Understanding the roles of different acid sites in Beta zeolites with different particle sizes catalyzed liquid-phase transalkylation of diethylbenzene with benzene

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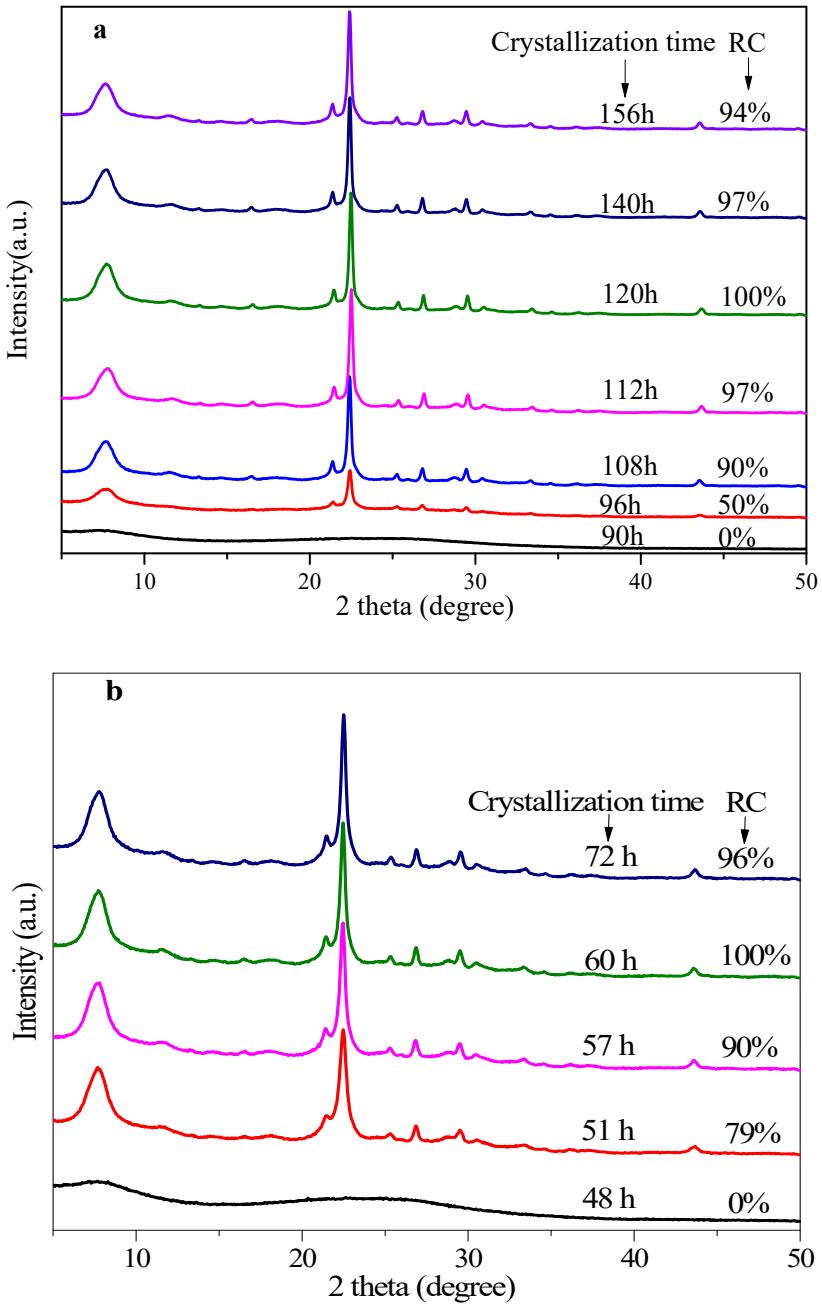

Fig. S1 XRD patterns of samples synthesized with (a) 0.0 and (b) 0.5 IMD at 140 °C for different time. The relative crystallinity (RC) was calculated based on the sum of characteristic peak height at 2θ = 7.8±0.1°, 22.5±0.1°, 26.9±0.1° and 29.6±0.1° of the samples synthesized for different time. And the RCs of the samples synthesized with 0.0 IMD for 120 h and with 0.5 IMD for 60 h were assumed as 100 %, respectively.

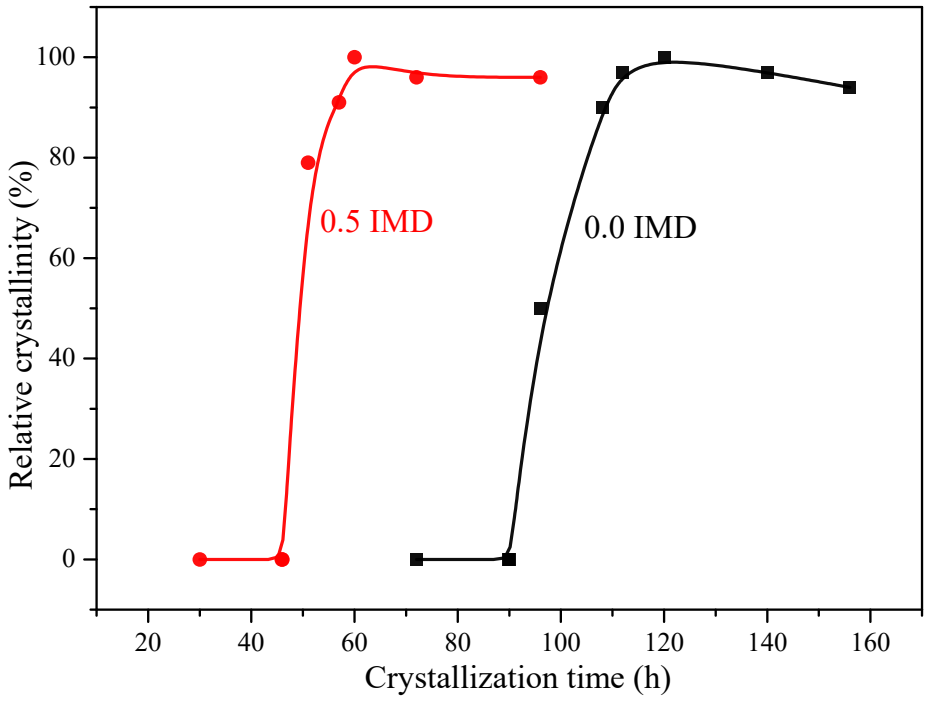

Fig. S2 Crystallization curves of Beta zeolites synthesized with IMD/SiO_2 molar ratios of 0.0 and 0.5 at 140 °C.

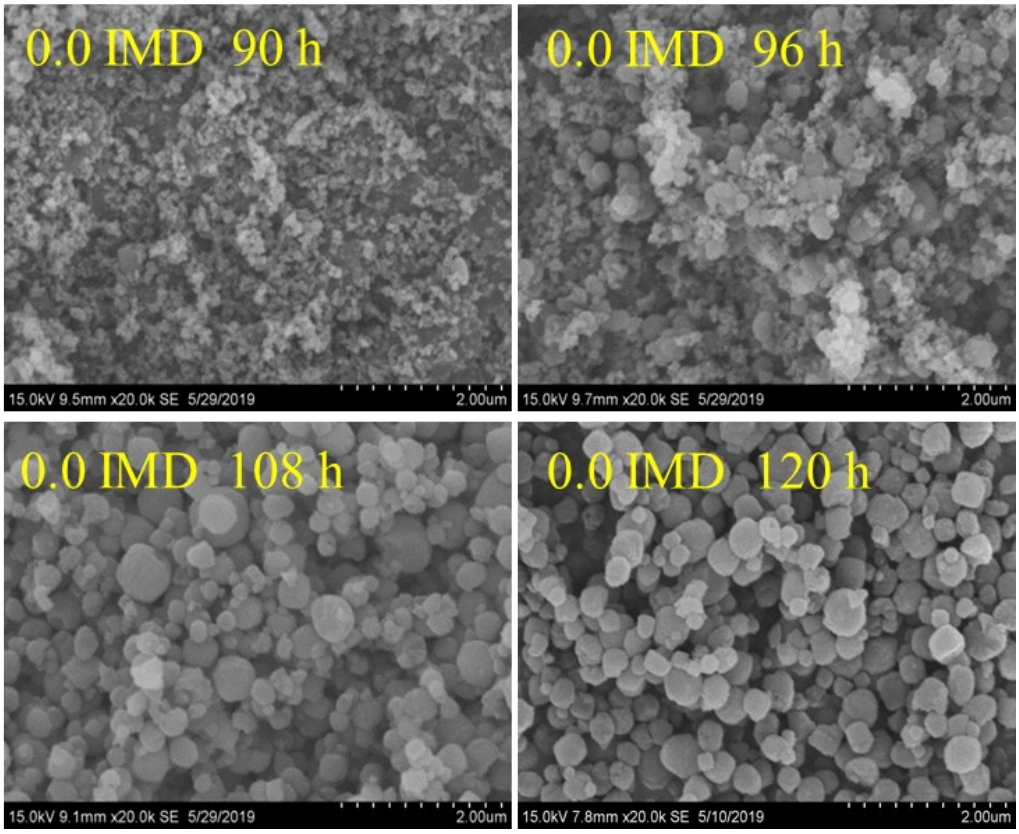

Fig. S3 SEM images of samples crystallized at 140 °C for different time with IMD/SiO_2 molar ratio of 0.0.

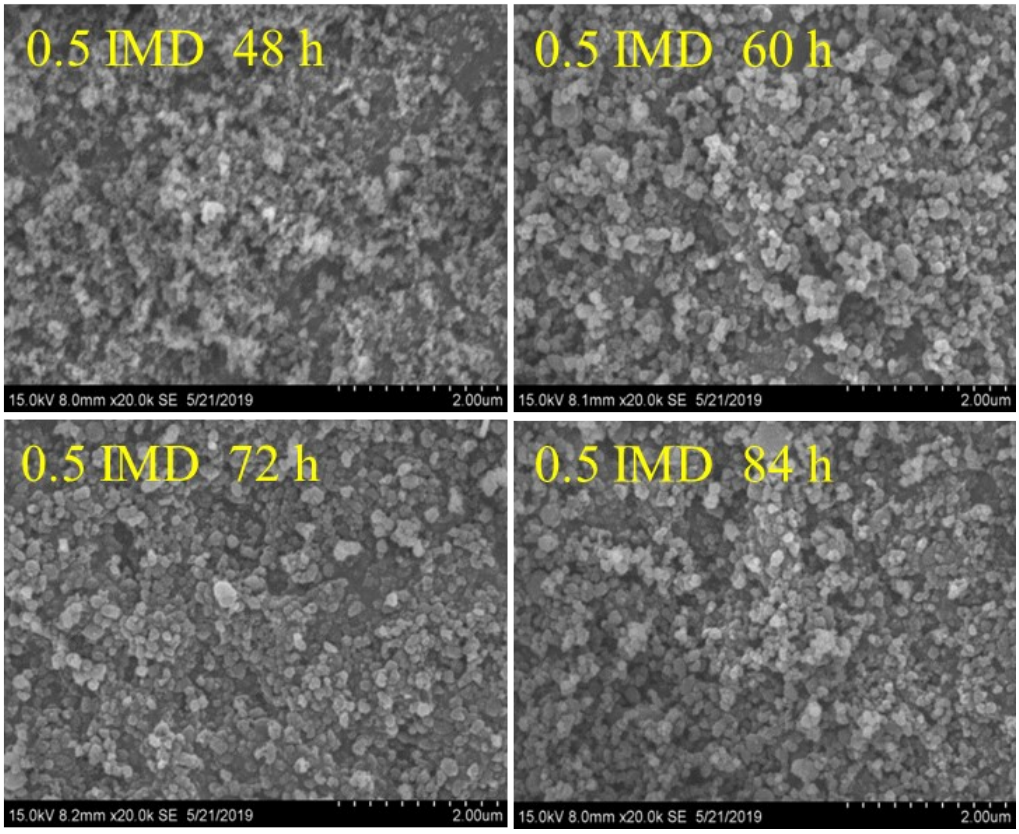

Fig. S4 SEM images of samples crystallized at 140 °C for different time with IMD/SiO_2 molar ratio of 0.5.

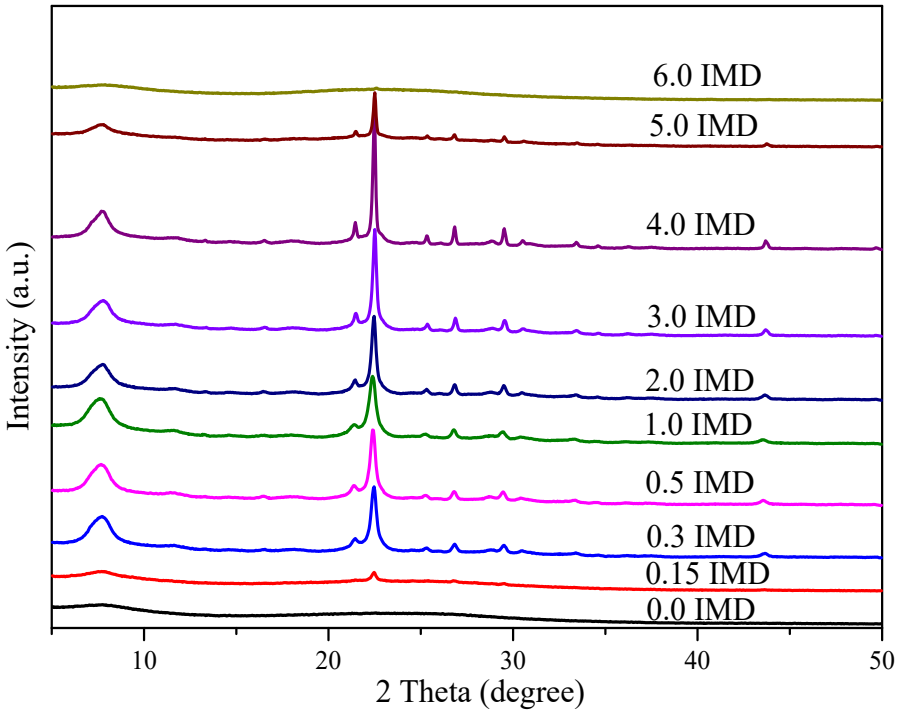

Fig. S5 XRD patterns of Beta zeolites synthesized with different IMD/SiO_2 ratios at 140 °C for 72h.

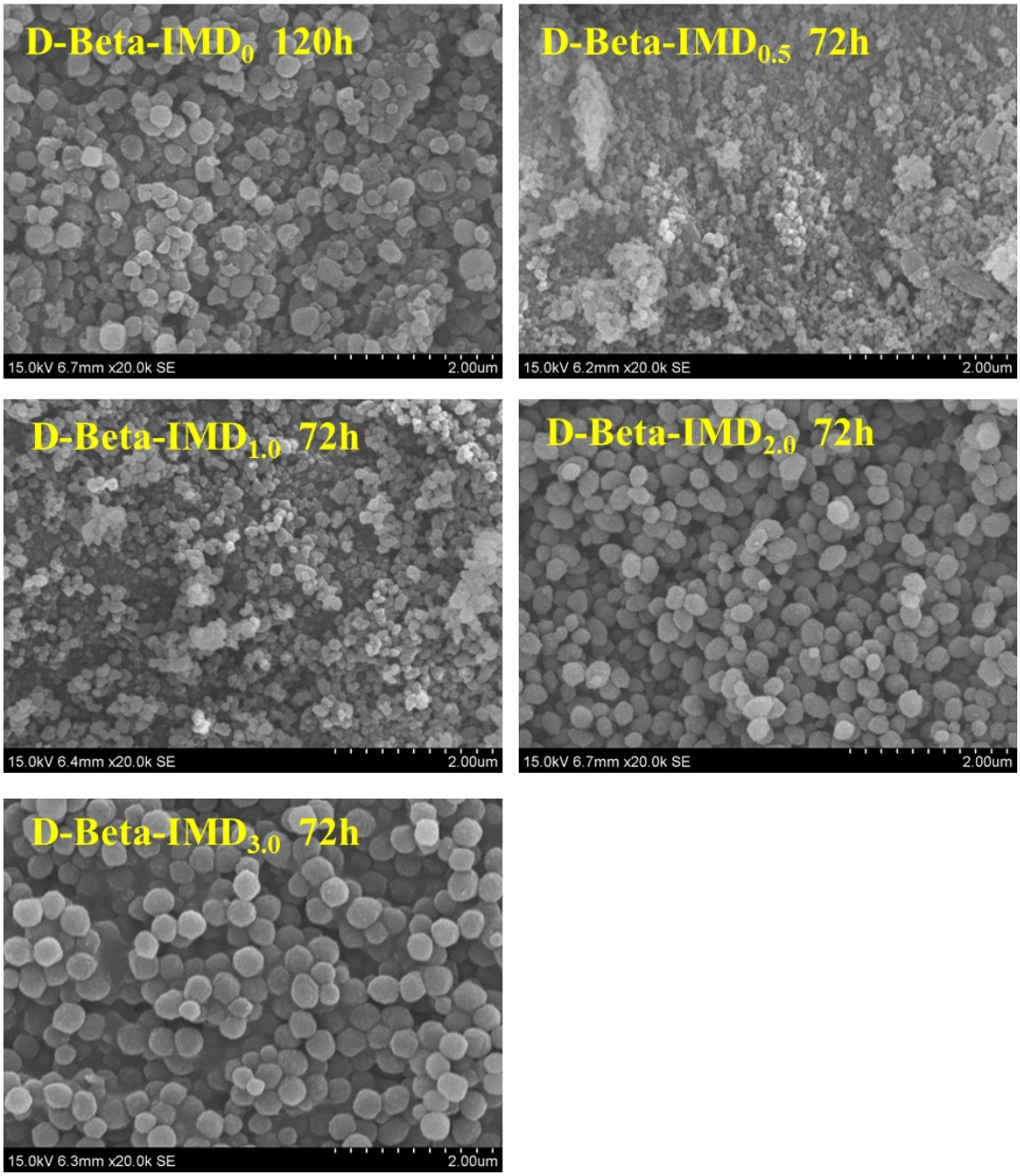

Fig. S6 SEM images of the products crystallized with different amounts of IMD under dynamic condition.

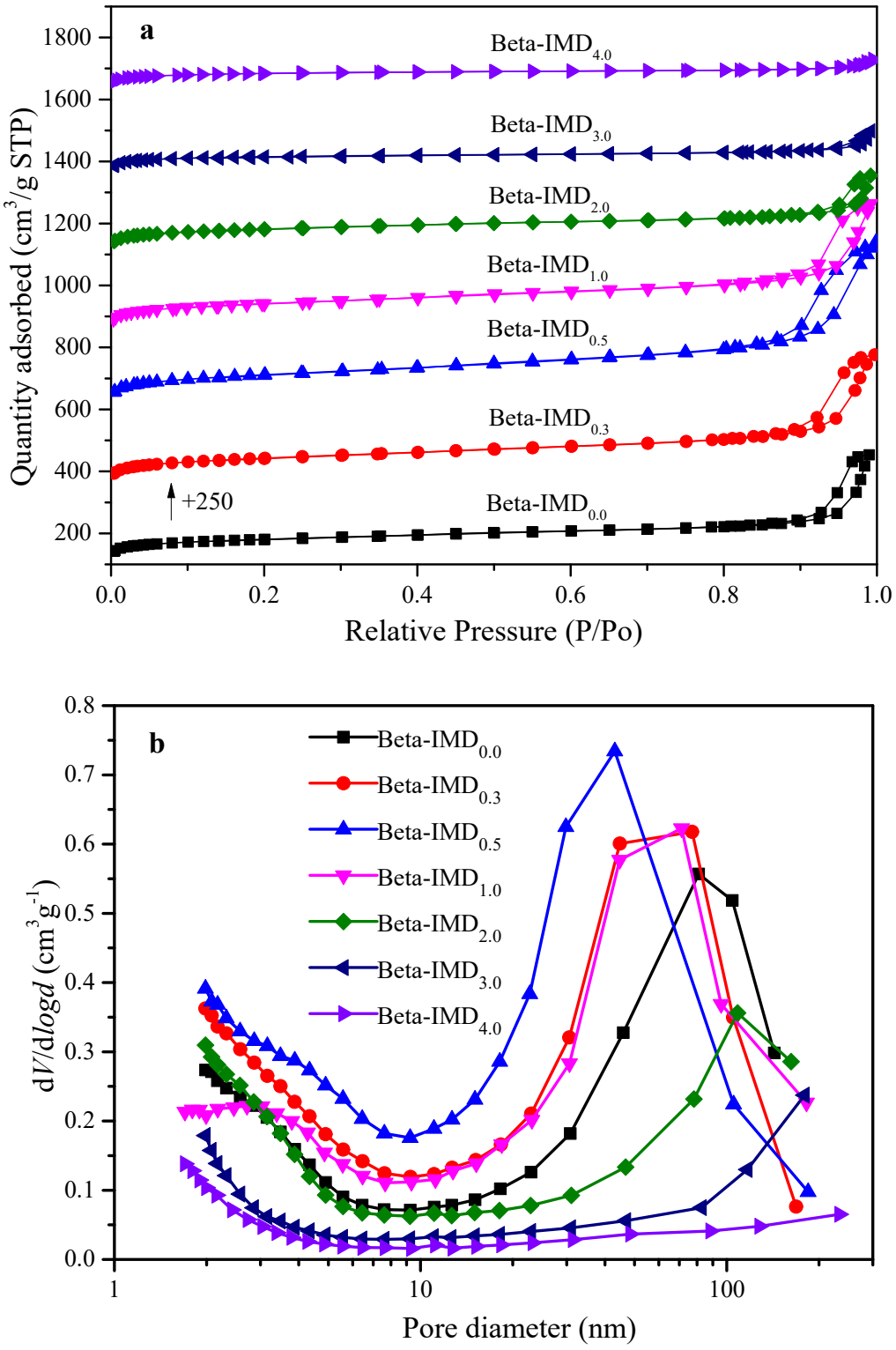

Fig. S7 The N_2 adsorption−desorption isotherms (a) and the corresponding pore size distribution curves (b) of Beta-IMD$_x$ series samples.

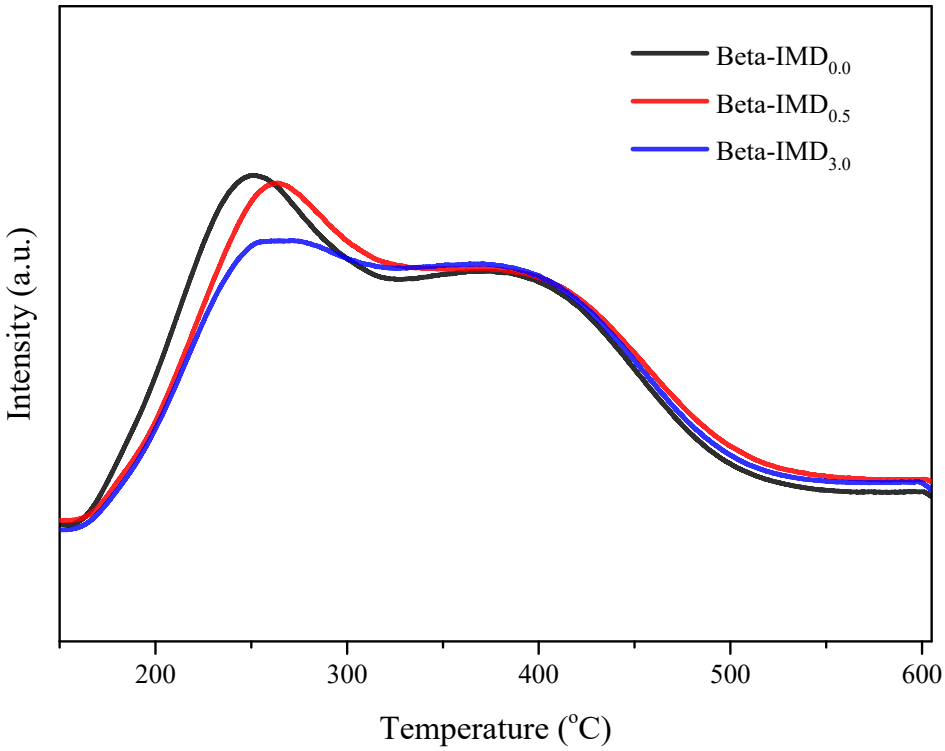

Fig. S8 NH_3-TPD profiles of Beta zeolites synthesized with different IMD/SiO_2 ratios at 140 °C.

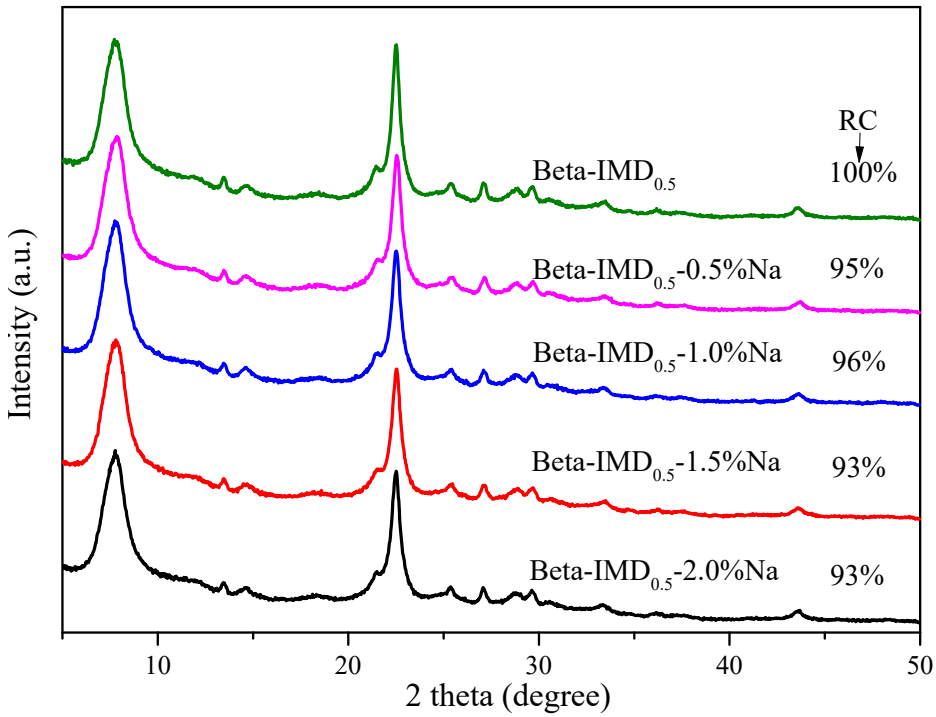

Fig. S9 XRD patterns of Beta-IMD$_{0.5}$-*x*%Na samples. The relative crystallinity (RC) was calculated based on the sum of characteristic peak height at 2θ = 7.8±0.1°, 22.5±0.1°, 26.9±0.1° and 29.6±0.1° of the Beta-IMD$_{0.5}$-*x*%Na samples. And the RC of the Beta-IMD$_{0.5}$ sample was assumed as 100 %.

Table S1 Textural properties of Beta-$IMD_{0.5}$-*x*%Na samples.

Sample	S_{BET} /m^2g^{-1}	S_{ext} /m^2g^{-1}	V_{micro} /cm^3g^{-1}	V_{meso} /cm^3g^{-1}
Beta-$IMD_{0.5}$	783	321	0.19	0.76
Beta-$IMD_{0.5}$-0.5%Na	782	322	0.19	0.72
Beta-$IMD_{0.5}$-1.0%Na	787	318	0.19	0.70
Beta-$IMD_{0.5}$-1.5%Na	794	322	0.19	0.70
Beta-$IMD_{0.5}$-2.0%Na	781	320	0.19	0.72

Table S2 Catalytic performances for liquid-phase transalkylation of diethylbenzene with benzene over Beta series samples.

Sample	Conversion/%		Products selectivity/%					
	Benzene	Diethylbenzene	Ethylbenzene	Triethylbenzene	Methylbenzene	C3benzene	Non-aromatic hydrocarbon	Heavy aromatics
Beta-$IMD_{0.0}$	13.10	76.81	97.84	0.70	0.12	0.09	0.16	1.08
Beta-$IMD_{0.5}$	13.74	79.16	97.96	0.59	0.09	0.09	0.15	1.08
Beta-$IMD_{3.0}$	12.93	73.08	98.23	0.79	0.06	0.07	0.14	0.68
Beta-$IMD_{0.5}$-1	14.14	74.03	98.01	0.88	0.12	0.09	0.15	0.73
Beta-$IMD_{0.5}$-2	13.15	65.66	98.04	0.95	0.12	0.10	0.12	0.63
Beta-$IMD_{0.5}$-3	7.95	47.50	97.14	1.49	0.18	0.04	0.13	0.95
Beta-$IMD_{0.5}$-4	3.27	21.83	95.90	1.70	0.42	0.07	0.19	1.68
Beta-$IMD_{0.5}$-5	0.96	4.77	92.08	3.75	1.28	0.26	0.44	2.02
Beta-$IMD_{0.5}$-6	0.21	0.99	82.55	8.13	4.89	0.00	1.94	2.40
Beta-$IMD_{0.0}$-TPP	3.26	16.26	97.34	1.96	0.18	0.07	0.11	0.34
Beta-$IMD_{0.5}$-TPP	2.82	14.71	96.69	1.74	0.50	0.11	0.16	0.78
Beta-$IMD_{3.0}$-TPP	4.42	22.35	96.61	1.82	0.13	0.05	0.09	1.29

Reaction conditions: 260 ^{o}C, 4.0 MPa, WHSV (diethylbenzene) = 2.0 h^{-1}, W(benzene)/W(diethylbenzene) = 3/1, time on stream = 5 h.