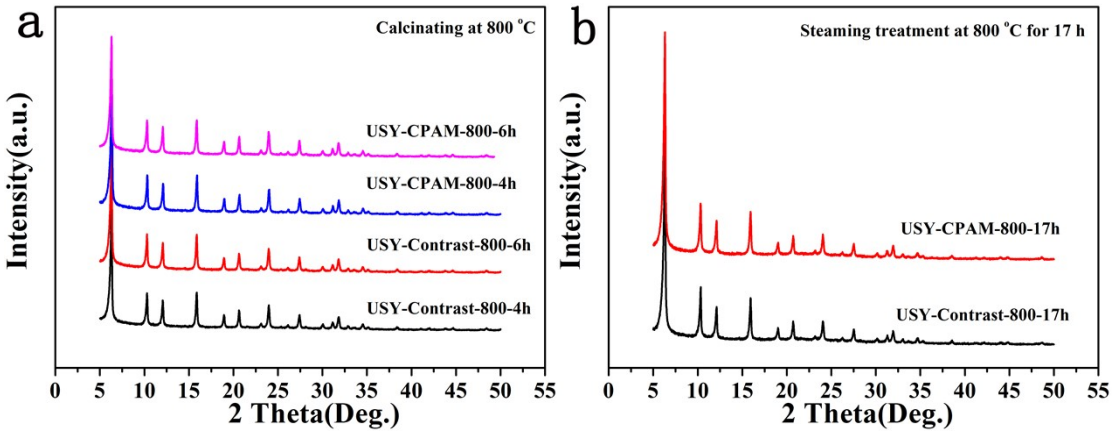

Figure S6 XRD patterns of USY-Contrast and USY-CPAM zeolites after calcinating at 800 °C for 4h and 6h (a) and steaming treatment at 800 °C for 17h (b).

Table S8 Crystallinity of USY-Contrast and USY-CPAM zeolites after calcinating at 800 °C for 4h and 6h and steaming treatment at 800 °C for 17h

Samples	Crystallinity / %
USY-Contrast-800-4h	81
USY-Contrast-800-6h	70
USY-Contrast-800-17h	60
USY-CPAM-800-4h	86
USY-CPAM-800-6h	83
USY-CPAM-800-17h	61

Table S9 Concentrations of Brønsted acid (B) and Lewis acid sites (L) for USY-Contrast and USY-CPAM zeolites.

Samples	Total acid sites (200 °C), μmol·g^{-1}				Strong acid sites (350 °C), μmol·g^{-1}			
	L	B	L+B	B/L	L	B	L+B	B/L
USY-Contrast	107	217	326	2.0	70	74	144	1.1
USY-CPAM	182	164	346	0.9	129	78	207	0.6

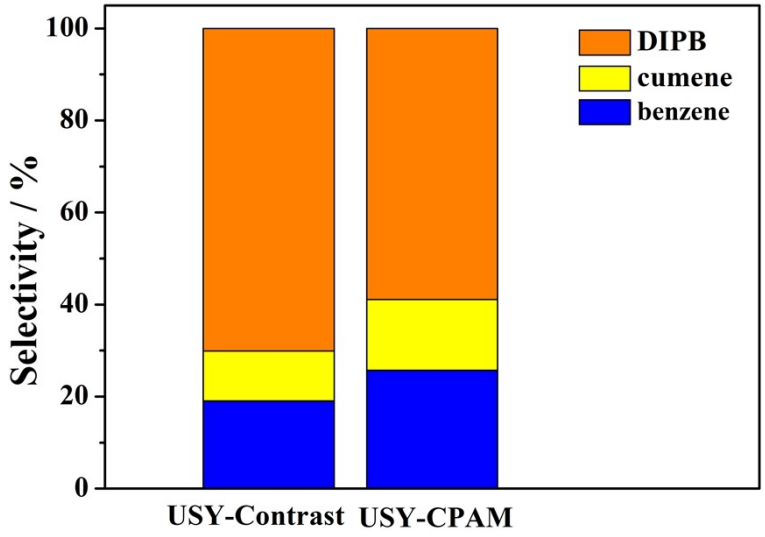

Figure S7 Selectivity on USY-Contrast and USY-CPAM catalysts during the TIPB conversion for DIPB, Cumene, and Benzene under identical conditions (T = 200 ºC, FTIPB = 10 μL/min, TOS = 15 min).