SUPPORTING INFORMATION

Effects of location of Al-species in hierarchical ZSM-11 on its catalytic performances in methanol to propylene

Qihao Wu, Zhuo Ji, Jiahui Zhang, Qirui Jiao, Zhongxu Wang, Yi Liu, Weijiong Dai*, Yan Wang, Wenlin Li, Jiajun Zheng *, Ruifeng Li*

(*College of Chemistry and Chemical Engineering, Research Centre of Energy Chemical & Catalytic Technology, Taiyuan University of Technology, Taiyuan 030024, China*)

*Corresponding Author:

Email: daiweijiong@tyut.edu.cn; zhengjiajun@tyut.edu.cn; rfli@tyut.edu.cn. TEL:+86 03516018384

Post Address:

College of Chemical Engineering and Technology, Taiyuan University of Technology 79# West Yingze Street, Taiyuan 030024, China

Table S1 Proportion of integrated peaks obtained by curve fitting of the ^{29}Si MAS NMR for various ZSM-11-*x* zeolites

Samples	SiO_2/Al_2O_3 ratio[a]	Si(3Si, 1Al) sites (%) (-106.0 ppm)	Si(4Si, 0Al) sites (%)			
			-110.4 ppm	-112.3 ppm	-113.7 ppm	-115.7 ppm
ZSM-11-60	49.01	16.32	13.13	32.94	24.63	12.97
ZSM-11-90	76.92	10.40	18.76	32.43	25.67	12.74
ZSM-11-120	98.40	8.13	14.60	38.02	24.28	14.97
ZSM-11-160	132.89	6.02	14.32	43.82	22.36	13.48

[a]The framework SiO_2/Al_2O_3 ratio is obtained from the ^{29}Si MAS NMR deconvolution results, according to the equation of $Si/Al = (I_{Q4} + I_{Q3})/0.25I_{Q3}$, where I_{Q4} and I_{Q3} are the intensity of Q_4 ($Si(OSi)_4$) and Q_3 ($Si(OAl)_1(OSi)_3$) peaks, respectively. In the ^{29}Si MAS NMR spectra, four Q_4 ($Si(OSi)_4$) peaks around -115.7, -113.7, -112.3 and -110.4 ppm appear, while the peak at about-106 ppm is assigned to the Q_3 ($Si(OAl)_1(OSi)_3$) peaks.

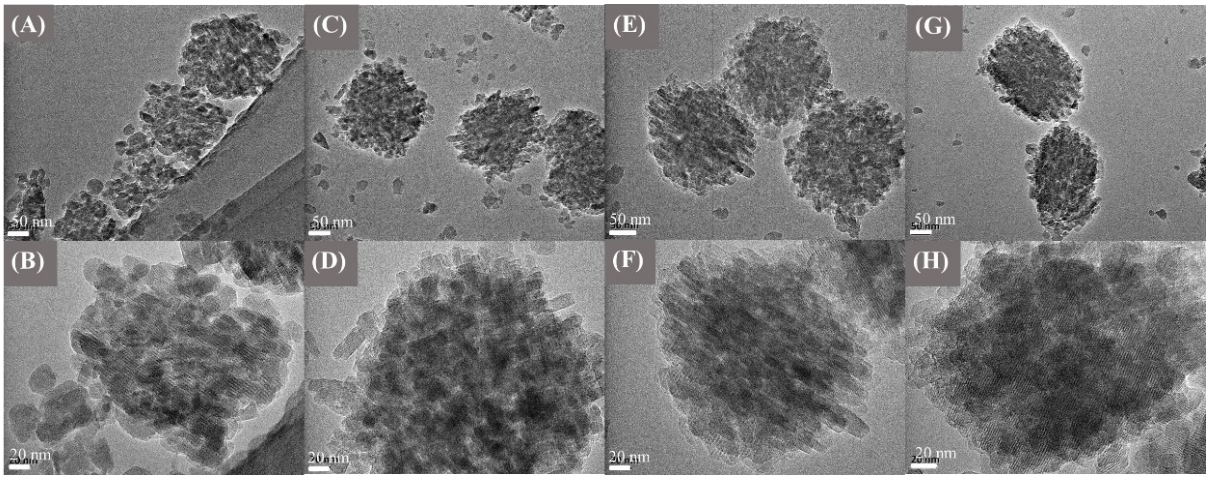

Figure S1 TEM images of the as-synthesized ZSM-11-*x*. (A) and (B): ZSM-11-60; (C) and (D): ZSM-11-90; (E) and (F): ZSM-11-120; (G) and (H): ZSM-11-160

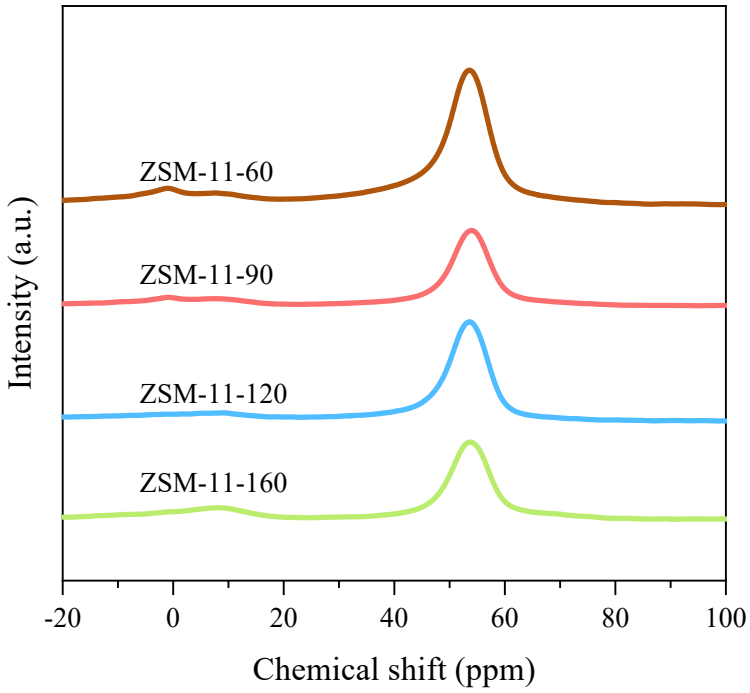

Figure S2 ^{27}Al MAS NMR spectra of the samples ZSM-11-*x*.

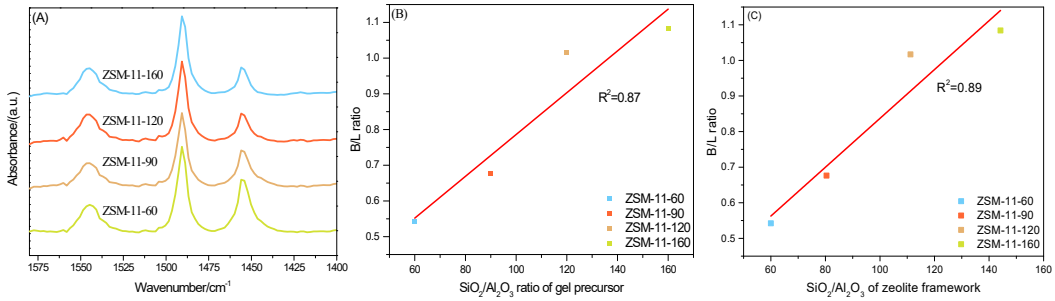

Figure S3 The infrared spectra of pyridine absorbed at 623 k (A); Influence of change in the Si/Al ratio of the gel precursors on the B/L ratio (B); Influence of changed Si/Al ratio of zeolite framework on the B/L ratio (C)

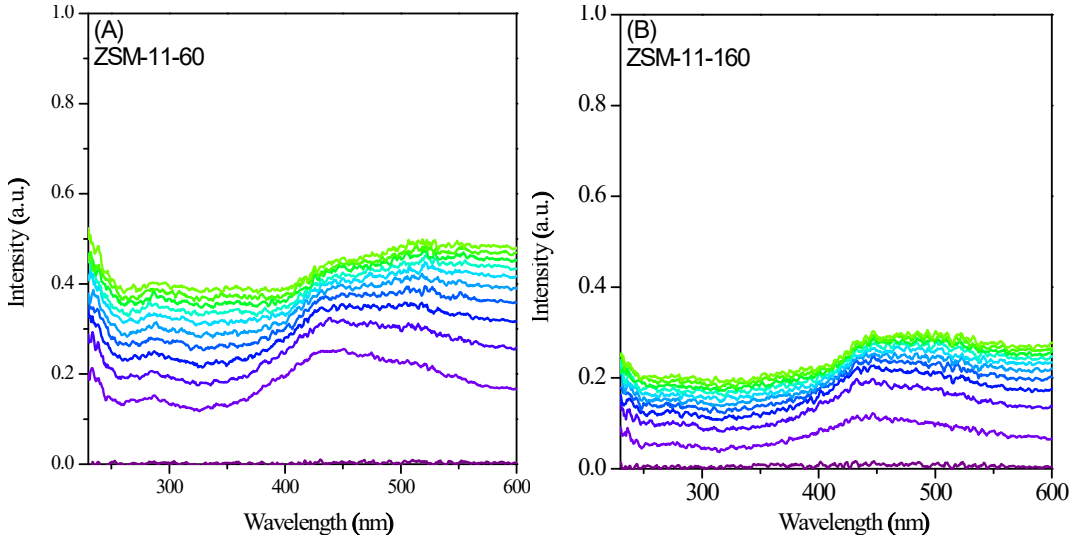

Figure S4 In situ UV/vis spectra recorded during the MTO conversion on ZSM-11-60 and ZSM-11-160 zeolite samples at the reaction temperature of 430 ℃. The band at ~250-290 and 400-500 nm is attributed to neutral alkylated benzenes/carbenium ions and the bicyclic species of aromatics with different degrees of methylation[1-3], respectively. Whereas, the band above 500 nm is assigned to highly condensed polycyclic aromatics (e.g., phenanthrenic/anthracenic species)[4]. Clearly, in comparison with the sample ZSM-11-60, the sample ZSM-11-160 shows a much slower increase rate at these band. The results further well explain the superior catalytic performance for highly catalytic stability of ZSM-11-160 in MTP reaction.

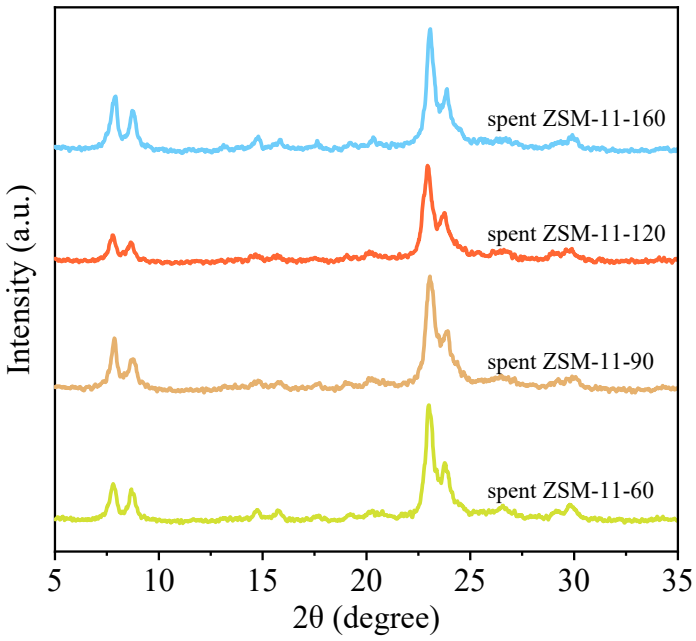

Figure S5 XRD pattern of the spent ZSM-11-x samples.

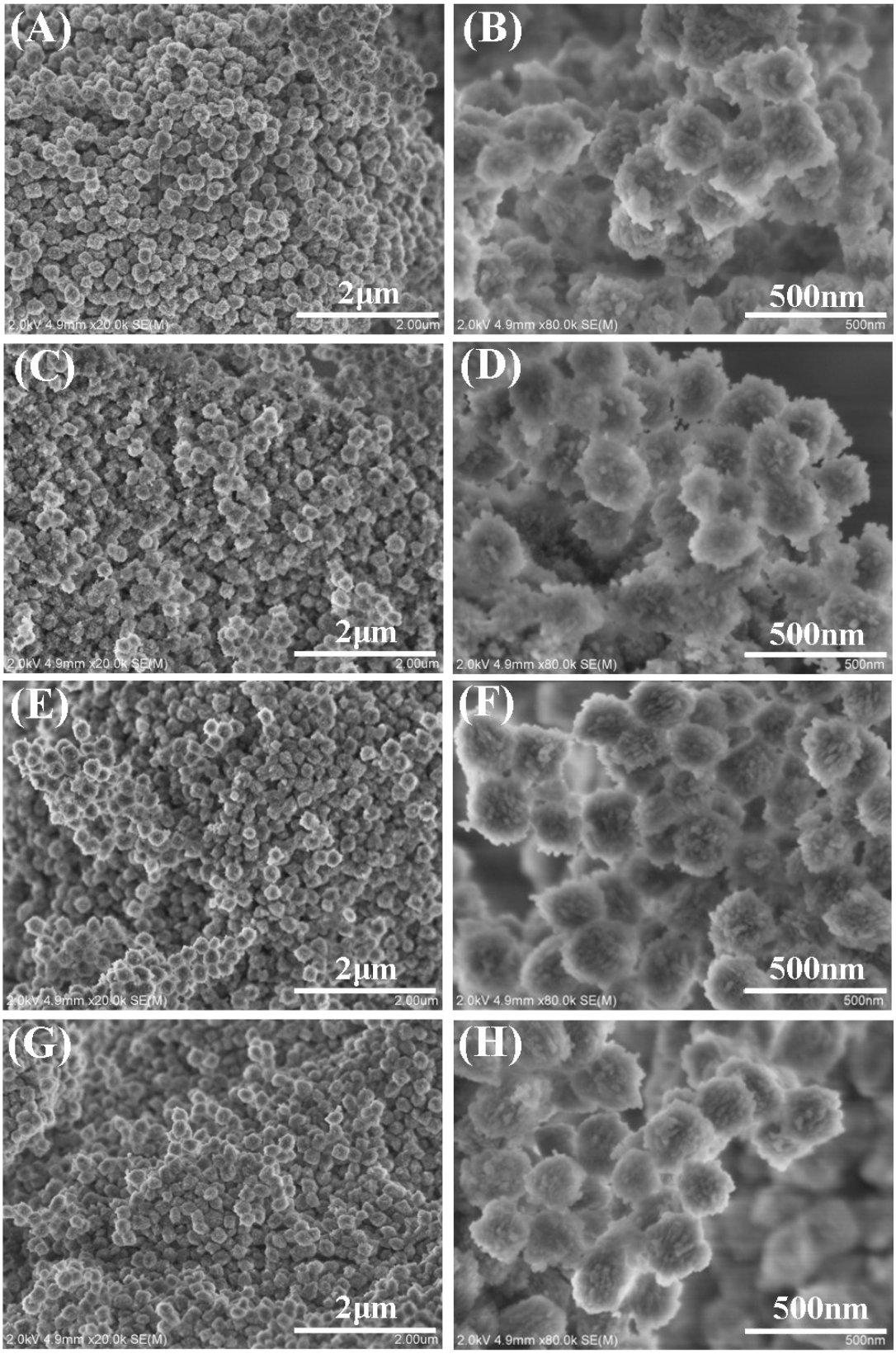

Figure S6 SEM images of the spent ZSM-11-*x*.(A), (B): spent ZSM-11-60;(C), (D): spent ZSM-11-90 (E), (F): spent ZSM-11-120 ;(G), (H): spent ZSM-11-160

References:

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